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Utilization of "Multiple Kinetic Technology KT" in Interior Architecture Design as Concept of Futuristic Innovation

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Abstract

New trends of interior architectural design aim to maximize available spatial space for flexible and futuristic interiors. Therefore, the design of a facility structure with its fixed and moveable interior components can have a significant impact on human performance leading to efficient interaction with surrounding spatial spaces. Interactive design is constantly proves creating memorable connection and empowering connection with beneficiaries' participants that can come to life in many forms, one of these many facility structures is implementing the interior architectural design approach of "Kinetic Technology".

Interior architecture is the design of a space inside any building that can be fixing. In addition, it can be the initial design and plan for use then later redesign to accommodate a changed purpose, or a significantly revised design for adaptive reuse of the building shell. Generally referred to as the spatial art of environmental design, form and practice, interior architecture is the process through which the interiors of buildings are designed concerned with all aspects of the human uses of structural spatial spaces. Therefore putting simply, Interior Architecture is the design of an interior in architectural terms, *(Wikipedia encyclopedia)*.

The paper presents variety approaches of innovation trends, that utilizing multiple kinetic applications for the scope, benefit of interior design elements. It will give valid benefits to interior planners and designers for efficient enhancement into their practical expertise. That experience will be achieved when implementing this technology of kinetic approach to achieve effective utilization of interior spatial spaces as dynamic quality of the spatial space's changeable size, continuity and to create a feeling of connectivity through the spatial space, which seems to virtual enlarge the small floor area.

Keywords

Key Words: Kinetic; Interactive; Technology; Innovation; aesthetic; dynamic movement

1. Purpose/ Emphasizing:

Obtain, analyzing various techniques in designing public and private spatial spaces by applying multiple kinetic technology through understanding kinetic systems. Therefore, it will enable interior designers to assess major aspects of kinetic types, and its related applications that provide benefits to the design process.

Our approach is to analyze all variety of innovated kinetic systems and its applications in a certain classification aiming to act beneficially by introducing interior designers, variety series of principles, standards and techniques appropriate for implementing kinetic systems.

Then to conclude basic criteria to be a guide when applying kinetic approach and it classifications, type of movement required, the scope of interior design as well as scale of the kinetic elements. Thus, we will present various approaches of innovation trends and accompanying solutions that utilizing multiple kinetic applications for the scope, benefit of interior design elements and its mechanical implementations.

1.1. Methodology and Structure:

We will depends on number of searchable implementations, descriptive approaches through brief review of previous experiences for designing and implement multiple kinetic technology new ideas to use in design public and private spatial spaces. Our intent is to clarify design kinetic principles and related mechanisms technology to help professionals with all types of its specification process.

We have three parts to explore as follows in *Figure 1*:

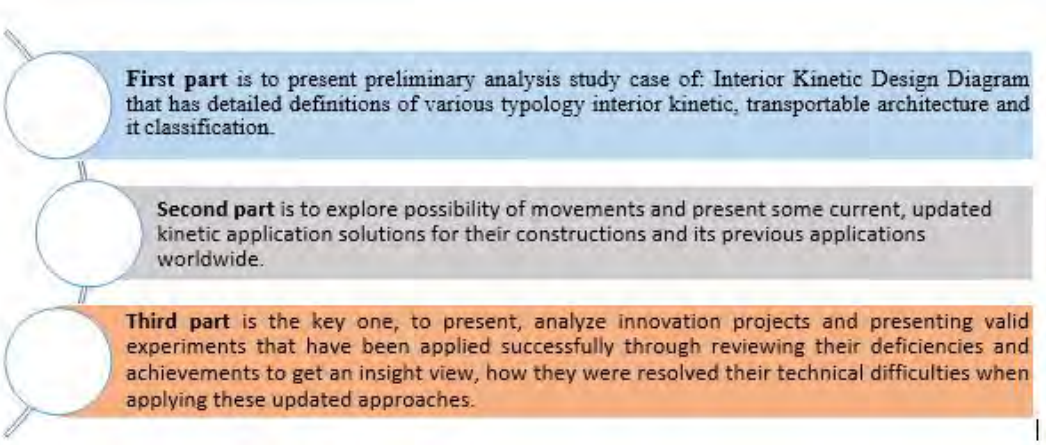


Figure 1.

The paper discusses innovative concept of internal[1] kinetic in the multi-functional architectural spatial space in terms of the animation, visual and plastic functions and the future trends in the internal motion design of the elements of interior architecture of floors, walls, partitions, ceilings and raw materials through analysis of a number of innovative applications and experiments in this field.

2. Introduction

Architecture in general has always consists of two parts, one is design and the other part science they are integrated join to act as one. Nowadays, we are living in era of technology and innovation where both have great potential manner to interact and help one another to provide adequate service rendering to the science of architecture and interior design taken as a whole. A design science marriage as known as "win-win "is a key issue, for fruitful partnership that designers strive to push their respective field of interior design forward by incorporating motion into architectural planners and interior designers give their beneficiaries another dimension by which to interact with their surroundings in a unify manner. The language of interior design is innovation .Einstein1said, "Imagination is the starting point of everything we do in life". The 21st century buildings and its interiors are an undisputed evidence of that: innovation concepts, stunning iconic designs, incredible facilities and latest technologies are forming concept of futuristic interior architecture design. All decorating trends of the 20th and 21st century depending on the category term of Technocentrism, *(Wikipedia encyclopedia)*. It is a term that denotes a value system that is, centered on technology and its ability to control and protect the environment.

Therefore, this introduction highlights the importance of applying kinetics into most of elements of interior design

[1] Futuristic Design Concepts, http://designlike.com/about-architecture/

producing futurist design in form and shape as well. We will concentrate on conceptual framework of kinetic architectural structures in the field of interior design.

2.1. Objective Goal:

Our planned goal is to identify the effect of major concepts, approaches and solutions of kinetic structure as form and shape into the design process of interior design for public and private spatial spaces. Such approach of applying kinetics will add a value and gain a benefit that helps to create new futurist ideas to used and deployed among variety applications of interior design whether within external or internal spatial spaces.

We will form certain diagram for interior kinetic structure to set our concept of how can kinetics consider as crucial element within the design process that lead to innovate new futurist ideas for interior design. Such diagram can be used by planners and interior designers as a guide or a criteria for new methodology when planning for new interior product that using the approach of kinetics. Therefore, certain definitions of kinetics types and approaches are necessary to add and explained within our study.

