The interactive digital direction in the interior design of libraries

Prof. Hussein Kamel El-Nabawi
Professor of Tourism Design, Department of Interior Design and Furniture
Prof. Asmaa Hamed Abd-Elmaqsod
Professor of Administrative Interior Design, Faculty of Applied Arts - Helwan University and former Dean of the Faculty of Applied Arts
asmaa_hamed@a-arts.helwan.edu.eg
Researcher. Radwa Ibrahim Abdel-latif Gamal
Master`s Student- Interior Design and Furniture Department, Helwan University
Radwa_ig@hotmail.com

Abstract:

The research presents a historical overview of the digital revolution for the development that libraries have gone through to reach digital libraries, the reasons for its inception, and it presents the interactive digital trend and its impact on the internal design of libraries, where it also became possible for the user to interact with the internal environment of the library, which provided an opportunity for new dimensions in the relationship between them, and realizing the impact of technology on the spaces function and creating an interactive environment that integrates the mental and motor activity of the user.

Public libraries lack the elements of interior design to achieve the interactive dimension, which negatively affected the functionality of the performance of libraries for their main objective, and as a result of their association with modern technologies, where digital libraries have become facing many challenges, especially after the explosion of knowledge, so they had to make plans and policies to develop the interior design for libraries.

The library buildings vary in terms of their designs, which adapt to the surrounding environment and the social conditions prevailing in the city, but there are some common elements through which these buildings can be evaluated, by studying the foundations and standards for interior design in interactive digital libraries, including: Location space, equipment, furniture, in addition to a good study of modern trends in interior design, including sustainable design, smart design, as well as interactive design for libraries.

Key words:

Digital Library -Interactive Library- Interactive design -Automation

Research problem:

1. The lack of interactive digital libraries in urban centers in the new urban communities in a way that is not commensurate with the era of technological development.
2. The public libraries lack the elements of the interactive interior design, which negatively affected the functionality of the performance of the libraries for their main objective, and their connection with modern technologies.

DOI: 10.21608/jsos.2021.100169.1092

Research importance:

- Taking advantage of the digital library through researching intellectual production, databases, and electronic portals to help solve problems and make decisions. This will naturally be reflected in the various roles and activities that the library performs, as there is a deep realization that the library is a tool for change or a tool for comprehensive development in society.
- Access to information that may not be available in the library itself, but rather obtained through cooperation agreements with similar libraries, or with libraries and information networks.

Research aims:

1. The objectives of the research are to find the foundations and standards for the interactive interior design of the library that supports the beneficiary in dealing with the information available in the libraries, which in turn will increase the speed of communication between researchers in the field of scientific production and publishing.
2. Acquisition of digital books produced by the most prestigious universities in the world, as well as those produced by publishers in various disciplines, in order to expand learning resources and provide documented content that helps to develop skills and knowledge experiences and the gradual transformation from a culture of memorization and indoctrination to understanding and innovation.

Research terms:

1. **The Library:** UNESCO defines the library as: "every organized collection of printed books and periodicals, or all other forms of documents, which is managed by a group of qualified personnel who respond to informational, educational, entertainment and research needs.
2. **Digital Library**: It is the library that owns computerized electronic resources only, and does not use traditional printed resources, regardless of whether they are available on the Internet first.
3. **Interactive Library:**

They are multi-purpose interactive halls and can be inside the library building. They contain computers, multimedia, interactive video, and digital technology. Interactive rooms are located in the library's courtyard, especially in workshops, group education courses and brainstorming.

4. **Virtual Libraries:** It is a library that exists on the Internet and has no place in reality. The digital information sources constitute all its contents. It is the library that constitutes electronic or digital resources and all their contents and does not need a building to contain them, but rather needs a group of servers and a network connecting it to the terminals for use.
5. **Electronic Library:** It contains both digital and paper sources of information. It archives, classifies and organizes the contents of paper sources into electronic sources that are easily accessible and know their existence.
6. **Automation - automatic control**[1]

The term automation is one of the old terms and is considered the product of intellectual, scientific and technical development over the ages,

Research Methodology:

The research combines several approaches to achieve its hypotheses:

1. The historical approach to trace how were the emergence and development of interactive digital libraries.
2. The descriptive approach, which includes the compilation of design and technical specifications for digital interactive libraries.
3. The analytical approach, which includes the analysis and interpretation of facts and information about digital interactive libraries and their ease of use for different groups.

