

Enhancing User Experience via Augmented Reality and Virtual Reality in Real Estate Industry

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Abstract

Real estate industry is one of the most successful industry and is a renowned key player in the economic movement. Therefore, it is crucial to improve the services and enhance the 'User Experience' for sustainability of the identified industry. In line with this, Augmented Reality and Virtual Reality are identified as the emerging technologies that elevate the quality of services provided by the real estate agencies which leads to further enhancement of the user experience. In this paper, we postulated that deployment of the trending technologies with adaption of the UX Honeycomb Framework enhances the User Experience. The data was collected via an administered online survey to probe on the postulated variables. Besides the survey, a field observation was conducted in order to ease validation process of the collected data through different means of sources. The non-probability sampling method was used and the respondents (n=200) consisted of potential home buyers and real estate agency employees from Bangladesh. Findings from the online survey suggest that the adaptability of the prevalent technology has increased and the efficacy of deploying these technologies promotes the sales process by minimizing cost and time. Besides that, the findings also suggest that the proposed framework enhances User Experience in the real estate industry as it is evident that there is a significant relationship between deployment of the emerging technologies and User Experience ($P \leq 0.05$).

Keywords: *Augmented Reality, Virtual Reality, User Experience, Real Estate.*

1. Introduction

Virtual reality (VR) is a hologram of a real-life natural environment produced by a computer. By wearing protective gear or sunglasses that enhance sight and hearing, users interact with the virtual world. The observation and interpretation of virtual world is close, and we perceive the world as human beings. Thus, the term virtual reality essentially means near reality which means a person can visualize the surrounding inside it as it is outside. It could mean anything of course in reality, but it generally refers to a specific type of optimization of reality. Virtual reality is the creation of a virtual environment using advanced computer technology developed by application company (Smithson et al., 2018). VR enables users to experience the product virtually, unlike

traditional user interfaces. Users are able to communicate with 3D universes instead of watching a screen there in front of them. The computer is converted into a facilitator for this imaginary world by simulating as many consciousness as possible, like those of clear vision, actual hearing, touch, and even smell. So far, the only limitations of near-real Virtual Reality thoughts and experiences are paid content affordability and relatively cheap computing power (Gandolfi, 2018).

According to Smithson et al., (2018), Augmented Reality (AR) is an actual live explicit or implicit view of a physical, real-world situation whose features are augmented by computer created visual information such as sound, touch, video, animations or GPS data. With the exception of

virtual reality, which generates a completely unnatural environment, augmented reality uses the external environment and interfaces relevant information on edge of it (Deaky and Parv, 2018). The applications of Augmented Reality and Virtual Reality technologies now create images of gaming and sci-fi films, however both have the capacity to change the purchase, lease and use of real life experience of the property (Kejriwal, 2018). Sotheby's International Realty, established in New York as a real estate company, offers potential future tenants virtual reality walk-throughs of the apartment buildings under development. Brokers and sales representatives can also use augmented reality-based applications to create property leaflets and even provide different views, including the neighborhood, campground and others. The user friendly and interactive experience overall would expand the pool of possible buyers or tenants, save additional costs, empower user experience from the subsequent developmental stages and increase pleasure and satisfaction. The bottom line is that the new future is experiential real estate and building (Anton, Kurillo and Bajcsy, 2017).

In Virtual Reality and Augmented Reality applications, there are many kinds of hardware, including haptic suits and niche systems that even enable visually impaired people to "see" their palates. However, the virtual reality hardware is a headset for most consumer and business applications, such as HTC company invented Virtual Reality devices identified as VIVE, Oculus Go and the Sony Play Station Virtual Reality (Series and Science, 2018). The mobile phone is connected with the Virtual Reality and Augmented Reality headset whereby the users can view the real world virtually. On the other hand, the Augmented Reality devices are tablets or a weary phone, are widely available such as the smart watches. In the current era, the dueling SDKs AR Kit from Apple and AR Kore from Google have gone into Augmented Reality and Virtual Reality races. Due to its three-dimensional computer-created setting, users can investigate and communicate with Virtual Reality (Deaky and Parv, 2018). A variety of instruments is used to boost sight, listening and touch sensation to produce the illusion of truth. Augmented Reality

is also used as an enhanced version of reality to add digital information with captured images or video.