2.2. Interior Kinetic Structure KS Diagram:

Interior kinetic structure KS diagram as shown in *Figure 2*, is a symbolic representation of information according to some visualization technique to guide planners and interior designers to innovate new ideas and

The technique we will use is a three-dimensional visualization diagram as follows:

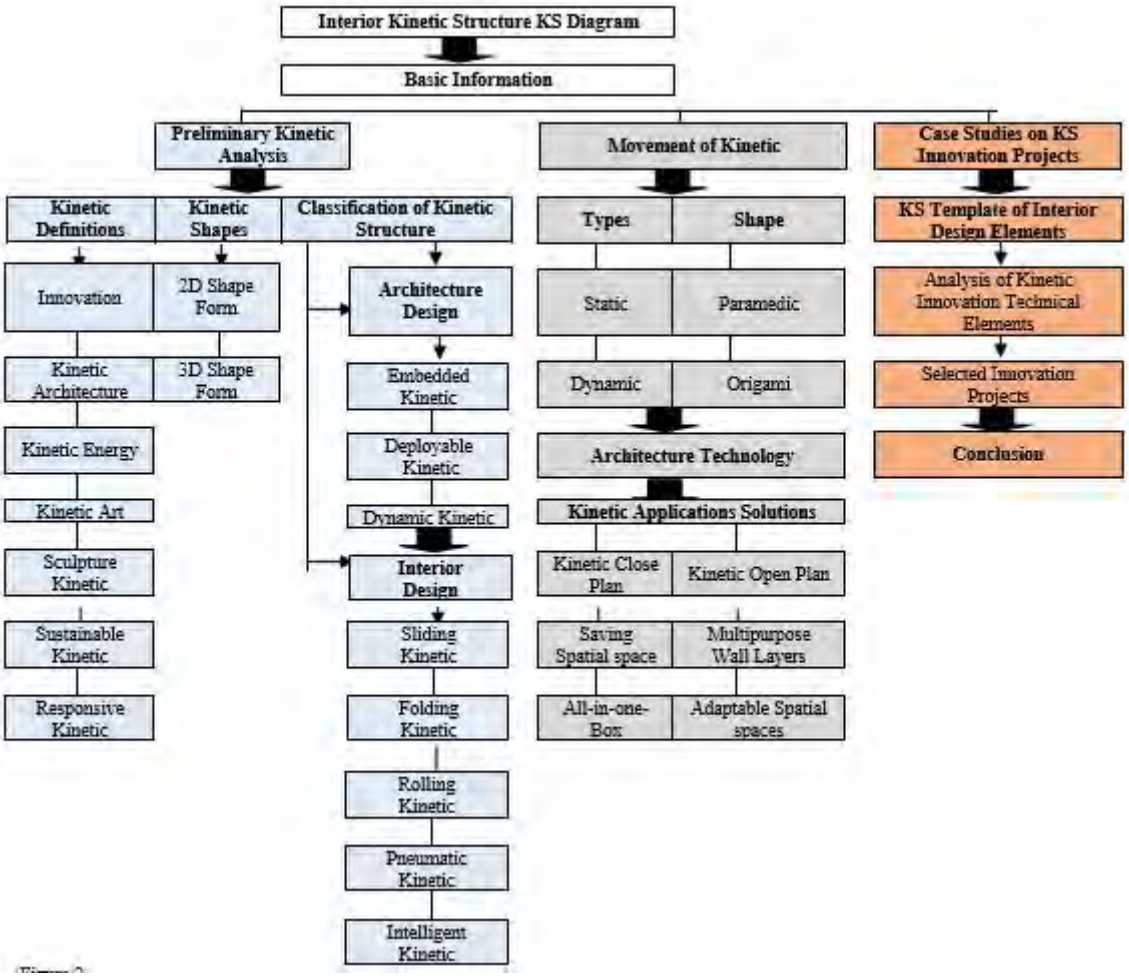


Figure 2.

2.3. Basic Information:

The process of creative design depends on many key factors that basic information the most important one. Such information provides a realistic overview over all initial stages of a design project including the client relationship, methodology and collation of information to spark innovative ideas and then, develop, deploy these ideas to access the designer creativity to produce potential solutions for the innovated ideas. The interior designers first, have to analyze the previous information to consider later on any of the creative process, the pre-design work, gathering and applying the methodology, which involves a great deal of information about human needs; requirements spatial space and site considerations that the project will be based.

The main requirements of design can be illustrated into human needs and requirements of the spatial space as following:

Human Needs	Requirements of Spatial space
Comfort	Usability
Noise control	Flexibility
Environment (solar, radiation)	Adaptability spatial space
Useable time	Interactive spatial space
Cost benefits	Shape activity

3. Preliminary Kinetic Analysis

3.1. Definitions:

a. Innovation[2] :

As extracted from businessdirectory.com, “Innovation is the process of translating an idea or invention into a good or service that creates value or for which customers will pay to call an innovation, an idea must be replicable at an economical cost and must satisfy a specific need”. The following *figure 3*, illustrate the process of five consequence stages as initial idea, assessment of idea, creation, innovation then stage of deploy into market and last but not least, accepted by its users or beneficiaries

Figure 3.

Initial Idea:

Previous information, uses, current application, new desire for a change, or modification or enhancement of current product or newly one all are basics for initialing the idea.

Assessment of Idea:

[2]https://ar.scribd.com/document/238126903/Innovation

The desired item or a product that created by the initial idea should be feasible, doable, in a reasonable cost, affordable and add positive value to the beneficiaries use and accompanying needs.

Creation / Innovation:

A new feature and product is created and innovated.

Market Deployment & Beneficiaries Acceptance:

Start production, deployment to markets, gain benefits and therefore beneficiaries' acceptance

b. Kinetic Architecture[3] **:** Kinetic architecture is a concept through which designed to allow parts of the structure to move, without reducing overall structural integrity. It lies in creating spatial spaces and objects that can physically re-configure themselves to meet changing needs

c. Kinetic Energy[4]: The energy of motion, observable as the movement of an object, particle, or set of particles. Any object in motion is using kinetic energy.

d. Kinetic Art: Is the art from any medium that contains movement perceivable by the viewer or depends on motion for its effect. Kinetic art encompasses a wide variety of overlapping techniques and styles (Wikipedia encyclopedia).

e. Sculpture Kinetic[5] **:** Is a type from kinetic art and is an art form such as an assemblage or sculpture made up of parts designed to be set in motion by an internal mechanism or an external stimulus, such as light or air.