Introduction:

There is no doubt that libraries and information centers face many challenges in light of the scientific and technical developments that the contemporary world is witnessing, especially after the explosion of knowledge.

The increasing reliance on new information and communication technologies on the part of libraries has also led to the imposition of a number of new challenges, mainly the need to develop methodological and practical frameworks for designing digital libraries and digital resources, regardless of borders and temporal and geographic barriers.

The interactive digital library was one of those effective developments in information and communication technology. The summit of this development can be reached through the international information network (the Internet), which has become a necessity of daily life. In the areas of development, training and management.

١- Types of libraries[2]

The types of libraries vary among themselves according to the entity that manages them, and they are:

1-1- National Libraries
1-2- Public Libraries
1-3- University Libraries
1-4- School libraries
1-5- Private Libraries
1-6- Digital Libraries

Image (1) showing the George Peabody Library, Johns Hopkins University, Baltimore, USA
https://www.cntraveler.com/galleries/2014-09-02/10-of-the-worlds-most-beautiful-libraries

Image (2) shows the Penang Digital Library
https://www.penangdigitallibrary.com/digital-library

1-6-1 -The reasons for the emergence of the digital library:
Perhaps the beginning of the emergence of digital libraries came as a result of the multiplicity of applications of modern technologies in the field of libraries and information.

2 -Brief on the digital revolution :

The progress of the human race is measured by the technological progress it has achieved, information age has reached twenty years today, and the development of technology, products and services are taking place at an amazing speed. Which will change our economy and society, and thus architecture and interior design radically.

3 -Smart library building:

The term smart buildings were used in the United States at the beginning of the eighties of the last century. Smart buildings were defined at that time by the Smart Building Institute as buildings in which multiple systems are integrated with high efficiency to manage resources and capabilities in order to maximize technical performance, increase revenue, rationalize operating cost, and achieve flexibility.

3-1-Aspects of intelligence in smart library building technology :
3-1-1-Lighting Control, it senses movement, meaning that as soon as you pass inside the corridors of the library, lights will turn on automatically, and many electrical devices inside the library can be controlled, such as identity devices, cooling, heating and others.
٣-1-2Air conditioning, heating and cooling control the temperature level inside and outside the library and at any time through a special thermostat compatible with most modern refrigeration devices from air conditioners or heating devices, and windows close by themselves when air conditioners start to do their job.
3-1-3-Protection, security system in it is advanced and allows continuous and direct monitoring of the library, whether from inside the library through fixed screens such as television, or mobile devices such as a mobile device.

3-1-4-Electromechanical gates and electric curtains, these systems control the library entrances automatically, as they can be set to open automatically for authorized persons or to close automatically at a certain time with a safety system.

3-1-5-Audio and video Controlling, the audio and video inside the library through the Audio & Video Matrix super distribution systems, which allow controlling receivers, operating computers, video game devices, and controlling surveillance cameras using a remote control, mobile phone, or the Internet, where it is possible to listen and watch in All parts of the library through the so-called (interactive viewing) feature.

3-1-6-Elevators, stairs and wheelchairs, automatically controlling the movement of elevators and stairs, as well as programming wheelchairs inside the library to track the movement of the beneficiary, and automatically returning the chairs to their specified places after use.

3-1-7-Books and information containers, controlling the determination of the appropriate place for the book on the open shelves so that the books are not placed in places other than the ones they were classified within, and providing the appropriate atmosphere for the book through various weather systems.

Image (3) shows the library of D.H. Hill Library Internet devices monitor the movement of furniture, the number of visitors and control digital signage
https://blogaruc.blogspot.com/2019/07/blog-post_31.html

4- Smart Interior Design :

The interior design can be considered smart, if it achieves its goal in the best way, but the intelligence intended here is to transform the environment in which the user lives into a smart environment that interacts and meets his needs.

Interior design is not intended to contain many smart devices and systems only, but these systems and devices must be integrated with each other and work in the path of achieving one goal.

4-1-The goal of smart interior design :

The goal is to create a smart environment capable of meeting the needs of individuals living in this environment, achieving comfort and luxury for them, and trying to facilitate their work in this environment to raise their productivity, by replacing dangerous work, physical work and repetitive tasks with automated factors.

4-2-Characteristics and qualities of smart interior design:

4-2-1-Response

The main objective of responsive interior design is a responsive environment that can respond to our needs and requirements and adapt accordingly, and this responsive environment is not entirely produced by a computer like virtual reality, but rather it is a crossing between reality and hypothesis, and in order to achieve this, the interior design must become sensitive and obedient and has the ability to adapt, so that its functions can change over time.

