

# Augmented Reality and the Interior Design Sector in Bahrain

Dr Nehal Almurbati

*Department of Architecture and Interior Design, University of Bahrain*

Isa Town, Bahrain

nalmurbati@uob.edu.bh

## Abstract

This paper presents an assessment of the utilization of Augmented Reality (AR) technology in the field of interior design. It reviews the use of AR within interior design offices in the Kingdom of Bahrain, serving as a sample of GCC countries in the Middle East. With the significant advancements in digital technology, virtual information techniques have become integral to architectural projects. AR technology offers numerous benefits for digital architectural design and construction fields, and it is increasingly recognized as a novel approach to interior design. In an AR environment or project, virtual paint, furniture, and spaces can be interactively displayed and modified in real-time on a screen, enabling users to experience virtual design elements in a real-world context.

Consequently, the AR environment becomes a new working environment for interior designers and architects in the construction industry in Bahrain. This research employs a qualitative approach of 5 interviews and secondary market research study to investigate the opportunities and obstacles associated with the adoption of AR technology in the construction sector in the Bahrain market, as well as in education institutions. The study proposes a framework for the application of AR technology in interior design, allowing users to view virtual interior design elements and interact with 3D virtual furniture data through a dynamic and flexible user interface. The results emphasize the importance of the technology in the field but also highlight the need to address several steps before fully harnessing its potential in design, including program reviews, budget constraints, practical application boundaries, and maintenance considerations.

**Keywords:** *Augmented reality, Interior Design, AR.*

## I. INTRODUCTION

### A. Augmented Reality and the Immersive Space

The phrase "augmented reality" (AR) describes a comparatively recent technological development that includes superimposing computer visuals on the physical world. As a result, it lets users see how virtual things are added to the real world and then engage with them. When used in a more general sense, augmented reality (AR) may be referred to as mixed reality (MR), which covers a multi-axis range of domains that include telepresence, virtual reality (VR), augmented reality (AR), and other associated technologies [1].

The first head-mounted display was produced by Ivan Sutherland in 1968, and it continued to advance until 1990, when the phrase "augmented reality" was coined. Then, ten years later, it quickly left the labs and emerged as the open-source ARTOOLKIT library in 2000. Moving to print and media in 2009 to Automation industry in 2014 and retail in 2017 [2] and [3].

The AR systems are based on the concept of merging digital information with the actual environment, allowing users to view them as a single entity. The integration of 2D and 3D images might be seen as a valuable technique in immersive virtual environments[3]. An essential aspect of augmented reality (AR) is its precise capability to determine the precise location and positioning of virtual objects, leaving the Tracking System an integral element of any AR system. In essence, an augmented reality (AR) system needs to actively track the user's perspective and guarantee that virtual things are accurately aligned with real-world objects.

An augmented reality (AR) system consists of essential elements including a display, a camera for capturing graphics, and application software installed on a computer. Additionally, various hardware devices such as camera phones, PDAs, laptops, Head Mounted Displays (HMDs), and wearable computer systems can also be used in conjunction with the system. The instruments have exhibited diversity and advancement, as exemplified by the utilization of hand-held gadgets in Microsoft HoloLens [3].

### A. AR, VR tools and Mixed realities in Architecture and Design

The Construction industry and Architecture as well as Engineering firms has thrived to benefit from new technologies in their competitive sector. Automation and digitalization was evidenced to offer high performance and accuracy for architecture and construction projects.

The sector benefited from several of visualization tools that allows viewing virtual models, interior furniture or buildings augmented in real world, where the term Mixed realities (MR) can also be coined to AR. Several authors indicated the use of AR in interior design applications [4,5]. This refers to its multi-axis spectrum nature that cover Virtual Reality (VR), Augmented Reality (AR), telepresence, and other related advanced technology [5,6].

AR system are connoted to a computer installed application software and a display screen as well as a camera for graphic captures along other wide spread hardware such as PDA, Laptops, HMD and wearable computer systems. These components are then connected to ARToolKit library the connect the architecture model or furniture between its virtual nature and the desired scene or space in the real world. Architecture of both newly proposed buildings or archeological sites can benefit from AR applications as seen in many researches [3,4,5,6].