That type could be for architectural or interior design as well as follows:

i. Sculpture Kinetic Construction[6]of the place, they have designed an empty place to transform into new futurist image by using sculpture kinetic construction for providing more relaxation feeling to its users better than it neglected without benefits or gains

Figure 4.

As shown above *in Figure 4*, they have used large columns with circle sheets by wooden panels that allow air and light to getting through via natural volume of lighting to the area with image of futurist in design and implementation as well.

i. Sculpture Interior Design Kinetic[7] **:**

As example in the field of interior design *figures 5(a-b),* Mark Davis's mobile series investigates the vast possibilities of how wood, metal material and line can deconstructed and reconfigured into new compositions each time it moved. Playing with weight, movement, and ultimately gravity, the mobiles naturally lend themselves to a planetary quality, thus source and reflection

[3]Kinetic Architecture, www.piglix.org

[4]Kinetic Energy, http://whatis.techtarget.com/definition/kinetic-energy

[5]Sculpture Kinetic, http://www.thefreedictionary.com/Kinetic+sculpture

[6]6Rest hole in the University of Seoul - UTAA, 2012, http://www.archdaily.com/440719/rest-hole-in-the-university-of-seoul-utaa/

[7]7New Mobiles by Mark Davis showed at Pucker Gallery, 2017, https://www.artsy.net/artwork/mark-davis-tribute-number-1

Figure 5. (a) (b)

f. Sustainable Kinetic Structure: Architectures and interior designers seek to minimize the negative environmental impact of buildings and its interiors by efficiency and moderation in the use of materials, energy, and development spatial space and the ecosystem at large (Wikipedia encyclopedia).

g. Responsive Kinetic Structure: Are those that measure actual environment conditions (via sensors) to enable building and its interiors to adapt their form, shape, color or character responsively (via actuators) (Wikipedia encyclopedia).

3.2. Kinetic Shapes[8] -KS:

A kinetic shape (KS) is a smooth two or three-dimensional shape that is define by its predicted ground reaction forces as it is press onto a flat surface to achieve aesthetic design form. There are two types as follows:

- ***Two-Dimensional Shape (2D)*** is a flat two-dimensional area enclosed by lines. For 2D shapes there are many forms of shape in this category, but the one that is related to interior design is "Dynamic Shape". As a matter a fact, Kinetics, it is actually dynamics. The first case of dynamic is called kinetics. So, dynamic it is "Every object experiences some form of motion which is the result of different forces acting on the object. Dynamics is the study of the forces which are responsible for this motion."
- ***Three-Dimensional Shape (3D)*** is a form of a three-dimensional area enclosed by a surface. That type of form could have; Hollow forms have volume and or, Sold forms have mass.

3.3. Classification of Kinetic Structures:

Typology of Kinetic Structures

[8]Elements and Principals of Design, Kevin Rigdone, PDF

Design using kinetic structure that include physical movement, could be apply within architecture design and interior design as well.

3.3.1. Kinetic Structures in Architecture:

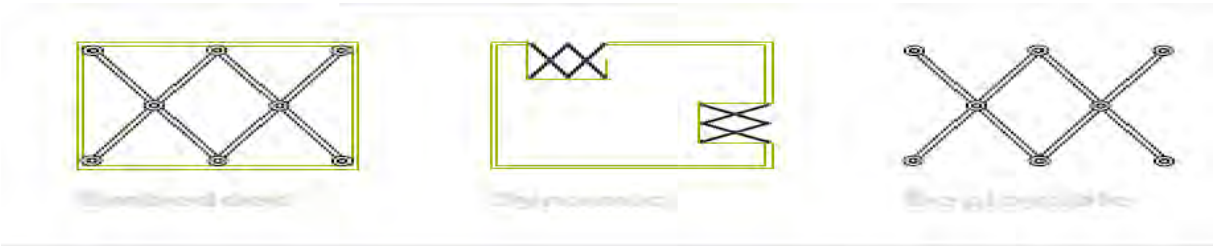


Figure 6.

- **Embedded Kinetic Structures:**such structure exists within a larger architectural whole in a fixed location, that used to control the larger systems and its respone according to modification of change of factors.
- **Deployable Kinetic Structures:**that one, exist in a temporary location and are easily transportable. There is a possibility within this structure to move, modify and change based on the plot area.
- **Dynamic Kinetic Structures:**That type of structure, include many applications such louvers, doors, partitions, ceilings, and walls as main elements of interior design (our focul topic).

Out of the above types of kinetic architecture mentioned, the dynamic structures are those that are going to study and to focus on in this paper.

3.3.2. Kinetic Structure in Interior Design[9] :

Different movements of kinetic used within interior design including sliding, folding, rolling and pneumatic movement, the following samples of these types and their accompanying solutions are:

Structure of Sliding Kinetic:

Sliding partitions define the spatial space as needed, they require considerably less spatial space in store or when open it allow more place for movement. The partition panel as *figures 7 (a-b),* hanged on a sliding mechanism, on the rollers in tracks, moves along the guide way and hidden there. The following is an example of kinetic sliding partition:

Figure 7. (a) (b)

· Structure of Folding Kinetic[10] :

[9]Sliding kinetic, http://www.plaisirdeden.com/sliding-doors-eb8134ef1f8a987c.html

[10]Typological Classification of the Recent Kinetic Architecture, Vincenzo Sapienza GianlucaRodonò†July 2016" Kinetic Architecture and Foldable Surface"

Folding kinetic applications in interior design can done through natural/manually or mechanical structure shape as follows:

Natural/Manual Folding Kinetic **:** Futuristic design for most elements of interior design comes in many forms, and shapes for insistence, folding light is part of a series of interactive light sculptures that allow the users to manipulate amount and quality of light radiating out from the center. As shown in *Figure8 :*

Figure 8.

As a basic cube made of painted wood cut at four corners in different shapes and hinged so these corners, can be opened and/or closed in many ways to control the light. A single energy efficient electric light bulb is located at the center of the cube. This bulb surrounded by a light diffusing shield and six horizontal yellow colored planes, evenly spatial spaced around the bulb and light diffuser. This design as one sample of Michael Janzen's many projects, explore new ways in which to reinvent the built environment through unexpected interactivity, which generates new forms and functions.

– ***Mechanical Folding Kinetic***[11] ***:*** *The purpose of folding is to manage, control the size whether by minimizing or maximizing the spatial space plot. Following example illustrate as figure 9, one of these folding systems which is Sky-fold Zenith:*

Figure 9.