4-2-1- Interaction:

The interactive interior design aims to create an environment capable of feeling and interacting in an understandable manner, that is, to play the role of human interaction with the occupants of the space, in order to improve the lives of the users of the space and make them more involved in their surroundings, thus providing them with greater comfort and making the spaces user-friendly, and more connected and responsive to user needs.

4-2-1-Kinetic:

This movement aims to respond or interact with the user of the space or perform functions that are impossible for a fixed interior design to perform.

It means the ability of the interior design to perform more than one function through one element.

4-2-1- Flexibility:

It means the flexibility of the interior design of the space and making it more efficient to suit the addition and change in the future when needed. It also means the ability of the interior design to adapt to the surrounding environmental conditions and the current and expected user needs .

5- Interactive Interior Design

The concept of interactive interior design arose as a result of the intimate relationship between man and computer, which is developing day after day, where the basic idea of interaction between man and space is based on making scenarios for the various activities practiced by man within the interior spaces, and programming them inside the computer through advanced programs, where there are sensors which works through infrared rays to identify the person when he enters the void and then control those spaces and internal devices to interact with him and meet his requirements.

١-٥- Components of Interactive Interior Design[7]

The interactive internal components are divided into three main components, from which emerge another set of components that will enrich the internal environment and make it an integrated interactive environment:

١- Components of the interactive interior environment (ceilings - walls - floors).

٢- The effects of interactive smart materials.

٣- Interactive devices and interactive furniture.

٢-٥- Interactive surfaces

Flat surfaces such as walls, floors, ceilings and furniture are associated with design and architectural aesthetic requirements, and these surfaces were often used to display decorative aesthetic things such as paints, decorative images and textiles, but with the technological development, which reached the implementation of many means of achieving interactivity, so that these surfaces become the same interactive environmental surface and it is transformed from architectural elements into a smart skin that can feel, control and respond to stimuli.

٥-٣- Use of interactive interfaces

The architectural environment can also be made alive by integrating different environments automatically, using and creating programming interfaces, or interfering with environments such as using displays of a specific space to move the space in a second place, for example a building Kunsthaus Graz in Australia by architect Peter Cook and Colin Fournier, implemented in 2003.

Image (4) shows the Kunsthaus Graz. Building

https://planetofhotels.com/guide/de/oesterreich/graz/kunsthaus-graz-art-museum-kunsthaus-graz

٥-٤- Interactive Floors:

This modern technology is one of the means of optical display technology that provides an enjoyable interactive experience and effective interactive participation.[8]

Interactive floors have emerged with the boom of the interactive movement in recent years and they fall into two main categories[9]

A - Sensor - based interactive floors devices are commonly used in dances and performances, such as the Magic carpet.

B - Vision -based interactive floors provide a more flexible and natural interaction on the surface of the earth, making it more close and realistic to the user.

5-4-1-Types of interactive floors:

A- Interactive floors with mechanical components:

It is a model of (sensor-based interactive floors) and emerged as a result of the remarkable technical and digital development of indoor floors resulting from the tremendous technological progress.

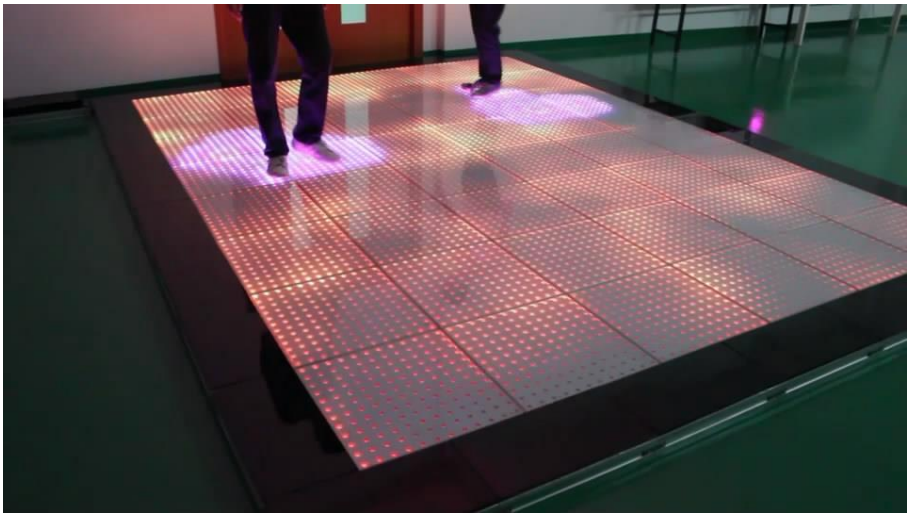

Image (5) shows interactive floors based on mechanical sensors
https://rigelighting.lightstrade.com/view/158161/P42interactivesensordancefloor,ChinaRIGEstagelight,ledfloor,tile,lightedup.html

