

Advantages of augmented reality technology to improve the user experience within commercial spaces

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ABSTRACT

Shops with their traditional status have lost their vitality and attractiveness to the contemporary user in light of the era of technological development. As the user has become linked to modern digital means, every user has a personal mobile phone that serves as a mobile computer that he relies on for many of his daily activities. Thus, introducing technological technologies into the design of commercial spaces has become considered a smart solution to link the user to the space and make him interact with it in an invisible virtual space behind the screens. In this research, augmented reality will be addressed in improving the user experience within commercial spaces and how the components and elements of this technology can be used to create an interactive relationship between space elements and user behavior, with a review of some models that illustrate commercial activity. Where the entered data is integrated with the real environment and the user is placed in a more efficient, interactive and more enjoyable environment, so that the user feels that the surrounding environment and its components are part of the real world in which he lives and not separate from it, and thus the philosophy of space has changed and it has been transformed into a medium that transmits information through augmented reality technology.

Keywords: Consumer behavior, commercial space, mobile applications.

1-Introduction

Augmented reality technology represents one of the technologies that captures the user's interest as a result of its ability to immerse him in an interactive environment that helps provide the user with advanced experiences, as it provides design visions that motivate the consumer to experiment. Designers' use of augmented reality aims to improve parts of the physical world for users through input (such as sound And video and 3D graphics) that are generated by a computer and integrated with GPS, GPS location capabilities, touch screens, sensors, and motion detectors that monitor changes in the user's environment in real time.

Whereas the user experience is everything that anyone experiences when dealing with any particular product or service; The role of augmented reality comes in improving the user's experience, starting with entering the online store and browsing the various products and choosing what suits him, then completing the purchase process all the way to the shipping process and receiving the product, in addition to the more immersive experience the technology provides while shopping inside stores and malls. Interactive experiences such as "touch and feel" and providing the product visualization feature in the AR application for the consumer to see the products and collect information about them, thus providing an enjoyable entertainment experience in addition to achieving the purpose of purchase.

2- Augmented Reality

Augmented reality refers to the possibility of integrating virtual information with the real world, so that objects in the virtual environment are equipped with information that integrates with the real environment surrounding the person, so that they appear as if they are an original part of reality, which can be used to enhance the user experience.

2-1. identification:

Augmented Reality (AR) is defined as: "An interactive technology that combines features of the real world with virtual objects through the use of mobile devices to provide a composite display through digital components integrated with the real world." [1]

2-2. Historical overview: [2]

- From 1960 to 1970: The designer (Ivan Sutherland) invented a device that works to provide a three-dimensional image that changes depending on where the user stands, through a group of sensors capable of measuring the location and angles of movement of the user's head (Figure 1).

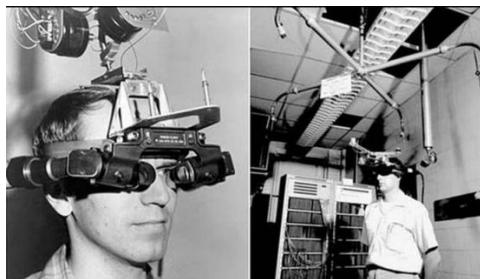


Figure 1. A picture of the first device that supports augmented reality.

https://www.researchgate.net/publication/292150312_Augmented_Reality_Technologies_Applications_and_Limitations

- 1975: Myron Krueger used new technologies that support augmented reality through touch sensors that are connected to computers so that they allow the user to interact with the movement of the virtual image in real reality simultaneously.
- 1990: The term augmented reality was coined for the first time by Tom Caudell, when he used a digital display screen to guide workers as they worked on assembling electrical wires for the aircraft industry.
- 1992: Created virtual installations, one of the first augmented reality systems, by Louis Rosenberg (Figure 2).



Figure 2. Shows virtual installations using augmented reality technology.

<https://www.talenthouse.com/articles/insider-info-the-history-of-augmented-reality>

- 1994: Azuma invented a tracking device that allows the user greater freedom of movement after the user was forced to remain in place.
- The beginning of the first decade of the twentieth century: Augmented reality applications spread as evidence of their historical development.
- 2014: Google created Google Glass devices, which are glasses that users can wear to experience augmented reality (Figure 3).