As shown above such system as designed, can increase / decrease the spatial space using full system of automation that can be easily adaptable based upon the requirements and needs of the beneficiaries.

– Mix-Structure of Sliding and Folding[12] :

Sometimes, two types of structural design can join acting in same product. For example, Jinlishi (Egood) can provide different flexible storage options for sliding, and folding partitions storage option according to different site requirements as needed as follows:

As shown above in *figure 10*, H storage styles are the most simple and popular option people use.

[11] Kinetic Behavior Dynamic Potential Through Architecture and design, Mai M. Youssef, 2017, https://www.witpress.com/elibrary/cmem-volumes/5/4/1658

[12] Foshan Egood Movable partition, www.chinajls.com

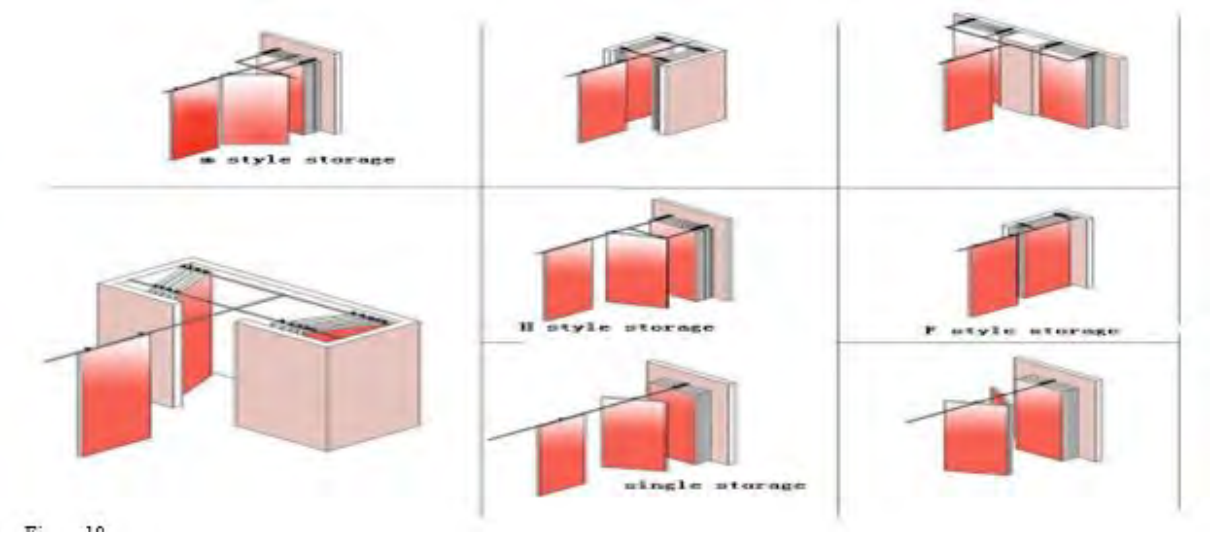


Figure 10.

– **Structure of Rolling Kinetic:**

The rolling and roll forming of structural shapes by passing them through a rolling a material or to bend or deform the work piece to a desired shape while maintaining a constant cross-section. It could be used in variety of materials such as wood, metal and glass as well.

The following example as *figure 11*indicates the movement of rolling (rotate) furniture as convertible coffee bench (spatial space of sear as a table is adjusting by rotating elements of the bench).

Figure 11.

– **Structure of Pneumatic Kinetic:**

Pneumatics (From Greek: $\pi\nu\varepsilon\acute{\upsilon}\mu\alpha$) is a branch of engineering that makes use of gas or pressurized airpower by compressed air or compressed inert gases*(Wikipedia encyclopedia)*. Such type is having the benefits of prompt, rapid, flexible and transformable that makes such approach is very feasible for international conferences, exhibitions and outdoors public and business events. The following is an example as *figures 12(a-b)* for construction done by Yale School of Architecture[13] .

Figure 12. (a)(b)

· Structure of Intelligent Kinetic[14] :

Intelligent kinetic systems structures are those that using hi-tech tools which have the ability of responsiveness with the movement by the human being. To perform this type of interaction, electronic sensors with controlled energy cells, system of LED lights are used to produce this type of intelligent responsive kinetic in the floors as a key element of interior design structure as *figures 13(a-b)*

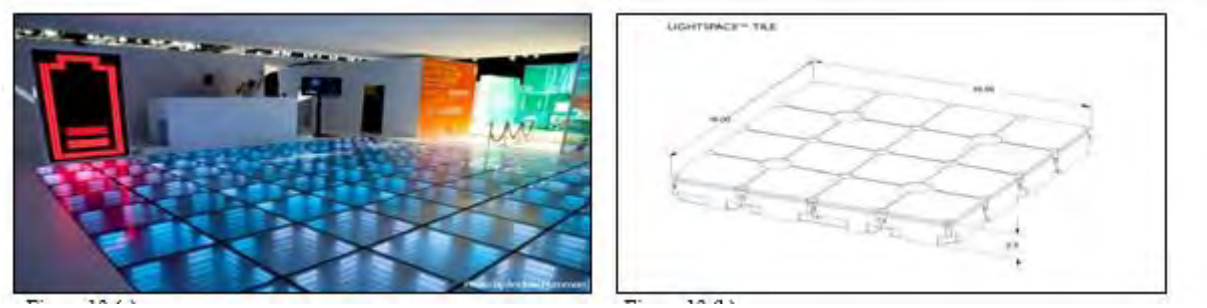


Figure 13. (a)(b)

4. Technology Movement of Kinetic Interior Architecture[15]:

Kinetic interaction within architecture can greatly affect one's experience. A designer embedding kinetics can often provide for a new kind of awareness. There are methods through which kinetic interior architecture can influence interior form as result of facing its forces, either during the design process or during the operation.

There are two main categories for forces in kinetic interior architecture and its response.

4.1. Static movement*:*

When computer-aided programs[16], used while designing futurist components of interiors there are many examples can be presenting to show how computerized designing can help, produce, and innovate various static movements for elements of interior design.

