The Application of Mixed Reality Technology as Innovative Approach in Museums

Rania Raouf Awadalla

Lecturer of Interior Architecture at Faculty of Arts and Design – Pharos University in Alexandria

KEYWORDS:

Mixed Reality (MR); Augmented Reality (AR); Virtual Reality (VR); Extended Reality (XR)

ABSTRACT:

Virtual Reality (VR), sometimes called Virtual Environments (VE) also the mixed reality (MR) has drawn much attention in the last few years. Extensive media coverage causes this interest to grow rapidly. Very few people, however, really know what MR is, what its basic principles and its open problems are. In this paper we will highlight the application of mixed reality technology as innovative approach to interior design, followed by applications of this technology in interior design. Additionally human factors and their implication on the design issues of VE are discussed. Finally, the future of MR is considered in two aspects: technological and social. We are going to discuss how the distinctions between reality and virtual reality will gradually dissolve as simulation technology and visual quality increase, which may lead to confusion among users about what is real and what is virtual and this will give the museum visitors a unique experience.

New research directions, technological frontiers and potential applications are pointed out in museums. The possible positive and negative influence of MR on life of average people is speculated.

1- Introduction

Charles Wheatstone's experiments in 1838 proved that the brain combines the several two-dimensional images from each eye into a single three-dimensional object. The user experienced a sense of immersion and depth when viewing two side-by-side stereoscopic images or photos through a stereoscope. "Virtual tourism" made advantage of the popular View-Master stereoscope, which was later developed and was patented in 1939. The popular Google Cardboard and low-cost VR head mounted displays for mobile phones utilize the Stereoscope's design ideas.

Standalone VR headsets now include advanced technologies and mixed reality systems. Tethering support for the Oculus Quest is promised, and smartphone-based VR initiatives start to wind down. VR headsets are now significantly less expensive, and computers that can operate them are almost universally available. Many cutting-edge headsets are coming. The main advancements include varifocal technology, extraordinarily broad fields of view, hand scanning, and eye tracking, to name just a few. At this point, it appears that VR and mixed reality are likely to become inseparable in the future. Major corporations like Apple are rumored to be working on mixed reality projects.

The research is based on the descriptive analytical method by studying the design dimensions of augmented reality technology. introducing modern interior design concepts and instructional approaches that stay up with the development age. shed some light on augmented reality technology and keep track of its interior design applications,

The interior designer must constantly keep up with technological advancement to address the various design and implementation issues that vary from one space to the next. As a result, reality technologies were used as augmented reality technology to develop interior design skills and solve problem, helping people underprivileged.

2- Mixed Reality Technology as Innovative Approach to Interior Design

Interior design is the process of working with the interior space, forming, and developing it entirely from an aesthetic and practical point of view to give the user comfort and enjoyment when utilizing the area. Some people also think that interior design is solely about altering the furniture or the colours of the walls, even though it may be found in buildings for residential, business, tourism, and recreational purposes, among others. What distinguishes augmented reality technology in interior design from 3D interior design software? The latter, although accurate, can only be seen through a screen without experiencing or moving in the space (seeing genuinely how the projects would appear when finished), and this is what technology has made possible. When compared to seeing 3D models, augmented reality has the power to produce immersive, creative experiences that are clearly superior. Some home improvement brands have already adopted this technology for consumers. The Dulux brand offers customers an opportunity to test its colours on their walls using its own Visualizer app, while IKEA Place lets users try on the company's furniture in their homes before making a purchase. These fun apps offer an opportunity to experiment with interior design, but the technology in them is relatively simple compared to the emerging augmented reality developments, created specifically for real estate professionals.

Firstly, let we clarify the difference between the mixed reality, virtual reality, and augmented reality. Each has its own different concept, and these methods have developed because of technological advancements and an increase in the use of contemporary technologies, and in the following we will clarify about mixed reality technology and what its concept. Through mixed reality, the user can effortlessly transition between the real and virtual environments while on foot, using a control arm, or by manipulating the surrounding environment with his hands. This allows the user to enter a different world where virtual interactions appear real and mimic the way people naturally interact with nature, making for a memorable and enjoyable experience.