Figure 3. Shows Google glasses with augmented reality technology.

<https://www.awanireview.com/google-wants-to-tackle-the-metaverse-with-new-ar-glasses/>

- 2017: IKEA launched its augmented reality application called IKEA Place, which brought about developments in the retail industry, as the application allows customers to preview home furniture options virtually before making a purchase.

2-3. How augmented reality works: [2]

This is done through the following steps:

- 1- Capture part of the real environment using a camera on a smartphone, tablet, or other device.

- 2- Scan the captured portion of the real environment to determine a point where additional information is overlaid using tracking devices such as infrared, laser, or sensors.
- 3- Once this point is determined, the augmented reality retrieves the content specified in the previous step with the aim of merging them together.
- 4- Forming a complete image consisting of a realistic background and virtual data that is overlaid, integrated, and interactive.

2-4. Types of augmented reality: [3]

A- Augmented reality with the presence of a sign:

This type is called Marker-based AR, as it relies mainly on recognizing a fixed image present in front of the camera (an image of a person - an image of an object - a QR code), so that the device determines the coordinates and direction of this image and then shows the 3D elements based on them (Figure 4).



Figure 4. Explains how augmented reality works with a marker.

<https://www.arageek.com/1/%d9%85%d8%a7-%d9%87%d9%88-%d8%a7%d9%84%d9%88%d8%a7%d9%82%d8%b9-%d8%a7%d9%84%d9%85%d8%b9%d8%b2%d8%b2-augmented-reality-ar>

B- Marker less augmented reality:

It is called marker less, and it is an augmented reality system that depends on the user's geographical location via GPS and provides information in the form of text or graphics and relevant information related to the location (Figure 5).



Figure 5. Demonstrates augmented reality without a mark.

<https://www.arageek.com/1/%d9%85%d8%a7-%d9%87%d9%88-%d8%a7%d9%84%d9%88%d8%a7%d9%82%d8%b9-%d8%a7%d9%84%d9%85%d8%b9%d8%b2%d8%b2-augmented-reality-ar>

C- Augmented reality through projection:

By projecting light or images onto a physical surface and allowing the user to interact with them (Figure 6).



Figure 6. Demonstrates augmented reality by projection.

<https://www.arageek.com/1/%d9%85%d8%a7-%d9%87%d9%88-%d8%a7%d9%84%d9%88%d8%a7%d9%82%d8%b9-%d8%a7%d9%84%d9%85%d8%b9%d8%b2%d8%b2-augmented-reality-ar>

D- Augmented reality based on overlay:

Where a pre-existing item is completely or partially replaced in front of the camera, such as the IKEA application, which allows its catalog to be replaced with virtual home furniture pieces (Figure 7).

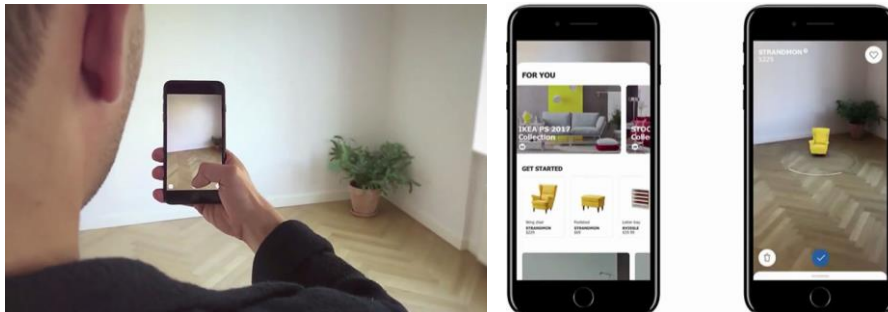


Figure 7. Demonstrates the IKEA Place application that realizes the concept of a smart store through augmented reality.