B- Reactive floors using piezoelectric materials: [1] [0]

Piezoelectricity works by the ability of some materials, such as crystals and some types of ceramics, to generate an electric field in response to the application of mechanical stress, as they are materials that produce potentials when loads and pressures are applied to them.

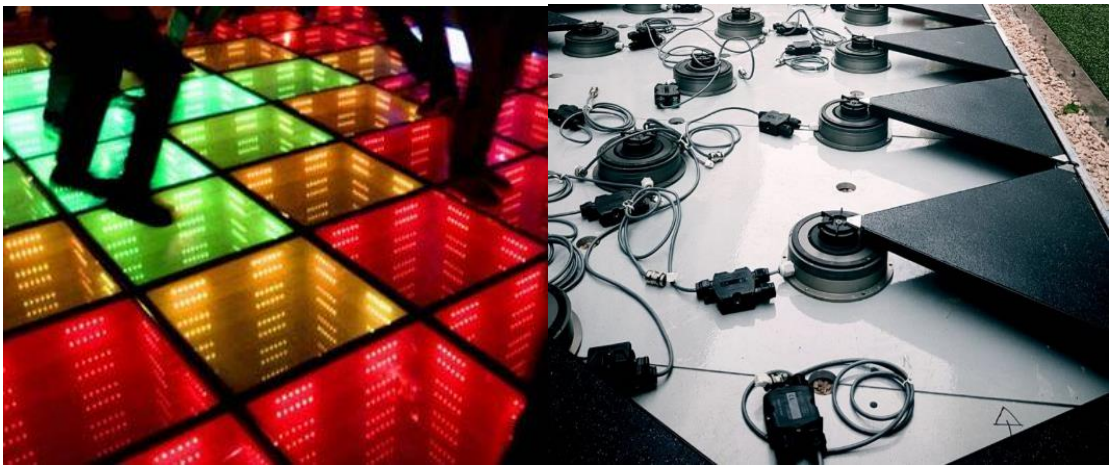

Image (6), (7) Interactive floors consisting of tiles, under which sensors are installed to interact with human movement.
https://about-energy.com

C- Interactive Projection Floor: [1] [1]

The idea of making this type of flooring is based on projecting the optical device (from the ceiling to the floor at a distance of more than 2 meters) so that the image appears on the floor, while providing the floor with sensors for the interaction of users.

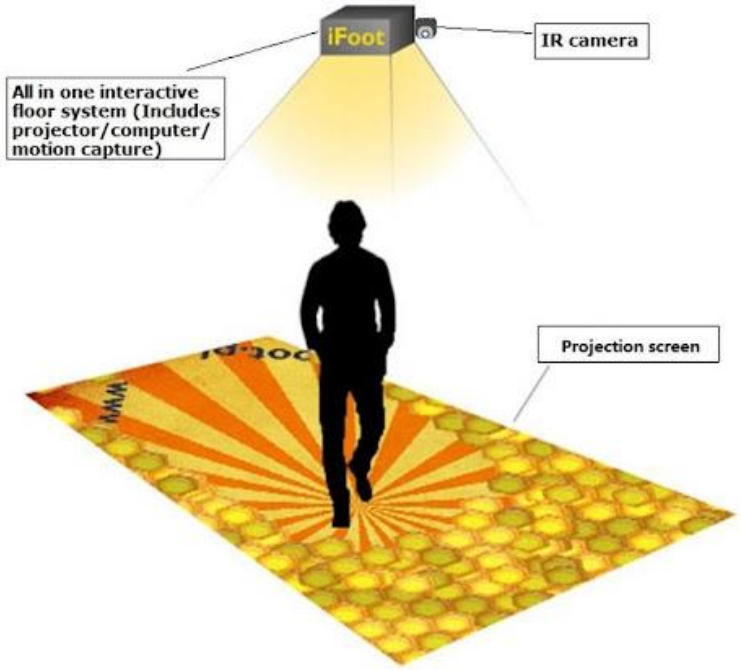

Image (8) illustrates the use of interactive floors, which combine the awareness of the movement of the body and the effect of this movement on the floor
https://www.chariotdisplay.com/interactive-floor-projection/floor-projection-games.html