2-1 The concept of Mixed Reality technology it is also called Hybrid Reality

It is a technology that combines the best elements of augmented reality and virtual reality, creating new environments and perceptions where physical and digital objects are present and interact with the real

world. As a result, it is neither a real world nor a virtual world, but rather a combination of real physical reality and virtual reality. One of the most famous examples of this technology is the game "Pokemon Go" that appeared in 2016.

2.2 The difference between augmented reality, virtual reality, and mixed reality technologies

Augmented reality technology is a technology that draws its inspiration from the real world the user lives in while also enhancing it with some additional data. For example, when wearing augmented reality glasses or using a GPS application, the user sees the real street as well as some default information about the desired location. Smart glasses or 3D Audio system can transport the user to a different reality environment using virtual reality technology, which allows the user to live the entire adventure by watching 360-degree videos. The most important of which are Samsung's Gear VR Glasses.

While mixed reality technology combines the virtual and enhanced worlds, the real-world scene is preserved while some virtual elements are added. As a result, it is like augmented reality in that you can view a real location, such as your home, and use mixed reality technology to add any decorations you deem appropriate.

You can also control the size of the added items, such as a chair or table, as well as their movement from one location to another. To improve the user experience when playing games, viewing videos, creating homes and gardens, and other activities, mixed reality technology combines the best aspects of augmented reality with virtual reality. (Figure 1)

Figure 1: difference between augmented reality, virtual reality, and mixed reality technologies. 2021

As a result of the advancement of technology and the introduction of contemporary technologies, a new world will be established in the future, and in the years to come, we will discover what secrets technology has in store for us.

The term "Augmented Reality" (AR) refers to a relatively new technology that allows users to interact with an environment that integrates computer-generated content with real-world places and/or activities. The real world is enhanced with virtual forms that can interact with them as they would in daily life. In addition to 2D and 3D forms, various types of digital information can be added to these settings, including audio files, videos, text, and even touch and smell media. It can be characterized as the technology that "allows computer-generated virtual pictures and graphics to instantly merge in seamlessly with the real surroundings. (de La Fuente Prieto *et al.*, 2017)

By creating a continuity model from reality for the virtual environment (Figure 2), Milgram and Kishino were the first to attempt to resolve the discrepancy between the real and virtual worlds in 1994. This proposal aimed to combine the real and virtual elements into a mixed reality that allows continuity between worlds.(Yuen *et al.*, 2011)
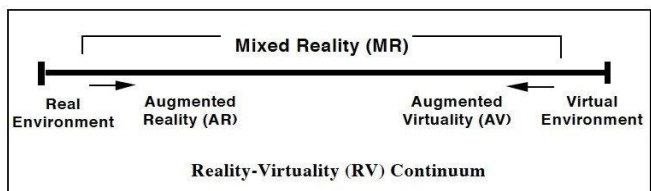

Figure 2: Milgram and Kishino's Mixed Reality on the Reality-Virtuality Continuum, Milgram and Kishino .1994

Within a set space, the designer essentially uses the three fundamental elements of interior design—colour, scale, and proportion. Thus, the main goal of AR is to give the user flexibility in design using these three fundamental ideas. The user can modify the proposed setting's virtual attributes as well as the furniture's component parts and arrange the furniture in various ways as though it were in a real environment. Information is extracted from the drawing and linked to the database using CAD

applications, and for the given space, all available engineering information is extracted from the furniture database.

Next, after loading geometric shapes, the user's area and direction of the scene are calculated. The engineering data is then converted based on the user's area and direction. Finally, using transformation matrices, images are produced that are aligned with other objects in the scene.