[13] Yale School of Architecture, http://architecture.yale.edu/people/henry-ng

[14] Intelligent Kinetic Systems, Michael A. Fox & Bryant P. Yeh, http://echo.iat.sfu.ca/library/fox_kinetic_systems.pdf

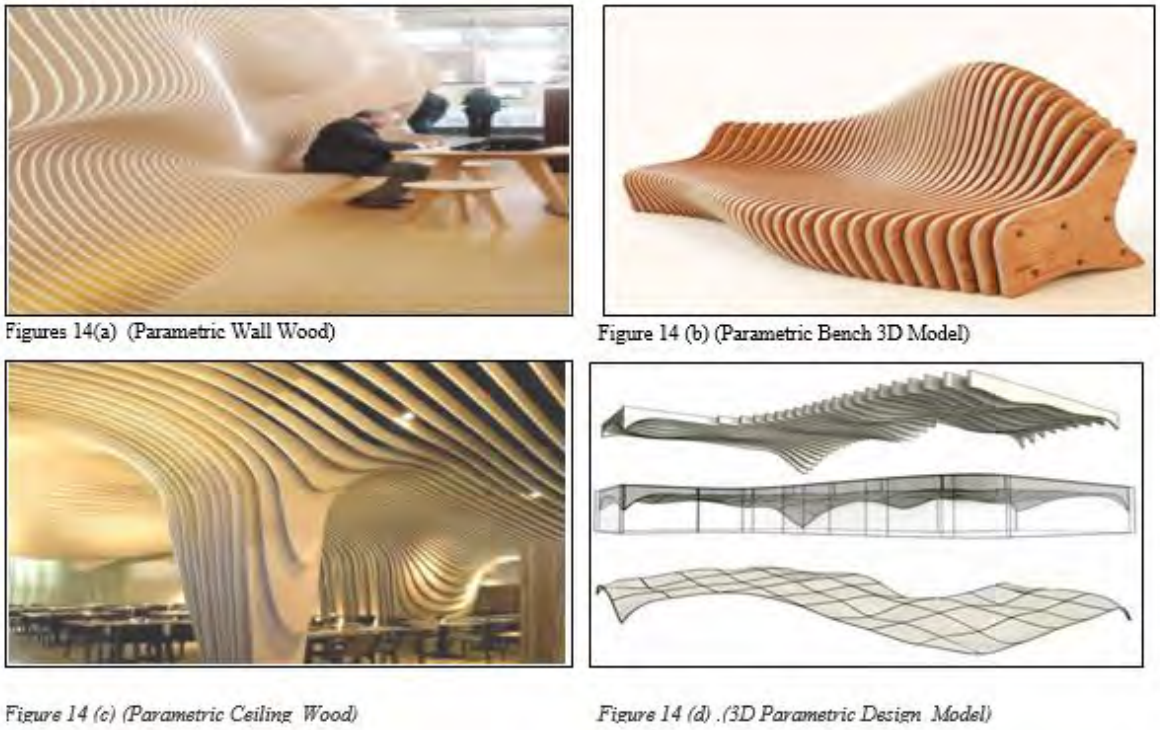
[15] Sustainable Vision of Kinetic Architecture, https://link.springer.com/article/10.1057/jba.2010.5

[16] https://www.pinterest.com/search/pins/?q=Kinetic%20architecture%20interiors&rs=guide

One of many examples for static movement is the parametric design:

4.1.1. Parametric Shape Design:

Parametric design is a process based on algorithmic thinking that enables the expression of parameters and rules that, together, define, encode and clarify the relationship between design intent and design response, *(Wikipedia encyclopedia)*. Therefore, it is a result of innovated idea to design number of wooden sheets, panels that is designed by computerized machine for cutting, placing and install in a unique futurist manner as shown hereunder for furniture seats (a bench[17]), walls[18] , as well as ceiling – *Figures 14 (a-d)*



Figures 14(a) (Parametric Wall Wood)

Figure 14 (b) (Parametric Bench 3D Model)

Figure 14 (c) (Parametric Ceiling Wood)

Figure 14 (d) .(3D Parametric Design Model)

Figure 14.

The above examples as *Figures 14 (c-d),* illustrate using 3D conception for exciting and interactive new design that gives a spatial space design a feeling of life. It is the moment in designs that think, innovative, and tries applying something completely different. The design aesthetic on this ceiling can use for any spatial space or even a dining area. This design could is delicate and elegant, almost an art piece

4.2. Dynamic movement[19]:

Kinetic dynamic movement is that can be transformable based on a change or according to needs of beneficiaries is applied within the following example of OLED LAMP, as unique combination of art design

and technology by Selux and design studio ART+COM which done in a dining room of private spatial

spatial space as *Figures 15*:

[17] ArchitectureBenchdividerFurniture,https://www.cgtrader.com/3d-models/furniture/sofa/parametric-bench

[18] LayeredOrganicParametricWallWood, https://lemanoosh.com/publication/auto-draft-287/

[19] Dynamic Movement in Light, https://www.ofdesign.net/interior-design/kinetic-oled-lamp-design-floating-silently-in-spatial space-2503

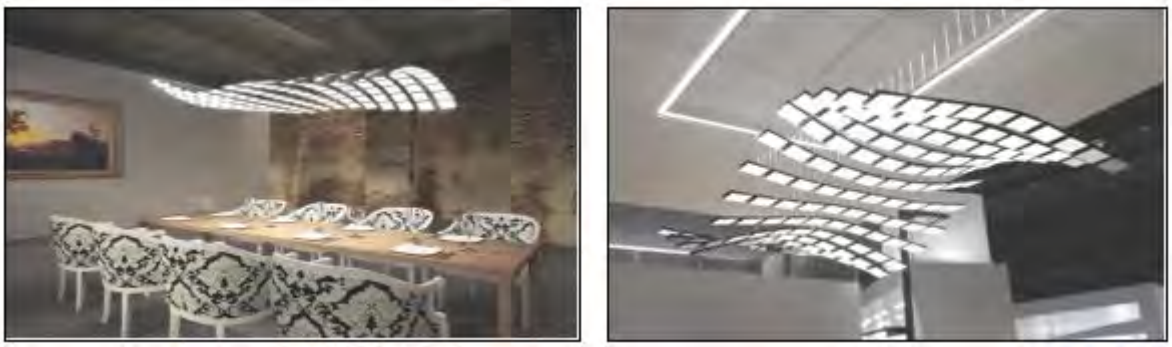


Figure 15. OLED LAMP)

4.2.1. Origami Shape Designs:

Origami (ŁŁ, from "*ori"* meaning "folding", and *kami* meaning "paper" is the art of paper folding, which is often associated with Japanese culture *(Wikipedia encyclopedia)*. Based on this definition, origami design is the art of folding all types of materials in general by combination of sheets to produce new shape, form a certain design as unique futuristic colorful output.

Figure 16.