Nowadays, real estate businesses have grown fast and it is a booming industry all over the world. Although the real estate industry is booming, the home buyers or customers are still facing dilemma when buying their own property as most of them are under construction and they are unaware of the exact design or architecture of their dream home (Foo and Weng, 2019). Therefore, the home buyers will need to wait until the construction is completed to view the property in real life. McKalin (2015) stated that customers are not satisfied with the end product as they do not like the layout or design of the whole apartment or the interior of the apartment. Sometimes, when the actual design of their dream home. Furthermore, the diversified customers from different area or country have different expectations and they are unable to maintain regular communication during the property construction period resulting in the rise of such problem (Fade, 2018). Thus, there is a need to address this issue using the trending technologies such as Virtual Reality (VR) and Augmented Reality (AR). The main advantage is that VR distributes a computer-generated environment with three dimensions (Elmqaddem, 2019). Customers who view in this VR environment can explore it in a number of ways and interact with it. In a sense, it's like taking a virtual tour of the house in which the home buyer is interested, except that they don't have to leave their current house. This way, users can save their valuable time and money. The main goal of these technologies are to improve user buying experience in real estate industry.

This research captures and elaborates the use of Augmented Reality (AR) and Virtual Reality (VR) in real estate industries. It paper also highlights the means to enhance the User Experience (UX) by using AR and VR technology in real estate industries which has been proven to be useful for the business owners and the clients of real estate industries as highlighted by Wittkopf, Lloyd and Johnson (2018). Besides this, the study is a significant endeavor in showing how

real estate industries can enhance the UX using AR. In line with this, the research aims to determine the efficacy of Augmented Reality (AR) and Virtual Reality (VR) in the real estate industry to

- determine the implementation issues related to Service Provider, Augmented Reality (AR) and Virtual Reality (VR) technology.
- assess user perception and attitude towards Augmented Reality (AR) and Virtual Reality (VR) in real estate industry using UX Honeycomb.
- analyze the relationship between Augmented Reality (AR) and Virtual Reality (VR) technology with user experience.

Based on the objectives of the research, the researchers have identified three hypothesis.

H1: Virtual Reality positively enhance User Experience in real estate industry.

H0: Virtual Reality does not enhance User Experience in real estate industry.

Virtual Reality enables designers to substitute expensive display houses, scale designs, and printed collateral – all of which need to be reworked and redesigned when ideas alter. In the 1950s, Morton Heilig, a cameraman in the movie industry, believed that cinema as an art should be able to bring the watchman into the screen. In 1962, Heilig actually developed a model of his idea, which he called "The Cinema of the Future" before digital computing in 1955, known as Sensorama. Adding on, Alkhamisi and Monowar (2013) stated that first AR system's

and VR.

enhance User Experience (EX). The specific objectives are as listed below:

most difficult job for most real estate agents is to get customers to buy or sign a rental agreement.

H2: Augmented Reality positively enhances User Experience in real estate industry.

H0: Augmented Reality does not enhance User Experience in real estate industry.

Augmented Reality enables designers to maintain printed collateral, but it provides the possibility to revive it. Augmented Reality is a smart mixture of the tablet, phone, and custom brochure instead of a scale model with its related expenses and constraints (Brenner, 2017).

H3: Services Provider positively enhances User Experience in real estate industry.

H0: Services Provider does not enhances User Experience in real estate industry.

The service provider provides a user-friendly, adaptable scheme and application media that transforms digital material into increased and virtual reality.

2.Literature Review

working prototypewas developed in 1968, after that Myron Krueger established a video laboratory for artificial reality in 1975 and this served as an area that allowed users to handle the virtual elements for the first time easily. Subsequently, AR then became a field of study in the early 1990s. The following figure 1 elaborates the evolution of AR.