2.3   The most important applications of Mixed Reality technology

Recently, augmented reality (AR) technology has been viewed as a new method of architectural design, where trials and research are carried out and used to improve the design process. Using virtual archaeology to enhance traditional understanding of architecture and archaeology inside a real historical location. The blending of digital data with how a person sees the physical world is known as augmented reality. Simply defined, if you can perceive something in your field of view, then you can utilize augmented reality to superimpose digital information or visuals over what you see.

With the use of this technology, we may combine the real and digital worlds to produce a hybrid environment where the two coexist and interact naturally. We call it augmented reality because it provides all users with a richer experience.

2.3.1   Here are the most popular initial applications:

2.3.1.1 sketchand+ system

It was one of the experimental models that was used in the early stages of design, which can have a big effect on the effectiveness of the entire architectural design process (Figure 3), 3D renderings. The application shown that actual, hands-on collaboration with models can be most productive during the early stages of design research.(Seichter, 2003)
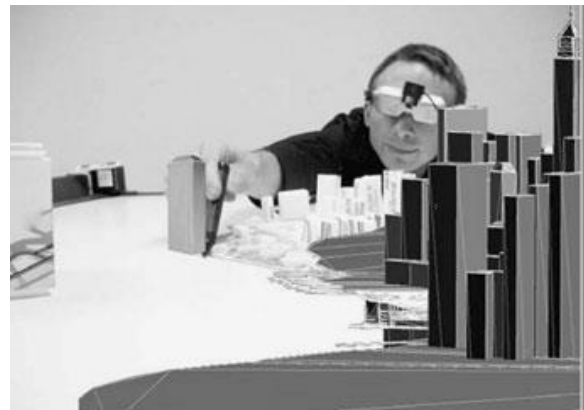

Figure 3: Sketchand+ System, Snapshot from a collaborative session with virtual models within a real model, Sketchand+ a Collaborative Augmented Reality Sketching Application .2006

2.3.1.2 ARTHUR project

In the realm of urban planning, where visual aids are employed as tools for design and urban design, a measurement point of view for design, by design and by design, and urban planning, it is regarded as a significant project in the design of the visual representation of reality display systems. (Figure 4).

Figure 4: The use of Arthur's project in the field of urban design, Computer Vision in the ARTHUR Project .2002

2.3.1.3 Computer Aided Augmented Reality - AR CAD

A technique known as Computer Aided Graphics was created by Datsun and Wang using augmented reality of specific mechanical details. This system enables users to view the design of a set of virtual pipes, and they are viewed by (Helmet Display - HMD) (Purdue ECT Team, 2007)through tracking marks to see them realised. The models are then created in the AutoCAD

programme and sent to an augmented reality programme dedicated to showing them instantly, and it can be seen Design from many angles within the real space. (Purdue ECT Team, 2007)

2.3.2 The most popular current applications

5.3.2.1 ARKI

Real-time rendering for architectural models is what this programme does. For both design and visualisation reasons, interactive 3D models with varied degrees of augmented reality are provided (Figure 5). Operating systems (Android/iOS/Android) can utilise the application, which just superimposes virtual 3D models on the real surface but also offers other interactive features like real-time shadow analysis and texture choosing. Users can also shoot and record video and images of the models. allowing for simple sharing via e-mail and social media.
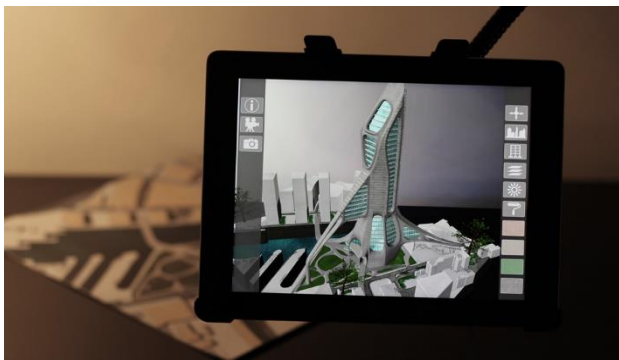

Figure 5: The use of ARKI the application in designing a built model, Lidija Grozdanic.2017