Mar-quee[20] [mahr-kee]: an ornamental canopy, often identified by a surrounding a cache of light bulbs, signaling entrance to a theatrical event. Mar-quise [mahr-keez]: a gem cut, yielding a low pointed oval with many facets. The installation as shown in *Figures 16*, such approach of design has utilized to fold the production sheets into a flower shape as new manner of implementation "origami design" in ceiling as one of most important elements of interior design. To complete the design, lighting has utilized to complete the flowering patterns start from the base, and move on up to create a new form of design applicable for other usages whether internally or externally.

4.3. Architectural Technology:

It can be summarized as the "technical design and expertise used in the application and integration of construction technologies in the building design process, *(Wikipedia encyclopedia)*. Generally there are numerous types of technologies systems in this regards, we will addressing those that are much in relation to the field of interior design as follows:

- Electricity - Multimedia	- Electromechanical - Mechanical systems	- Digital technology

Continued on next page

[20]SCAD Digital Fabrication Club (L) Abnormal, http://www.arch2o.com/scad-digital-fabrication-club-l-abnormal/

Table 1 continued

- Hydraulic Systems	- Thermoelectric Conversion Systems

4.4. Kinetic Application Solutions:

Effective and efficient designing spatial spaces have to accomplish two main factors, flexibility and comfort to earn beneficiaries satisfaction. There are new trends for multiple kinetic used in the spatial space design as the following:

4.4.1. Multiple Kinetic Designs in Close-Plan:

The concept of multi-purpose layout for closed-plan environments is changeable functional in interior walls ,floors and ceiling for multi- uses spatial spaces and uses them for storing according to the need.

4.4.2. Kinetic Spatial space-Saving Solution:

Figure 17.

The above diagram as *Figure 17,* for Spatial space-saving Hong Kong Flat by Architect Gary Chang is an example of how can small flat of 32 sq. meters formed in many uses of the spatial space including; bedroom, bath, kitchen, and living room as well as intended desire through folding its components fitting the requirements of user. While it is not in use, all these folded areas could close and folded down to save spatial spaces as its prime goal of the design.

4.4.3. Kinetic All-in-One Box Solution[21] :

As *figure 18*, the concept of all-in-one box is to design many different applications to include within one limited spatial space or area. Thus, the following example illustrate how to fold, extract and joining-in many functions serving the concept of "rooms within rooms" that enable the designer to consolidate many useful forms into one scope of spatial space. Such design uses foldout and slide-out components of modular furniture to act as single unit

[21] http://weburbarist.com/2013/07/10/fold-out-room-12-ulta-compact-living-pods-systems/

Figure 18.

4.4.4. Multiple Kinetic Designs in Open-Plan:

Kinetic Maximize Spatial space Solution [22](Multipurpose Layout of Open-Plan)

The concept of multipurpose layout for open-plan environments is a flexible organization of interior spatial spaces, which based on arranging the spatial space as needed. Layers of partitions are in used freely to control and manage the spatial space whether by maximizing or minimizing feasibly. Such approach in design currently is in use by many planners and interior designers since nowadays the available spatial space are limited in spatial space through kinetic movable and sliding walls or hinged partitions as *figures 19 (a-c):*

Figure 19 (a) Closed Sheets

Figure 19 (b) Opened Sheets

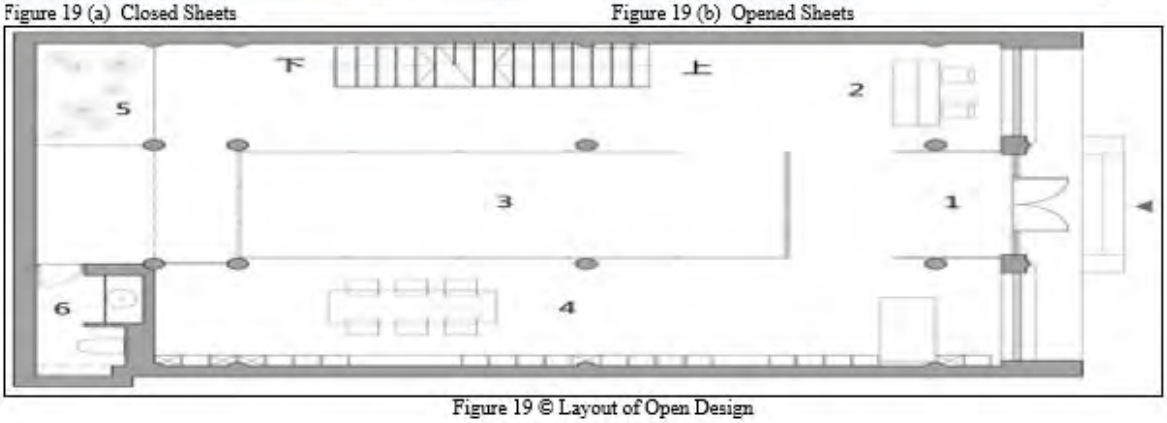


Figure 19 © Layout of Open Design

Figure 19.

Turn a multi functional large spatial space into smaller specific areas to relax, work, eat and sleep with these ideas for dividing open-plan rooms without building walls or engaging in major renovation. These open-plan zones can be temporary measures that fold away when you do not need them or more permanent structures, to give purpose

[22]https://www.dezeen.com/2015/11/05/arch-studio-foldaway-walls-exhibition-spatial spaces-beijing-rongbaozhai-western-art-gallery/

to a large empty room, as shown above in *figures 19(a-c)*

5. Case Studies on KS Innovation Projects:

In this last part of the paper, we have selected number of kinetic structure innovation projects that implemented to study, identify and analyze its descriptive approaches through our review over some previous experiences for designing and implement multiple kinetic technology new ideas to use in design public and private spatial spaces.

Our intent is to clarify most updated innovation designs been done in the kinetic structure, principles and its related mechanisms in the field of interior design applications and technology to help professionals with all types of its specification process as a guide when performing the design phase.