Figure 1. Augmented reality throughout history (Alkhamisi and Monowar, 2013)

2.1 Implementation of Augmented Reality and

Augmented Reality (AR) and Virtual Reality (VR) technology play a vital role in gaming industry like Pokémon GO of Niantic Labs game (Roth, 2017). In the automotive industry, the development of AR and VR is heavily involved for a number of reasons according to (Gay-Bellile et al., 2015). Meanwhile, in the construction industry AR and VR are used constructions of bridges, parks and other modern private constructions. AR and VR have also been utilized in the defense sector. The AR field has a lengthy and ironic history of military-specific applications from the start of the field (Baek et al., 2018). In addition, its application in the military has assisted to advance technology from drug supply to maintenance and repair in numerous areas of application. Thus, it has proven that AR technology can benefit military applications. An association of Augmented Reality, Virtual Reality and Service Provider in Real Estate Industry have created a specialized software suite whereby AR allows their users to imagine, edit and share their 3D prototypes in both Augmented Reality and

Virtual Reality in Different Sectors

Virtual Reality (Hulivahana, 2017). Adding on, the company's productions are based on a single engine. In order to optimize interaction and real-time viewing, this engine uses 3D data. Service provider's Virtual Reality and Augmented Reality offer the link between media producer and various mobile devices, enabling the customers to regulate and transmit media material seamlessly with their portable applications of the highest standard (Mandal, 2013).

2.2 User Experience (UX) Honeycomb Model

The focus of the User Experience (UX) is to understand in depth what consumers need, what they value, their skills and their constraints. The company's goals and objectives of the project manager are also taken into consideration and UX best practices encourage the value and perception of the items and associated facilities by consumers (Orlova, 2016). Figure 2 depicts the Honeycomb model that highlights the seven criteria of User Experience.



Figure 2. The Honeycomb Model of User Experience (Morville et al., 2006)

The seven criteria depicted in figure 2 are:

- i. Useful: The item or service of a company must be helpful and satisfy a requirement. If the item or service does not meet the demands or requires of the user, then the item itself has no true objective (Liu et al., 2016).
- ii. Useable: It should be simple and easy to use scheme in which the item or service is supplied. Systems should be intended in an easy to comprehend and familiar manner and it should be as brief and painless as appropriate for a customer to learn through the curvature (Liu et al., 2016).
- iii. Findable: The information must be readily available and easily navigable. If an issue arises, one should be prepared to discover a remedy rapidly and it should also be possible to build up the navigational framework in a sense (Lee, 2018).
- iv. Credible: It needs to be trustworthy with its products or facilities.

Augmented Reality (AR) and Virtual Reality (VR) are credible to their users they keep users data safe and secure (Wesolko, 2016).

- v. Desirability: The visual aesthetics of the product, service, or system need to be attractive and easy to translate and the design should be minimal and to the point (Wesolko, 2016).
- vi. Accessible: The item or services should be intended to provide the same user experience even for disabled people (Wesolko, 2016).
- vii. Valuable: The item should be valuable to the users so that after using the product users feel that this product is valuable to them (Coie, 2018)

2.3 User Experience on Augmented Reality and Virtual Reality in Real Estate Industry

The Admin in the Real Estate Company can customize the implementation of AR into a dream home system to cater to the needs and expectations of their customers by rearranging a space with various combinations of furniture and finishes of materials in the virtual world (Wang, Cheng and Guo, 2019). In a study conducted by Heinzl and Azhar (2017), Home-style promises "Your personal 3D design playground" with a functionality that places first-class 3D models of physical furniture products into the customer virtual home. Therefore, AR can project an unfinished project as a complete and utter development, with different buildings in estimated locations. Technically, AR headsets do not permit users or new home buyers to be placed at one location; they can simply move around and just remain productive even while taking part in other tasks. It is also a significant reason why AR has a greater impact on the enterprise market, despite being above VR on the current production curve as claimed by Smithson et al. (2018). Hence, Augmented Reality and Virtual Reality technologies are one of the world-changing technologies which applies to real estate industry all around the world.

3. Research Methodology

According to Hartnett and Cooper, (2010) privacy and confidentiality are two key principles that must be addressed by all researchers when assembling and conducting research. This chapter begins with an introduction then describes the research design employed in this study. Population size and sampling method is also identified before executing the research plan. For data collection, quantitative method is used and an online survey is conducted using random sampling whereby the 200 respondents are potential home buyers and Real estate industry staffs from Dhaka, Bangladesh. The collected data is analyzed using the SmartPLS to determine whether to support or reject the null hypothesis. Smart PLS has some dominant advantages as it works well with small sample size (Davari and Rezazadeh, 2013).