<https://www.arageek.com/1/%d9%85%d8%a7-%d9%87%d9%88-%d8%a7%d9%84%d9%88%d8%a7%d9%82%d8%b9-%d8%a7%d9%84%d9%85%d8%b9%d8%b2%d8%b2-augmented-reality-ar>

2-5. Mechanism for using augmented reality: [4]

This is done through the following components (Figure 8):

A- Sensors: They are divided into:

- Special sensors to collect information about the application environment, such as temperature, lighting ratio, etc.
- Sensors that collect inputs such as the location and orientation of the user or the user's surrogate, such as mobile devices. They are considered devices that track the user's location, the direction in which he is moving, and his speed, and update these variables as they go and send them to the central processing unit. The devices need a high-resolution camera and Wi-Fi, 3G, or 4G to enable Internet connection that will allow data to be sent.

B- Processor: It analyzes the sensor inputs, stores and retrieves data, performs application program tasks, and creates appropriate signals to display.

C- Display device: The display device is the component that causes an appropriate signal to appear that affects the user's senses, such as the computer screen and mobile phone screen for the purpose of visual display, or headphones and speakers for audio display, or contact lenses, and other devices and tools that support augmented reality.

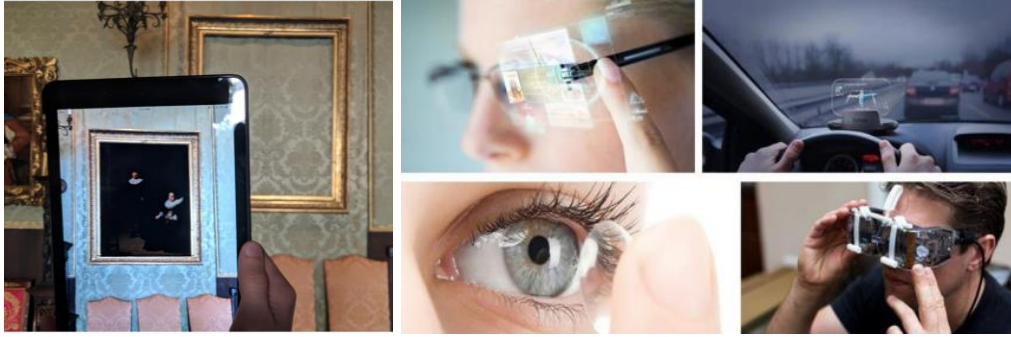


Figure 8. Shows some devices and tools that support augmented reality technology.

https://mjaf.journals.ekb.eg/article_137287_14d42be09b39b82e2043ba735b140420.pdf

3- The mechanism for utilizing augmented reality to improve the user experience within commercial spaces:

3-1. Mobile augmented reality applications linked to stores:

Augmented reality applications are designed in a way that allows the user to interact and enter the augmented reality application and thus displays offers specifically designed for this product. These applications are designed in a way that allows the smartphone to be equipped with many services and functions that are implemented in the user's physical environment and are specifically designed to promote the product or service using the smartphone camera [2].

- **Zara app:** [5]

Fast-paced retailer Zara recently released an AR campaign, placing AR displays in 120 stores around the world and the experience was something completely different from the usual application of AR in retail.

Zara has taken a different approach by providing an AR app that works in stores alongside clothing displays and window displays with the aim of increasing sales and improving the customer experience.

Customers inside and outside stores can use augmented reality via the Zara AR application for IOS and Android so that they can point their smartphones at the store windows - which are an empty space with no mannequins or clothes - to show animated displays of international male and female models and enjoy the AR experience. For the best models of Zara's sporting goods, after displaying the augmented reality users can then purchase the model collections instantly from the app, or from the store itself. In addition, online shoppers can hover their phones over the delivery of the package and view the augmented reality experience of their purchases similar to a scale model on top the box (Figure 9).