A recent shift to use AR within Building Information Modeling software (BIM) are also gaining popularity and showing efficient use[4].

In interior Design the application of AR has been rapidly growing since 2017. ARKit expanded iPhone AR capabilities

and applications within the design field [5]. Most of the developed applications looked at kitchen configuration and furniture optimization as seen in IKEA furniture “smart Store” concept [5,7] or ‘AR furniture’ [7].

Other AR application in interior design uses Augmented Reality Image Synthesis (ARIS). In this models used real-time photo-realistic augmentation of an object photographic with synthetic computer generated objects [8].

This application allows the user to manipulate and interact with the view in a specific context like a room or a hall or even an exhibition. Other applications within the interior design field are IKEA Place, RoOomy, iStaging and DecorMatters, Figure 1 .



Figure 1- Use of AR in interior design

### B. Benefits and obstacles of Adopting AR

Automation and digitalization of 2D plans and 3D visualization was evidenced to offer high performance and accuracy for architecture and interior Design projects. Such technologies help also in reducing cost and increasing construction efficiency. These ready models from Sketchup or 3Ds Max that offices use to render their design proposals can be directly inserted in their target location in a construction site or a non-furnished room using clients phone camera. Successful AR experiences were recorded by furniture and home décor company Dekoruma.

Dekoruma created an AR experience for their clients using printed postcards with AR content. Clients could scan the postcards of house layouts with a custom AR app, and fully designed 3D versions of the space would appear on top of the postcards. This allowed clients to see how their space would look when furnished with Dekoruma's products [9]. The resulted immersive experience can help design studios upgrade their design catalogue and increase their merchandise sales.

Many designers nowadays upload their 3D models and renderings of their products with a user AR-powered apps for furniture selection and supplement. The customization aspect upon client respect can be considered an important added value for the design service [9,10].

These AR application were also noted to help design companies customize their clients experience and enhance their marketing campaigns. Also research found that AR renderings allows higher investments and clients closure rates. Moreover, research found customization nature in AR allows a higher emotional connection and a feel of clients

being on control of the process with a simple, effective opportunity to follow products details and visualize in their personal space or determined locations.

Nevertheless, the adaptation of AR within Architecture and interior design offices may face several challenges. The Learning curve, length of the learning time and the variety of available AR programs [9]. Other technical difficulties can be noted in the smart phones hardware quality and configuration, as well as the operating system versions of the different clients [10].

Research indicates that the quality of 3D assets used in the AR application can also affect its performance. If the assets are of low quality, it can lead to the failure of the entire application. Additionally, scaling the application to different customers and their adaptation to new ways of visualization can also cause limitations [10, 11].

The AR use within Interior design firms are growing in trend Internationally and regionally within Middle Easter countries considering their added values discussed earlier. Nevertheless, the topics lack proper investigation and data in literature within the Middle East. The current research found focuses on the real estate sector in Bahrain and Architecture market in Saudi Arabia only [12,13]. More research is needed to assess this application in Bahrain as an example of other countries and evaluate the technology performance and its challenges.

## II. METHODOLOGY

The objective of this study was to evaluate the practicability of utilizing augmented reality (AR) within the interior design and architectural offices in Bahrain, as well as to provide an explanation for their concerns in order to devise solutions to address them. Accordingly, on the basis of previous literature that is comparable, this research chose to conduct interviews with a number of companies that are both new and well-established in the Bahraini market where they have been operating for between two and fifteen years. The findings of this study are based on secondary data gathered from important augmented reality statistics that reflect the market share and data analysis for the year 2023 [13], as well as primary data obtained from interviews with Bahraini interior designers [14].