A self-administered questionnaire is used to perform the survey due to its convenience, low cost, the significant reduction of preconceptions and greater anonymity (Skinner, 2007). Adoption of the questions for the survey were from multiple sources which have been validated in the past researches. In this research, the questionnaire included highly structured Likert-type scales questions. Researchers applied the Likert scale layout as the scale was appropriate for the method of self-administered survey. A 5-point Likert scale was used for all items defined in the questionnaire (Joshi et al., 2015). The questionnaire of this study was divided into two sections consisting of overall 27 items. Respondent's demographic variables such as gender, age, marital status, and education level were included in Section A. On the other hand, Section B included measurement of the dependent variable and independent variables with a scale ranging from 1=Strongly Disagree to 5=Strongly Agree. The variables are as depicted in the following figure 3 below. The figure 3 represents the relationship between the independent variable and dependent variables of this research. As depicted in figure 3, the independent variable produces the effect in a causal relationship and must occur in time before the dependent variable (Delucchi, 2018).

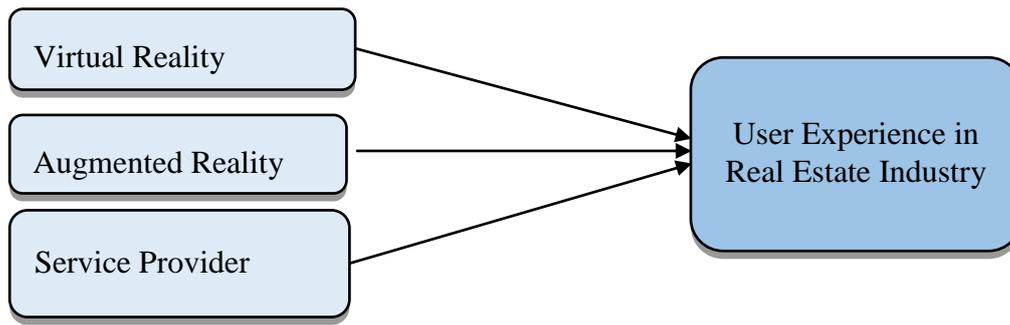


Figure 3. Conceptual Framework with Independent Variables and Dependent Variable

Data collection process was done using an online form. In order to collect quantitative data, the questionnaires will be allocated to the participants based on sample size (Brown, 2010). A total of 200 respondents responded to the study. The respondents, in this study consisted of real estate buyers' or customers and the real estate company's employees or staffs. This finding was used as the primary data analysis while secondary data analysis were gathered from various sources

such as the internet, past study, past surveys and past publications, surveys, newspapers, magazines, books (Siau and Hall, 2016). Primary data were gathered for this study through study by supplying the participants with questionnaires. Documentary, survey and those from various sources are the primary three kinds of secondary data. The entire process is captured in the following figure 4 where the 2 phases are depicted clearly.

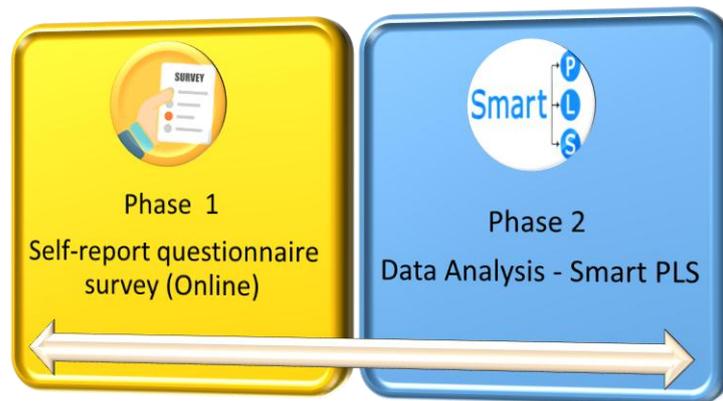


Figure 4. Research Phase

4. Findings and Discussion

The study deployed the trending technologies such as Virtual Reality (VR) and Augmented Reality (AR) to determine the efficacy of these tools to enhance User Experience (UX). The data collected from these 200 respondents were used in the study and further analyzed to determine the validity of the proposed research hypothesis.