٥-٥- Interactive walls:

Interactive walls are a special type of computer applications on interior and exterior architectural walls that have become characterized by their amazing high capabilities, which serve many life applications, and are one of the most suitable models for interactive applications that are highly exciting for the recipient.[1] [2]

١-٥-٥- Types of Interactive Walls:

A- Aegis Hypo surface:

In which there is a physical interaction between the design elements and the user, and thus a three-dimensional change occurs for all units of the surface as a result of the response to external stimuli such as sound, movement, light and heat, to result in dynamic design formations as a result of rearranging its units[3] .

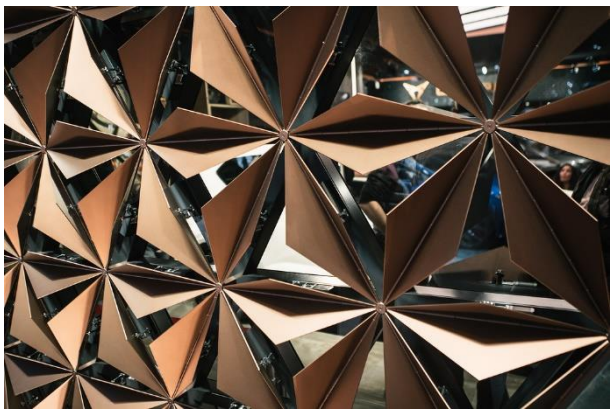

Image (9) shows the use of interactive floors, which combine the awareness of the movement of the body and the impact of this movement on the floor
https://www.flickr.com/photos/todotoit/41069589811

B- Interactive Projection walls: [1] [4]

The walls turn into a Projection Screen to display digital designs, thus blending the real and the virtual. The t-frame is the first and most popular form of interactive wall using low-cost projection software and touch-enabled hardware.

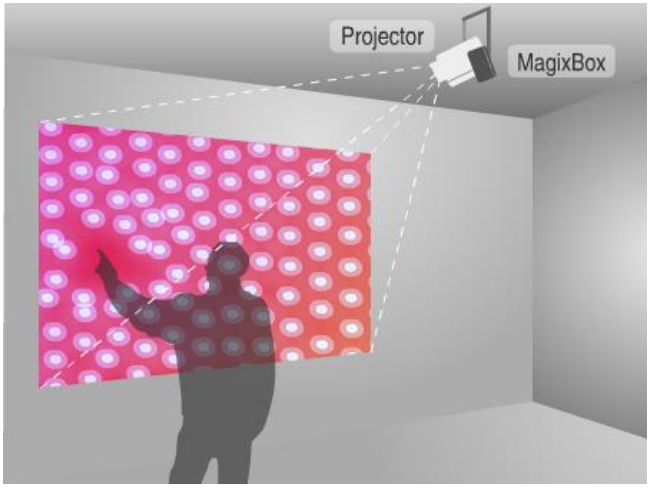

Image (10) shows the interactive wall shapes in the Projection Screen system
https://www.motionfitness.com/MotionMagix-Interactive-s/505.htm

C - Wall touch screen: [1] [5]

It consists of touch screens, through the use of "liquid crystal displays LCD", which are sensitive to light and transparent, as the screen is made of smart materials that clean themselves, which interact with hand movements.

Image (11) shows the shapes of the interactive walls with a touch screen system
www.netvision-it.com

٦-٥- Interactive Bishops:[1] [6]

Digital technology has played an important role in the development of the design thought of ceilings, whether resulting from a formal or functional point of view, so that the ceiling interacts with the internal and external environment of the spatial space.