In order to demonstrate interest in the application of augmented reality (AR) within interior design services, five designers with experience ranging from one to fifteen years in the design industry participated in semi-structured interviews. These interviews were conducted after the designers had completed a brief survey. The individuals being interviewed are architects and designers who are currently working on a wide range of projects, which include both residential and commercial structures. In order to categorize the findings, thematic coding of the benefits and drawbacks of augmented reality was utilized.

## III. RESULTS AND DISCUSSION

Following an in-depth analysis of studies and market projections regarding the applicability of technology in the field of architecture, numerous forecasters projected that the employment of augmented reality and virtual reality in

conjunction with artificial intelligence would become increasingly prevalent in the building industry. According to studies conducted by Science Soft [15], the market for augmented reality (AR) is projected to reach \$10.7 billion in 2019, and it is anticipated to increase to \$72.7 billion by 2024, demonstrating a compound annual growth rate (CAGR) of 46.6%. It was also discovered that one of the most popular uses of augmented reality technology is interior design. This is due to the fact that that application offers cost savings and reduces the amount of time required for the production of interior design.

Vertebrae, an augmented reality and three-dimensional e-commerce platform, conducted a survey with 201 customers and found that 78 percent of them would rather engage with augmented reality than watch a thirty-second video [9]. The procedure, which is depicted in figure 2 by [15], demonstrates how the client augmented reality interior design application functions as the connection between the user's smart device and the back end, which consists of the 3D model database and the algorithms that power all of the AR app modules.

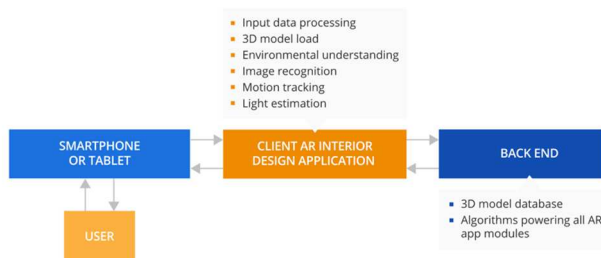


Figure 2 The AR app as a mediator between client and Backend,[15]

"AR/VR helps to remove some of the fear and anxiety that a client might have about committing to a design plan that they are unsure of," Barbara McInnis, who works with Barbara Hayman Designs, said in an interview with the Designers Today website. She explains that when it comes to the uses of augmented reality in the field of design and architecture, the architects and designers who were interviewed had a degree of understanding that ranges from fundamental to moderate. Out of the seven people who were questioned, two of them are already using it, and three of them have confirmed that they will be using it in the near future. In addition, they are in the process of providing their design suggestions and visualizations. The majority of respondents uniformly agreed that the most well-known advantage of augmented reality (AR) is the ability of customers to see items in their own personal environment. This was the conclusion reached by the majority of respondents when they were assessing the benefits of AR in the design stage.

The capacity of augmented reality enables customers to personalize their experiences, which is the second most popular feature of this technology. The third advantage that was promised by the interviewee was that augmented reality has the ability to allow for a higher emotional connection to the project that is being targeted.

She states: "This is because it enables clients to feel as though they are in control of the process and the allocation of space."

It is also noted here that the power of the technology to enhance office services and marketing, as well as to enable a greater investment and customer closure, was a key element [figure 3]. In conclusion, the technology was a significant component. During the course of the interview, one of the participants made the following statement: "provide a clearer imagination and visualization for the clients of their space, increase interaction." From a different point of view, augmented reality seems to be valued by an interview as a tool for translation and communication. The statement that he makes is that "provide a clearer imagination and visualization for the clients of their space, increase interaction."

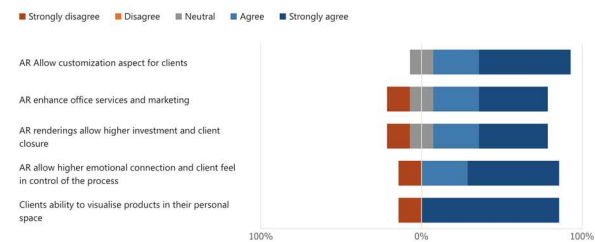


Figure 3 Advantages of using AR in Bahrain design sector

The findings of the interviews that were carried out brought to light the most significant challenges that are associated with the adoption of augmented reality, which is the extensive amount of time that is required for busy office designers to learn how to utilize it.