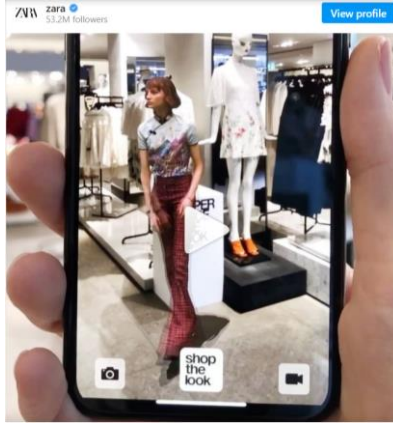


Figure 9. Demonstrating the Zara application, where the mannequins inside the store windows were replaced with animated fashion displays by taking advantage of augmented reality technology.

<https://futurestoreseast.wbresearch.com/blog/zara-augmented-reality-app-virtual-model-strategy>

3-2. The development of display methods within commercial spaces:

As augmented reality technology is characterized by dynamism and interactivity, it has therefore been used in methods of displaying products in a three-dimensional form that allows users to interact with them, and benefited from it in commercial spaces to display products, whether in external display windows or inside the commercial space, which are constantly changing due to the diversity of products, in an easier way. It is faster than traditional display methods, thus enhancing users' relationship with the products, increasing their loyalty to the company, and adding entertainment dimensions to them.

- **Jewelry display unit inside the Helzberg Diamonds store:** [6]

Helzberg Virtual Ring Experience can be considered a wonderful experience to help customers find the perfect ring and give them greater confidence in their jewelry purchasing decisions, which modernizes the diamond purchasing experience with augmented reality, giving shoppers the opportunity to try on almost more than 100 ring styles, through display units that allow visitors to try and explore the many options. They can also share their selections with friends and family via email and social media.

Along with offering the Helzberg Virtual Ring Experience customers can view all the detailed features of the selected diamond up close on a 24-inch 4K display (Figure 10).



Figure 10. The augmented reality customer experience inside the Helzberg Diamonds store.

<https://dimin.com/insights/not-your-average-retail-experience>

3-3. Development of interior design elements for commercial spaces:

Augmented reality technology can be used to develop interior design elements, as it is applied in both horizontal and vertical levels, including floors, ceilings, walls, partitions, display units...etc., which achieves several advantages such as displaying a larger quantity of products in the smallest possible display area. With the freedom to choose alternatives, thus benefiting from them in small commercial spaces, and achieving the economic benefit from lower costs, whether in construction or maintenance, in addition to increasing the interactive experience with consumers and achieving an enjoyable shopping experience for them.

- **Interactive Windows Display:**

It allows shoppers to try on clothes virtually according to their choices by taking advantage of augmented reality technology to allow them to choose the type of clothes they want to try on without having to measure them or search for them in the store. An example of this is the Timberland clothing display screen, which is an interactive screen equipped with a camera to take a picture of the users, sensors to capture their movement; The user stands in front of the screen to have a picture taken of himself, and by moving his hands in the air, which is automatically captured by the sensor, the clothes are selected and fitted to his body. The user can also take a picture of himself, transfer it to his smartphone, and conduct the experiment using the Timberland mobile application. [7] (Figure 11).



Figure 11. Timberland's augmented reality experience is demonstrated by the use of an interactive display window equipped with sensors that capture the user's movement and transmit it to the screen, so the user controls the type of clothing he wants to try on.

<https://www.youtube.com/watch?v=5TZmQPdhpak>

- **Interactive Mirror:**

The interactive mirror is used in stores to try on clothes virtually, as it shows the details of wearing and wearing clothes to the buyer as if they were real, in addition to helping him with information about the best suitable outfit for him according to his own standards, which saves time and effort.

FXGear Company introduced the “Avatar Virtual Fitting” simulation by creating the FX Mirror internet-connected mirror as a virtual fitting solution that instantly creates a 3D avatar of the customer in real-time using augmented reality (AR) technology by providing the customer with sizing suggestions for outfits resulting in immersive try-on experiences more efficient and convenient shopping; Where customers can get suitable size recommendations and see how different clothes look in real time and at a 360 degree angle; The fit of the items is determined through the brand's size chart, which suggests the most appropriate size based on an analysis of the users' body size, which saves the need to try on any actual clothing. [8](Figure 12).