١-٦-٥- Types of interactive ceilings

A- Reactive ceilings with mechanical components Aegis Hypo surface: [1] [7]

The interaction is physical between the design elements and the user, and thus a three-dimensional change occurs for all units of the surface as a result of the response to external stimuli such as sound, movement, light and heat,

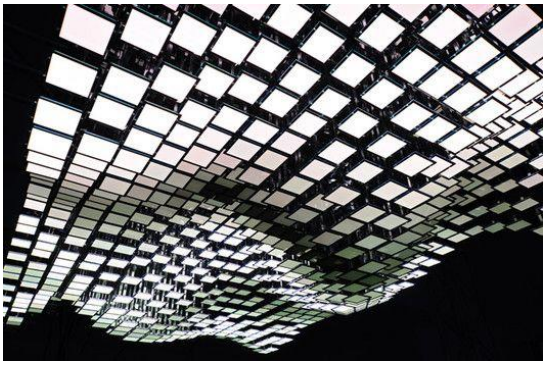

Image (12) shows different models for the use of interactive ceilings with mechanical components

B- Ceilings manufactured from digital screens. Media display[1] [8]

Ceiling interact with the internal or external environment of the building. Ceilings manufactured from digital media display are used, and they give a sense of the third dimension in the design and are used as a means to attract attention.

Image (13) shows different models for the use of ceilings manufactured from digital screens

Results

Through the study, several results appear to us that can be summarized as follows:

1. Good design of digital library spaces depends on many design principles and criteria that must be well known before applying modern technologies to design.
2. The application of modern technology used in the library's interior design methods creates a kind of interaction between the user and the library.
3. The interactive interior design helps to easily renew and update the shape of the library space according to the functional needs, and the dazzling factors also contribute to attracting users.
4. Interactive displays provide the opportunity to view the largest number of books in an attractive and interactive manner within a limited space.
5. The use of smart materials in the interior design of the library provides attractive and eye-catching display methods that encourage the customer to constantly turn out.

Recommendations

1. The necessity of having interactive digital libraries in urban centers in the new urban communities in line with the era of technological development.
2. Achieving the conditions of the interactive interior design to achieve an interactive environment between the user and the library and to reach new dimensions in the relationship between them.
3. The necessity of achieving the conditions of sustainability in the design of interactive digital libraries.
4. The interactive interior space has become a necessity and quality within the many facilities, which is commensurate with modern technology.
5. It is necessary to move towards the establishment of smart buildings, which have a role in achieving better solutions for the surrounding environment.

References:

• Abdel Aziz, Omnia Magdy - Sustainability Criteria for Smart Technologies in the Interior Design of Institutions for Caring for Children with Physical Disabilities in Egypt from 6: 12 years - PhD Thesis - Department of Interior Design and Furniture - College of Applied Arts 2017

• Khamis, Hadeer Mostafa Ahmed - Interactive Interior Design Philosophy for Developing the Environment of Educational Activities for the Secondary Stage - PhD Thesis - Faculty of Applied Arts - Helwan University - 2019

• Sorour, Mohamed. Interior Design for Digital Malls, Master's Thesis, Faculty of Applied Arts, Helwan University, 2010.

• Zorob, Fatima Mahmoud Rizk - Automation and its role in improving the performance of personnel affairs departments in government ministries in the Gaza Strip - a study presented as a supplementary requirement to obtain a master's degree in Business Administration - The Islamic University of Gaza 2008

• Hassan, Saeed Ahmed, Libraries and their cultural, social and educational impact. Cairo: Arab Thought House, 1991.

• Diab, Hamed El-Shafei, University Libraries Management: Its Theoretical Foundations and its Practical Applications, Egypt: Gharib House for Printing, Publishing and Distribution, 1989.

- Al-Najiri, Dina Mahmoud Rashad - The role of the interior designer in developing children's libraries - published research - Journal of Applied Arts and Sciences - Faculty of Applied Arts - Damietta University – 2020
- Mohamed, Doaa Abdel Rahman - The effect of using the digital revolution and smart materials in the design of the interactive interior space - published research - the second international conference - Faculty of Applied Arts - Helwan University – 2012
- Samir, Ola - The effect of using smart fabric in the development of interactive interior design - Research - Faculty of Applied Arts - Helwan University
- Dempski, K., Harvey, B., Supporting Collaborative Touch interaction with High Resolution Wall Displays. In 2nd Workshop on Multi-User and Ubiquitous User Interfaces. Jan. 2005 at IUI 2005