On the other hand, this is an example of unhealthy consumption because several platforms and software enable ready-modeled interior furniture or products and make it possible to re-create them in an augmented reality environment by utilizing online portals. The fact that this reality was proven to be the driver beyond youthful studios that practiced using augmented reality more frequently than well-established and experienced offices was also discovered. This can also be justified by the fact that new educational systems and programs in architecture and interior design in Bahrain encourage the usage of augmented reality and virtual reality by their students in juries at the university level.

The perceived expensive cost of augmented reality is the second reason for the delay in its implementation, as shown in figure 2. It is possible that the cost of purchasing the instruments and establishing a fundamental augmented reality experience for the projects areas of pieces of furniture might vary anywhere from 300 BHD to 600 BHD. The other impediment that was discovered was the various smart phone hardware that is accessible in Bahrain, as well as the quality and configuration of these phones, which may cause customers to refuse augmented reality. Also, the rejection from current designers to learn and use the technology is seen as a barrier. The fact that not many designers agree in seeing the potential within the technology led to the obstacle of scaling the application to differ customers and their adoption to new wat for visualization, figure 4.

One of the interviewee stated: “The pool of clients who can afford it is so small in Bahrain! Unless it was mostly focused towards hospitality/commercial designs where the budget is a bit more higher. (...But from my current job experience, most these projects work in a fast time line with minimal costs) which makes the whole AI approach an uncertainty in Bahrain!”.

The emerging findings are consistent with the advantages and challenges that have been discovered in the literature [9,10,11]. However, a new topic that was not adequately addressed was the education and exposure of designers to evolving technologies, as well as the experimenting with new modeling and presentation strategies. Additionally, the rapid development of augmented reality and artificial intelligence tools made it possible for cheaper and more efficient technologies to spread in the local market. On the other hand, there are not a lot of design offices in Bahrain that are successful enough to allocate sufficient time within their development goals to educate or teach their designers on how to use any of these technologies.

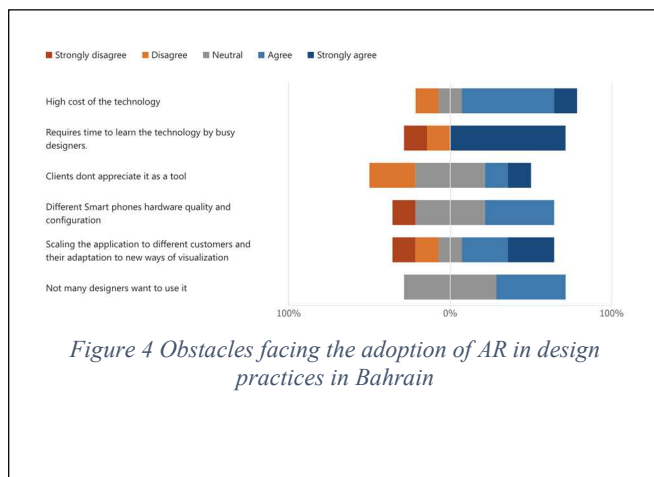


Figure 4 Obstacles facing the adoption of AR in design practices in Bahrain

#### IV. CONCLUSION

When we realize how significant augmented reality (AR) is in the design and construction industry today, it is imperative that we make it a priority to learn about it and implement it in the design area. The digital modeling and augmented reality immersive experiences technique that comes with this technology has the potential to revolutionize the design

industry and establish itself as the new standard for concept visualization and the actualization of innovations.

This study outlined both the benefits and the challenges that contemporary designers in Bahrain are confronted with. It is necessary for the construction industry and the education sector to link the use of augmented reality with the future requirements of their customers. In order to adequately prepare design students for a technologically advanced field, the process will need to address issues pertaining to cost, technical assistance, and training. These issues can all be incorporated into a new academic curriculum for design students.

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