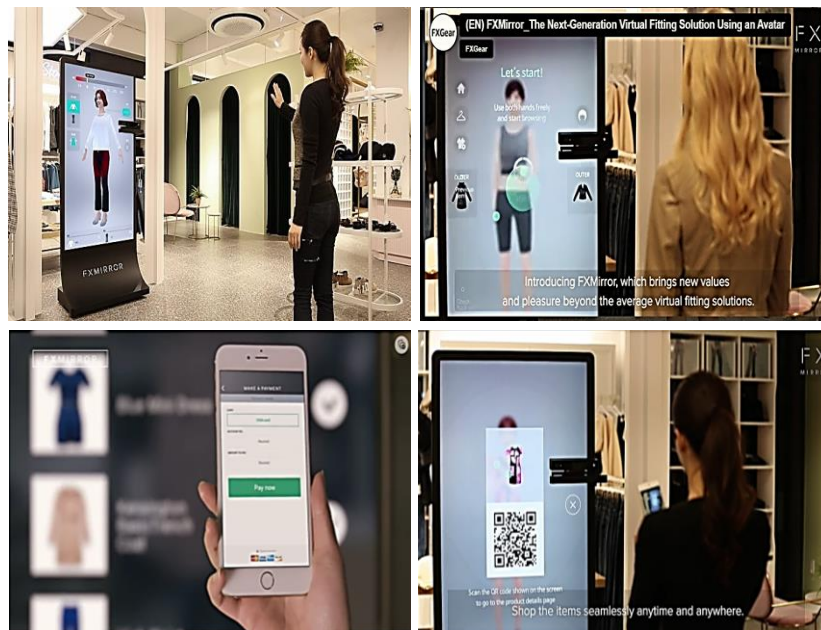


Figure 12. FXMirror Interactive Mirror is a 3D virtual solution based on augmented reality, allowing customers to try on the clothes in the store; It is shown on the body at a 360-degree angle.

<https://dedikj.en.made-in-china.com/product/NZaJpTXDbmVO/China-Fxmirror-Digital-Mirror.html>

- **Digital interactive table:**

It is a table whose surface is a digital screen that operates with touch technology and is connected to the Internet. It has many applications in restaurants, through which one can choose what the individual wants to eat without dealing with the restaurant staff. One can also watch the food while it is cooking to suit one’s own taste, in addition to the possibility of playing with it. The adjacent table can also be used in stores to display products on its surface and view information about the product, such as price, colors, and available offers [9] (Figure 13).



Figure 13. A model of the IRT table, which has an application that allows him to choose the ingredients of the food he wants and order it electronically through the table itself. It can also recognize the user's smart phone and issue orders to the program, so it pays directly; the table contains a magnetic strip installed underneath it that works through scanning technology.

<https://raiffeisen.ua/en/biznesu/blog/irt-interaktivni-tehnologi-dlya-sferi-gostinnosti-73>

3-4. Achieving pleasure in addition to the functional goal:

• Le Petit Chef Experience at Four Seasons Hotel: [10]

- City/Country: Cairo/Egypt.
- Year of implementation: 2021.
- Design goal: Achieve a combination of entertainment and dining through an immersive culinary journey with 3D visuals.
- Design idea:

The little chef "Le Petit Chef" was born in April 2015 in France in the town of Marseille. The design idea is based on designing a special 3D display for the interactive Le Petit Chef (the smallest chef in the world) experience where restaurant goers can see the little chef preparing meals on the plates of restaurant goers in the form of animation, his virtual height on the table is only 6 cm, relying on the latest 3D technologies; The design team used Panasonic PT-VZ570 LCD projectors that provide a combination of high image quality and low overall cost, and also has extensive experience in the field of AR.

- User Experience:

1- The Le Petit Chef experience begins with waiters placing pure white plates on each table to ensure the projections are clearly visible with the help of overhead projectors and digital mapping. The 3D presentation then begins with a glimpse of the little chef and his cooking adventures. The journey of enjoying the show then begins until the chef finishes preparing the

customers' orders virtually and then presents them with the appetizers, then the main course and then the dessert, creating a 3D theater on the entire table. Le Petit Chef is simply one of the most unique dining events in the world.