It is essential to determine whether or not the information gathered from the questionnaire is accurate for the studies and that is why I have analyzed the results. After gathering information, the first phase was to perform a reliability test

using the alpha coefficient of Cronbach to determine whether or not segment B products are free of random error. SmartPLS software is used to check validity. SmartPLS one of the leading software application and its full form is "Partial Least Squares Structural Equation Modeling" (PLS-SEM) (Kwong-Kay Wong, 2013). The alpha ratio of the Cronbach has a variety of 0 to 1. If the outcome is nearer to 1 then the factors are more reliable. The reliability test for the dependent and independent variables was conducted in this study.

Table 1 shows the description of a reliability test.

Table 1. Reliability Test

Construct Reliability and Validity				
	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
AR	0.904	0.916	0.896	0.562
SP	0.961	0.962	0.961	0.779
UX	0.969	0.97	0.969	0.819
VR	0.911	0.946	0.895	0.572

It was found that the scores of all factors of the Cronbach's Alpha are greater than 0.6. AR=0.904, SP=0.961, UX=0.969, VR=0.911 which indicates that this study's factors are accurate and can be used for further examination.

The descriptive assessment was also carried out for the respondents' population information to interpret age range, gender group, type of education, occupation, and salary 200 responses have been collected and analysed. To represent demographic information of the respondents, Section A of the questionnaire has been used. The demographic profile of the respondents has been described with the help of frequency and cumulative percentage methods. Based on the analysis, the demographics of respondents are listed below: Gender: Male: 63.2%; Female: 36.8%

- Age Group: 25- 30 years: 36.8%; 30-40 years: 36.8%; 40-50 years: 24.5%; 50-60 years: 1.9%;
- Education Level: Postgraduate Degree: 57.1% ; Undergraduate or High School: 42.9%
- Occupation: Employed = 62.7%; Self Employed = 37.3%;
- Income Level (Bangladesh Currency): 30000-40000: 21.2%; 40000-50000: 30.7%; 50000-60000: 24.1%; 60000-70000: 10.8%; 70000-Above: 13.2%;

The following table 2 shows the influence of virtual reality on UX (User Experience). Respondents think that the accessibility of VR knowledge is increasing in Bangladesh. In addition, they perceive that it's a positive attitude towards their country where increasing accessibility of technology is a good sign for Bangladesh.

Table 2. Virtual Reality's Mean Standard Deviation and Average (Mean and SD)

Items	Mean	Standard Deviation
VR1	1.505	0.557
VR2	1.510	0.656
VR3	1.625	0.703
VR4	1.665	0.757
VR5	1.675	0.685
VR6	1.680	0.691
VR7	1.695	0.716

In table 2, it is noted that the highest VR7 (Mean=1.695 and SD= 0.716). Respondents also agreed that Virtual Reality is easy to use and it

can simplify the complex design of the property for user's better understanding, second highest VR5 (Mean=1.68 and SD=0.691). The average

mean is 1.622142857 and the standard deviation is 0.680714286 which indicate that virtual reality has some impact on User Experience.

The following table depicts the impact of User experience and usefulness of using Augmented Reality. Respondent think that Augmented Reality

is easy to use and it can simplify the complex design of property for user's better understanding and respondent also agree with this statement that the technology of Augmented Reality is still new in real estate industry of Bangladesh but it's becoming popular and available day by day.

Table 3. Augmented Reality's Mean Standard Deviation and Average (Mean and SD)

Items	Mean	Standard Deviation
AR1	1.630	0.723
AR2	1.660	0.703
AR3	1.555	0.705
AR4	1.630	0.673
AR5	1.675	0.741
AR6	1.615	0.698
AR7	1.665	0.716

In table 3, the highest mean is in AR5 and AR7 (mean=1.675, 1.665) and (standard deviation accordingly = 0.741, 0.716). The average mean is 1.6328 and the average standard deviation is 0.7084 which represent that Augmented Reality has a significant impact on User Experience (UX).