2.3.2.2 Storyboard VR

Architects, artists, and other creatives can use it as a free rendering and modelling tool. By dragging, moving, resizing, and arranging the 3D models, users can change them. where the user can utilise, the graphic tools provided in the application to design, construct his own storyboards, upload graphics, and maps of places (Picture 5). Designers can swiftly exchange ideas and receive comments thanks to the application's simplicity of use, and what sets it apart is the ability to display graphics virtually, like in PowerPoint. (Figure 6)

Figure 6: The use of Storyboard VR application, Lidija Grozdanic.2017

2.3.2.3 Pair application

Using an iPhone device, the user may drag and drop 3D models of furniture into the spaces using an application that combines computer technology with augmented reality (Picture 7). For more than five hundred manufacturers, the application includes more than 200 types of home and office furniture, and new products are introduced daily. The ability to freely move about the virtual model and in real space is this application's most notable feature. (Figure 7) (Lidija Grozdanic, 2017)

Figure 7: The use of Pair application, C. JeffraJ. HilditchJ. WaagenT. LanjouwM. StofferL. de GelderM. J. Kim, 2020

3. Application of augmented reality in architecture and interior design

3.1 Kennedy Space Centre Visitor Complex

People can understand historical events better with the use of augmented reality museums. In the Legends and Heroes exhibit at the Kennedy Space Centre, for instance, a dynamic AR experience lets museum visitors view the actual 9 Gemini space capsule using

augmented reality technology. Visitors can also watch a spacewalk experience where the astronaut describes his experience through a voice comment. The multi-directional 3D theatre, built to give visitors the impression that they are swimming in a huge expanse, is the experience's high point. As renowned astronauts like Alan Shepard, John Glenn, Jim Lovell, and Neil Armstrong welcome them to join their epic adventure into the deep unknown, breath taking images immerse them from every angle. (Figure 8) (Space Coast Daily, 2015)

High-tech, interactive show components and special effects, such as virtual holograms and augmented reality, will be used to bring early space relics from the Mercury and Gemini missions, such as the original Mercury Mission Control Centre, to life. Visitors can learn about each of the 91 heroic and iconic astronauts who have been admitted through 2015 within the new U.S. Astronaut Hall of Fame. In the end, visitors will be moved by the stories of NASA's space heroes as they draw connections to their own struggles and successes. The new Heroes and Legends will be integrated into the Rocket Garden, transforming the area formerly held by Early Space Exploration, providing visitors with a fresh and elevated viewpoint of the massive collection of vintage rockets.

Figure 8: The U.S. Astronaut Hall intended to inspire the next generation of space explorers, Space Coast Daily . 2015

3.2 Jinsha site museum

The archaeological site of Jinsha, which was uncovered in February 2001, is on display at the Jinsha Site Museum. It is situated in China's Chengdu. It was the seat of the ancient Shu Kingdom over 3,000 years ago. People would congregate here to pray and offer sacrifices. The complex, which is five square kilometres in size, was built during the 12th and 7th centuries BC.Over 5,000 artefacts made of gold, jade,

and ivory were discovered when the site was excavated by researchers. Now, the museum's visitors may view them via augmented reality.

They can download an app to view the goods in 3D and explore them. The app also offers more thorough details about the items and their intended uses. A gold mask and a totem made of gold foil are two artefacts that were highlighted by the AR experience. The visitor is given a close-up, detailed view of the mask as it appears to float up and rotate in front of their face. (Figure 9) (Charlotte Coates, 2019)

Figure 9. the mask as it appears to float up and rotate in front of their face, Charlotte Coates. 2019

3.3 Cincinnati's Museum of Natural History & Science

A new virtual reality experience from Birdly allows users to fly around the Palaeozoic Era and interact with dinosaurs. The Cincinnati exhibit places two V2 Birdly devices in the recently renovated dinosaur hall at the Museum of Natural History & Science. (Figure 10) (Owen Ralph, 2019)

Figure 10: Visitors can take to prehistoric skies and interact with dinosaurs on a new virtual reality experience from Birdly, Owen Ralph. 2019