The following template as shown within *figure 20*, identifying the selected innovated projects as its elements, function and target to achieved in each one respectively:

Type of Spatial space	Interior Design Elements	Functional Usability / Design Shape	Innovated Project	Target Achievements
Public University	Ceilings	Interactive/ Dynamic	Aurora, the interactive kinetic ceiling by Michael Franco, 2016	Unique, Impressive to Users
Public Restaurant	Partitions	Expandable, Interactive/ Dynamic Origami	Facet by Murielle Meijs, Alison Milne Design, 2012	Unique, Aesthetic
Public Facility	Doors	Accessibility, Movable, Transformability/ Folding, Parametric	Spectacular Curtain Door by Matharoo Associates, 2012	Piece of Art, Aesthetic, Impressive
Private Interiors		Accessibility, Movable, Transformability/ Folding, Origami	Evolution Door by Klemens Torggler, 2014	Unique, Aesthetic
Private Interiors	Walls	Accessibility, Movable, Transformability/ Dynamic Folding	Sculptural Wall, by Vlad Mishin, 2013	Unique, Impressive to Users
Private Interiors	Seating Furniture	Expandable, Interactive/ Dynamic Origami	Flat-pack kinetic Seating System, by Thomas Hurd, 2014	Piece of Art, Aesthetic, Impressive
		Movable, Transformability/ Folding, Parametric	Kinetic Chair by, Jessica Banks, 2014	Unique, Aesthetic

Figure 20.

CEILINGS & PARTITIONS:

Responsive Kinetic Design[23]

Interior Elements	Typology of Kinetic	Kinetic Structure	Kinetic Shape	Kinetic Solutions	Typology of Technology
Ceilings	Architecture, Responsive	Pneumatic	Dynamic Circle	Aesthetic Interactive Innovation	Multimedia, Digital, Thermoelectric

Architect and designer BehnazFarahi likes movement,Farahi has installed a kinetic ceiling at the University of Southern California that reacts and moves in response to the people walking beneath it.

As shown herewith in *figure 21*, the ceiling measures 15 x 15 feet (about 4.6 x 4.6 m) and has five floating motion disks covered in industrial felt.There are also four discs that don't move.

The discs can move both up and down and can rotate in various directions, which means the ceiling can get quite

[23] Aurora, the interactive kinetic ceiling, Michael Franco, 2016, http://newatlas.com/interactive-ceiling/42525/

expressive.

Figure 21.

The ceiling is activated through a connected Xbox Kinetic motion-capture camera that translates movement into the actuation of the ceiling panels. In addition to having the discs respond to movement, the installation also has special lighting that turns on and off based on the path of a visitor to the room. "This project aims to rethink the conventional rigid, solid architectural spatial space through its combination of shape changing form, responsive lighting, adaptable spatial spaces and interactive responses," says Farahi. "It is an attempt therefore to reimaging the possibilities of sensory spatial spaces and robotic architecture."

PARTITIONS[24] :

Facet by Mireille Meijs, Alison Milne Design using the approach of ***Origami*** interior structure in walls and partitions as the following *figure 22*:

Interior Design Elements	Typology of Kinetic	Kinetic Structure KS	Kinetic Shape	Kinetic Solutions	Typology of Technology
Partitions	Architecture, Art Kinetic	Folding	Origami	Adaptable Spatial spaces	Electromechanical

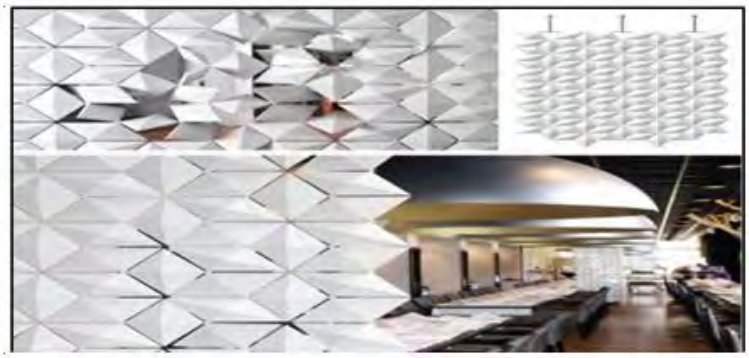


Figure 22.

Bloomming has collaborated with 3form on this new product innovation. Facet is an interactive solution with a unique aesthetic for partitions, screens or large-scale Centerpiece applications. Facet brings a new dimension to interior spatial space design. Designer Mireille Meijs used PCABS and aluminum to create this modular system.

[24]Facet by Mireille Meijs / Alison Milne Design, 2012,http://alisonmilne.com/2012/01/13/facet-by-mireille-meijs/

DOORS:

SPECTACULAR CURTAIN DOOR, by Matharoo Associates

Interior Design Elements	Typology of Kinetic	Kinetic Structure KS	Kinetic Shape	Kinetic Solutions	Typology of Technology
Doors	Sculpture	Rolling	Paramet-ric	Aesthetic Innovation	Electromechani-cal

Matharoo Associates[25] , an architectural firm from India completed one of the most interesting doors

In the following *figures of 23 (a-c),* presenting new unique innovation of curtain door in different form and shapes. This design is a piece of futuristic art in a manner that is not design by others before or applied elsewhere

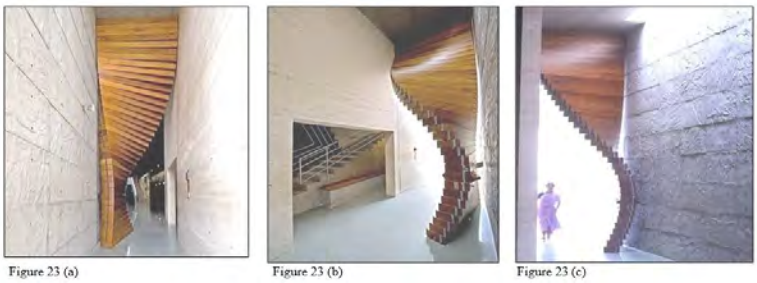


Figure 23.

The manufacture used teak wood in implementing the design, which we can remind us of piano riddles, by linking number of thick Burma teak together in a harmony and smoothly way while opening or closing the door.

EVOLUTION DOOR[26] **,** by Klemens Torggler:

Interior Design Elements	Typology of Kinetic	Kinetic Structure KS	Kinetic Shape	Kinetic Solutions	Typology of Technology
Doors	Art Kinetic	Rolling	Origami	Aesthetic Innovation	Mechanical systems

One of Austrian designers named "Klemens Torggler" had invented many previous tries to design a door with very fast, flexible and dynamic in action to save spatial space with easy movement for open or to close features. During many times before, he continues to add more features or enhancement within the design by adjusting the components itself or using updated technology. At last, his last project as shown in *figures24 (a-b)* called The Evolution Door which containing four panels opening and closing respectively based on simple move by user hand. In his last design, allow the panels to move more flexible. By the help provided by kinetics, it easily folds itself as folding/origami shape of kinetic to turn around repeatedly before aligning again into a form of rectangle shape. The special construction makes it possible to move the door sideways without the use of tracks.