- Hayward V, Astley OR, Cruz-Hernandez M, Grant D, Robles-De-La-Torre G. - Haptic interfaces and devices. Sensor Review 24(1), (2004).
- Imran Patel, Ceramic Based Intelligent Piezoelectric Energy Harvesting Device, book edited by Costas Sikalidis, ISBN 978-953-307-350-7, Published: September 6, 2011 Kelly L. Dempski and Brandon L. Harvey: Touchable Interactive Walls: Opportunities and Challenges, ICEC 2005, LNCS 3711,2005,
- Leonardo Amerigo Bonanni (2005), Design of Intelligent Interiors, Master Thesis, Massachusetts Institute of Technology, USA, 19, 20
- Michael Fox, Miles Kemp. - Interactive Architecture - Princeton Architecture Press, New York, 2009.
- Soro, A, Paddeu, G. and Lobina, M.L., Multi-touch Sensing for Collaborative Interactive Walls, Human-Computer Interaction Symposium, Boston: Springer, 2008,

http://www.ala.org/educationcareers/careers/librarycareerssite/typesoflibraries
https://adelghezzal.wordpress.com/2015/10/10/
https://www.aruc.org/-/--9-62
http://www.hyposurface.org/

---

[1]Zorob, Fatima Mahmoud Rizk - Automation and its role in improving the performance of personnel affairs departments in government ministries in the Gaza Strip - a study presented as a supplementary requirement to obtain a master's degree in Business Administration - The Islamic University of Gaza 2008

[2] http://www.ala.org/educationcareers/careers/librarycareerssite/typesoflibraries

[3] Mohamed, Doaa Abdel Rahman - The effect of using the digital revolution and smart materials in the design of the interactive interior space - published research - the second international conference - Faculty of Applied Arts - Helwan University – 2012

[4] https://www.aruc.org/-/--9-62

[5] Abdel Aziz, Omnia Magdy - Sustainability Criteria for Smart Technologies in the Interior Design of Institutions for Caring for Children with Physical Disabilities in Egypt from 6: 12 years - PhD Thesis - Department of Interior Design and Furniture - College of Applied Arts 2017.

[6] Leonardo Amerigo Bonanni (2005), Design of Intelligent Interiors, Master Thesis, Massachusetts Institute of Technology, USA, 19, 20.

[7] Sorour, Mohamed. Interior Design for Digital Malls, Master's Thesis, Faculty of Applied Arts, Helwan University, 2010.

[8] Hayward V, Astley OR, Cruz-Hernandez M, Grant D, Robles-De-La-Torre G. - Haptic interfaces and devices. Sensor Review 24(1), pp. 16–29 (2004).

[9] • Khamis, Hadeer Mostafa Ahmed - Interactive Interior Design Philosophy for Developing the Environment of Educational Activities for the Secondary Stage - PhD Thesis - Faculty of Applied Arts - Helwan University – 2019 pp125-126.

[10] Imran Patel, Ceramic Based Intelligent Piezoelectric Energy Harvesting Device, book edited by Costas Sikalidis, ISBN 978-953-307-350-7, Published: September 6, 2011 under CC BY-NC-SA 3.0 license, p16

[11] Khamis, Hadeer Mostafa Ahmed - Interactive Interior Design Philosophy for Developing the Environment of Educational Activities for the Secondary Stage - PhD Thesis - Faculty of Applied Arts - Helwan University – 2019 pp30.

[12] Kelly L. Dempski and Brandon L. Harvey: Touchable Interactive Walls: Opportunities and Challenges, ICEC 2005, LNCS 3711,2005, p. 196

[13] http://www.hyposurface.org/

[1] Soro, A, Paddeu, G. and Lobina, M.L., Multi-touch Sensing for Collaborative Interactive Walls, Human-Computer Interaction Symposium, Boston: Springer, 2008, p. 207 2 - http://labomc.it/tframe [4]

[1] Dempski, K., Harvey, B., Supporting Collaborative Touch interaction with High Resolution Wall Displays. In 2nd Workshop on Multi-User and Ubiquitous User Interfaces. Jan. 2005 at IUI 2005. [5]

[1] Mohamed, Doaa Abdel Rahman - The effect of using the digital revolution and smart materials in the design of the interactive interior space - published research - the second international conference - Faculty of Applied Arts - Helwan University – 2012pp14 [6]

[1] Al-Najiri, Dina Mahmoud Rashad - The role of the interior designer in developing children's libraries - published research - Journal of Applied Arts and Sciences - Faculty of Applied Arts - Damietta University – 2020 [7]

[1] Khamis, Hadeer Mostafa Ahmed - Interactive Interior Design Philosophy for Developing the Environment of Educational Activities for the Secondary Stage - PhD Thesis - Faculty of Applied Arts - Helwan University – 2019 pp32. [8]