2- Soon, a hot meal of the food chosen by the visitor appears, and each part of the animation turns into realistic meals served to diners (cooked by real chefs), often bearing a striking resemblance to the animation, and then miraculously transforms into physical form in an unparalleled dining experience (Figure 14).

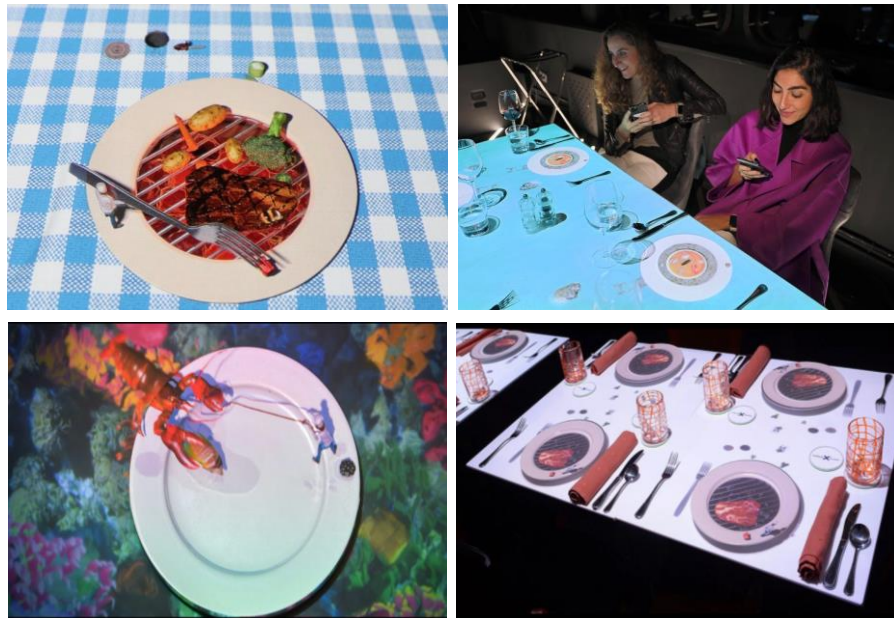


Figure 14. The user experience inside Le Petit Chef restaurant at For Season Hotel in Cairo

<https://lepetitchef.com/cairo-fourseasons-lpc1>

4-Results and Discussion:

- In light of the previous study, the interior designer must arrive at design solutions For commercial spaces using augmented reality technology and developing innovative design ideas by taking advantage of the reflection of this technology on commercial spaces.
- Augmented reality technology has an influential role in facilitating the purchase decision-making process by providing the possibility of trying virtual products or elements in the real environment in three dimensions and choosing what suits the user within minutes and with full awareness and awareness of the real space and its elements.
- Augmented reality technology works to create an interactive environment between the user and the product within commercial spaces, in addition to achieving an entertainment aspect during the user's shopping trip.
- Shopping centers need to use modern digital and technological tools such as augmented reality technologies and mobile applications in order to increase productivity and efficiency to the greatest extent possible on the one hand, and in order to create a dynamic, attractive and very interesting experience for consumers who are always looking for amenities on the other hand.

- Augmented reality has a significant impact on customer engagement, brand awareness or corporate loyalty.
- Since augmented reality (AR) allows adding virtual digital information to the real world in real time, this provides many previously unimaginable options for customers and communicating with them, and has the ability to put virtual products in the hands of customers, which provides opportunities for users to interact with the brand. Or service or product and thus improve the user experience.

5. Conclusion

The research derives its importance by shedding light on augmented reality technology in terms of concept, definition, components and types, as well as the user experience and its reflection on the elements and components of commercial spaces, and then examining how to benefit from it in improving the user experience, by examining applied models that illustrate this.

In this research, we discussed the definition, characteristics and types of augmented reality technology, then moved on to know its impact on the purchasing behavior of consumers and the way commercial activities are performed, and its role in improving the user experience within the commercial space.

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