3.4 Smithsonian National Museum of Natural History, Washington, D.C.

The new exhibit "Augmented Reality Dinosaurs" on display at the Natural History Museum uses digital technology to revive the late Cretaceous time. Through this immersive experience, visitors are taken into a virtual replica of an old habitat where Tyrannosaurus rex, Triceratops, and Troodon formerly roamed, allowing them to walk among the giants and even "touch" them without running the risk of being eaten. (Figure 11) (Charlotte Coates, 2022)

Figure 11. "Augmented Reality Dinosaurs", Kirstin Fawcett.2014

3.5 The National Museum of Singapore

69 drawings from the William Farquhar Collection of Natural History Drawings are the main subject of the display. Visitors can engage with these through interactive, three-dimensional animations. Visitors can examine the paintings using the camera on their phone or tablet after downloading an app. (Figure 12) (Charlotte Coates, 2022)

Figure 12. This augmented reality project, developed by the Japanese digital art collective teamLab, brings the illustrations to life. The photos provide audiences a fascinating new way to interact with and examine them, Charlotte Coates.2022

The Tango-capable Lenovo Phab 2 Pro phone that is provided to visitors will take them to six different locations within the museum. For instance, guests will be able to hear and see a whale's possible appearance and sound when they are standing underneath the glass corridor on the museum's second floor. Even selfies can be taken using it. Up until it was repatriated to Malaysia in the 1970s, the whale skeleton had been on display there since the early 1900s. (Figure 13) (Nabilah Said, 2017)

Figure 13. Google's Tango technology is being used by the National Museum of Singapore to bring the history of the famous structure to life, Nabilah Said.2017

4. Challenges and problems facing augmented reality technology in architecture and interior design

4.1 Obtaining information in the industrial field

This is because there is a lot of information used in the planning and development stages of any building, and this information shows up in the electrical, air-conditioning, mechanical, and infrastructural projects. Most of the data is preserved as two-dimensional visuals, which makes creating models appropriate for augmented reality challenging and complex.

4.2 Preparing simulated models for reality

Accurate data and measurements of this world's dimensions must be gathered to add digital data to it. One of the biggest problems facing augmented reality in the field of architecture and design is the application of a methodical and precise way to produce virtual models of reality.

4.3 Technological limitations

The biggest barrier to the development of augmented reality technology continues to be technological. For instance, when using this technology, very accurate trackers are required because even a small tracking error can lead to incompatibility between virtual and actual models.

Other obstacles as well:

• Long-range sensors and trackers must be developed to capture everything around the user.

• The success of augmented reality systems depends on their ability to deliver excellent quality in real time.

• The scientific research community for computer science and mental health is looking for a solution to this problem since it occasionally causes the user to feel confused due to the unreasonable overlapping of actual and virtual models, which affects the user's feeling.

5. the future of the interior spaces of museums with mixed reality technology

The intention is to use digital technologies to improve the visitor's museum experience. The following list includes a few systems that fall into two groups:
- Mixed reality displays.
- Gain access to support networks.

ExFloasion, Bousight Table, and Floasion Table are the three techniques available to overlay virtual visuals onto real-world exhibits. Their main selling point is their optical system, which produces 3D effects without the use of special glasses. These are helpful for providing visitors with some intuitive explanations of the actual museum exhibits.

However, we believe that total services—both before and after visiting the museum—are crucial. These services include networked visualization of the traffic situation (Breathing Museum), social networking to share guests' emotions (Post-Visit Board), and unique keepsakes for each tourist (Peaflet). They are successful at encouraging greater awareness and driving visitors to museums.(Mariapina Trunfio, 2019)

Figure 14. The enabled landscape is the future of augmented reality, the intersection of our landscape and our digital world. 2018

However, applying augmented reality to architecture and interior design is just the start. The role of the interior architect may change in the future to include not only designing the building's physical structures and altering its internal architecture, but also collecting the data necessary to create an augmented reality experience inside the structure. Because of this, not everyone is in favour of augmented reality in the architectural industry.