WALLS: Transforming Sculptural Wall[27]

Interior Design Elements	Typology of Ki-netic	Kinetic Structure KS	Kinetic Shape	Kinetic Solu-tions	Typology of Tech-nology
Walls	Sculpture Kinetic	Sliding, Folding	Origami	Saving Spatial spaces	Mechanical systems

As shown in *figures 25 (a-e)*, proper utilization of spatial space is a main factor of successful spatial space design. Thus, in a spatial space area of 60 sq. m apartment area designed by Vlad Mishin, with sculptural blocks wall

[25]Matharoo Associates, Curtain Door, 2012, http://freshome.com/2012/09/27/express-to-impress-spectacular-curtain-door-by-matharoo- associates/

[26]Torggler's Evolution Door,2014, http://www.businessinsider.com/klemens-torgglers-kinectic-door-2014-2

[27]Sculptural Wall, by Vlad Mishin, 2013,https:/www.behance.net/gallery/6775861/Transformer-apt

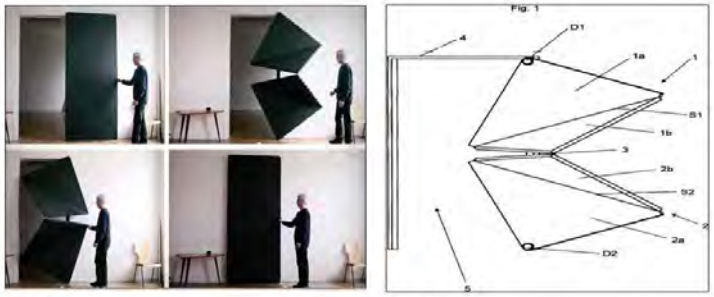


Figure 24.

that easy transformable to separate or dividing the area as required needs of the beneficiary is new application in design. The wall itself consists of black metal framework and plywood.

Figure 25 (a) (Modern Apartment with Transform Sculptural Wall)

Figure 25 (b) (Opened Partition with Transforming Sculptural)

Figure 25 © (Rotating Block with Transform Sculptural Wall)

Figure 25 (d) (Kitchen with Transforming Sculptural Wall)

Figure 25. (e) (Plan of Modern Apartment withTransforming Sculptural Wall)

SEATING FURNITURE: Flat-pack Kinetic Seating System

Interior Design Elements	Typology of Kinetic	Kinetic Structure KS	Kinetic Shape	Kinetic Solutions	Typology of Technology
SEATING FURNITURE	Sculpture, Intelligent	Sliding, Folding	Origami	Saving Spatial spaces	Fabrication Unit

The following example in new innovated kinetic furniture as shown *in figure 26* is "Flat-Pack Kinetic Seating System", created by Thomas Hurd called Polytope[28] . Polytope is an environmentally conscious flat-pack seating system ideal for temporary seating needs.

This piece of art, comes pre-cut, flat, packed and can be assemble in 15–30 seconds, Polytope is light for easy stacking and redeployment, allowing for dynamic use of spatial space.

SEATING FURNITURE: Kinetic Chair[29]

[28]Flat-pack seating system, by Thomas Hurd, 2014, http://www.core77.com/gallery/20249/core77-design-awards-2011/#image=50
[29]Kinetic Innovated Chair, by Jessica Banks, 2014, https://bondstreet.com/blog/the-future-of-furniture/

Figure 26.

Interior Design Elements	Typology of Kinetic	Kinetic Structure KS	Kinetic Shape	Kinetic Solutions	Typology of Technology
SEATING FURNITURE	Flat-Pack Kinetic	Sliding, Folding	Origami	Saving Spatial spaces	Fabrication Unit

As shown in *figure 27 (a),* Jessica Banks' company is an engineering boutique specializing in the innovation and fabrication of kinetic furniture, lighting and wearable's. That design house, make responsive and reaction furniture that moves, this example of new innovated kinetic chair that fixable, light, and in simple design with a vision.

Figure 27 (a) Kinetic Chair by Jessica Bank

Figure 27 (b) The Ollie Chair by RockPaperRobot

Figure 27.

While as in *figure 27 (b)* another company named RockPaperRobot title "*The Ollie Chair*"[30]*: Shape-Shifting Seating, Created by RockPaperRobot* called "tambour" traditionally used in roll-top desks, a tambour is a flexible surface made of wood slats adhered to a textile canvas. Using a tambour as a seating surface is an innovation that gives the Ollie Chair its unique movement and shape-shifting abilities.

6. Conclusion

Futuristic multi kinetic interior architecture design has proved that it is one of the most spectacular trends in interior spaces, furnishing all types of spaces. In addition, futuristic kinetic applications presented herewith provides an opportunity for Egyptian planners and interior designers to see new image of the future by applying kinetics approach within most of interior design plans and applications as well as enable having prime interior trends in the near future to develop futuristic concepts to benefiting the design process. Interior designers will have the ability to perform scientific combination of their given talents and practical vision for more efficient and enhancement in the design using proper utilization of multiple kinetic technologies and its solutions.

We have concluded that multi kinetic technology KT is a key for allowing interior designers and planners to solve problems of aesthetics, develop their design as unique, futuristic form of design. Our study revealed many aspects of new design and materials of kinetic technology in design applications making a benchmark for ideal criteria for planners, interior designers in Egypt and others within the region to serve as guide, or reference while applying

[30]The Ollie Chair, RockPaperRobot, 2017, https://www.kickstarter.com/projects/144629748/the-ollie-chair-shape-shifting-seating

the mentioned approach KT. This paper has given the crucial importance of technologies, hi-tech solutions and its fields of applications into elements of interior design through applying different types of kinetics as effective mean to fulfill innovated ideas that having the features of futuristic and creativity.

Egyptian architects and interior designers will grasp a vision that enable designing in more flexible, transformable, more adaptable to human needs and interaction with surrounding environment. Such vision is achievable as obtained from our paper results and studies done over selected numbers of kinetic innovation projects has conclude numerous ideas, applications, creative solutions and design that develop more innovative creations useful for their enhancement for designing new ideas, trends that will help in our scope of interior design today and later on. Thus, such results will give flexibility to designing of spatial spaces via applying new techniques in designing tiny spaces for residential areas to achieve target requirements of simplicity, conform, and cost effective that currently these spaces having huge demands in the Egyptian market. Wide implementation of these new designs using multi kinetic technology will open new lines within furniture manufactures to add, produce modern, unique futuristic unis to save time, effort and providing comfort with valid satisfaction accordingly.

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