British novelist and architectural historian Owen Hopkins, worries that as augmented reality technology develops, individuals may be able to project a new façade onto buildings, making the architect's original design useless.

Whatever the advantages of augmented reality, experts agree that it has the potential to fundamentally alter the way that architecture is done. Whether it's enhancing the client-architect relationship with realistic renderings of designs or even completely redefining the architect's job by shifting from designing physical installations to creating the data layer. One of the most fascinating innovations to date is undoubtedly augmented reality.

6. Results

•   Technology that uses augmented reality has a significant impact on the interior design process. And one way to achieve so is to make it possible to test-drive virtual design items in the real world, from furniture to wall coverings to finishing touches for interior decor.
•   Through an immersive three-dimensional experience where he sees historical landmarks in a

virtual three-dimensional manner from all sides and in all details, which is sometimes difficult to see in their true place, augmented reality plays a significant role in enhancing the designer's historical culture.

7-Conclusions

By the end, no one can predict with certainty what the future of augmented reality in Architecture and interior design will bring. In fact, this technology has advanced so quickly since it was first thought of as science fiction ten years ago that it is difficult to foresee where it will take us. But there's little doubt that AR will help architecture advance to new heights.

8- Recommendation

• The interior designer should offer the ability to view the client's interior design elements in three dimensions and make a quick decision while being fully aware of the space and its components.
• The interior designer should use the benefit of the augmented reality technology to provides a language of dialogue between the designer and the client. We must make it as a part of our design process and in site that the client can imagine the reality of the design in the site.
• Educational institutions and research centres should use the virtual reality also the augmented reality in the development of the highly educational process. enhance new technology in courses curriculum to graduate a student capable of keeping up with the future
• Augmented reality also plays a significant role in enhancing the designer's historical culture. So, the state must use such technology in our museums.

9- References

Charlotte Coates. (2019), "Virtual Reality (VR) and Augmented Reality (AR) are both huge in the museum sector.", *Blooloop*.

Charlotte Coates. (2022), "How Museums are using Augmented Reality", *Digital*.

de La Fuente Prieto, J., Castaño Perea, E. and Labrador Arroyo, F. (2017), "Augmented reality in architecture: Rebuilding archeological heritage", *International Archives of the*

Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives, Vol. 42, International Society for Photogrammetry and Remote Sensing, pp. 311–315, doi: 10.5194/isprs-archives-XLII-2-W3-311-2017.

Lidija Grozdanic. (2017), "The Top 5 Virtual Reality and Augmented Reality Apps for Architects", *Archipreneur*, 27 August.

Mariapina Trunfio, S.C.A.M. (2019), "Measuring the impact of functional and experiential mixed reality elements on a museum visit", *Taylor & Francis* , Vol. 23 No. 16, pp. 1990–2008.

Nabilah Said. (2017), "National Museum of Singapore uses augmented reality to tell building's history", *Straitstimes*.

Owen Ralph. (2019), "Jurassic Flight VR experience draws crowds at Cincinnati museum", *Blooloop*.

Purdue ECT Team. (2007), "Augmented Reality Computer-Aided Drawing (AR-CAD)", *Emerging Construction Technologies, Division of Construction Engineering and Management, Purdue University, West Lafayette, Indiana*.

Seichter, H. (2003), "Sketchand+ a Collaborative Augmented Reality Sketching Application", pp. 209–222, doi: 10.52842/conf.caadria.2003.209.

Space Coast Daily. (2015), "Kennedy Space Center Visitor Complex Breaks Ground For 'Heroes and Legends'", *Space Coast Daily* .

Yuen, S.C.-Y., Yaoyuneyong, G. and Johnson, E. (2011), "Augmented Reality: An Overview and Five Directions for AR in Education", *Journal of Educational Technology Development and Exchange*, University of Southern Mississippi, Vol. 4 No. 1, doi: 10.18785/jetde.0401.10.