Adding on, table 4 depicts the impact of service provider on user experience. Respondents agree that an efficient online service for Augmented Reality and Virtual Reality can provide enjoyable and attractive experience to the users (SP4 Mean=1.845, SD= 1.01).

Table 4. Service Provider's Mean Standard Deviation and Average (Mean and SD)

Items	Mean	Standard Deviation
SP1	1.790	0.988
SP2	1.690	0.966
SP3	1.785	0.953
SP4	1.845	1.010
SP5	1.825	0.997
SP6	1.800	0.949
SP7	1.830	0.991

Table 4 also depicts the accessibility of Service Provider for Augmented Reality and Virtual Reality in Bangladesh is increasing day by day (SP7 Mean=1.83, SD=0.991). The average mean and standard deviation of service provider are 1.795 and 0.979 which mean that service provider has significant impact on UX.

The following table 5 displays the mean and standard deviation of UX. Respondents think that better UX by using Service Provider for "Virtual Reality and Augmented Reality" be able to make the communication between clients and the real estate company stronger (UX7 Mean=1.8 and SD=1.025).

Table 5: User Experience’s Mean Standard Deviation and Average (Mean and SD)

Items	Mean	Standard Deviation
UX1	1.795	1.011
UX2	1.790	0.925
UX3	1.810	1.002
UX4	1.760	0.971
UX5	1.815	1.010
UX6	1.790	0.973
UX7	1.800	1.025

As captured in table 5, respondents agree that User Experience can be enhanced by using Virtual Reality, Augmented Reality and Service Provider (UX1 Mean=1.795; UX2 Mean=1.79; UX3 Mean=1.81). The average mean is 1.79 and standard deviation is 0.988 which conclude that AR, VR and SP have significant impact on User Experience.

In order to determine the connection between independent variables and dependent variable and test the hypothesis, some statistical analysis was performed. The result of the statistical assessment reflects a powerful connection between all the independent factors and the dependent variable. There were created to evaluate three hypotheses as explained further in the end of this section. According to the exam, all the theory has been adopted which implies the involvement of Augmented Reality (AR) and Virtual Reality (VR) and the service supplier has a powerful impact on the improvement of user’s experience in the Real-Estate Industry.

5. Conclusion

The result in this study shows that the respondents agrees that Augmented Reality is easy to use and it can simplify the complex design of property for user’s better understanding as claimed by Brenner (2017). The respondent also agreed that the technology of Augmented Reality is still new in real estate industry of Bangladesh but it’s becoming popular and available day by day. Besides this, the research has proven that the accessibility of Virtual Reality technology is increasing in Bangladesh as the respondent supports the deployment of such technologies is it acts as an indicator of the economic development

of Bangladesh. In regards to the Service Providers, the accessibility of Service Provider for Augmented Reality and Virtual Reality in Bangladesh is increasing daily. Adding on, an efficient online Service Providers for Augmented Reality and Virtual Reality has proven that it provides positive User Experience to the home buyers. Therefore it supports all the three hypothesis below and rejects the null hypothesis.

- H1: Virtual Reality positively enhance User Experience in real estate industry.
- H2: Augmented Reality positively enhances User Experience in real estate industry.
- H3: Services Provider positively enhances User Experience in real estate industry

In nutshell, the research successfully evaluated the customer’s perception and behavior towards Augmented Reality and Virtual Reality in the real estate sector using UX Honeycomb model, an effective model proposed by Morville et al (2006; 2010) to analyze the connection with user experience between Augmented Reality (AR) and Virtual Reality (VR) technologies to suggest a model to improve User Experience (UX). However, since Bangladesh is a developing country where the customers are struggling to own a desired or dream home from the real estate sector, this research could only reach out to the elite group of customers as these technologies are only available in metropolitan cities

and not in rural areas of Bangladesh. The research has brought to surface the importance of implementing the trending technologies such as Augmented Reality (AR) and Virtual Reality (VR) in real estate industry as it provides the positive User Experience (UX) to the customers or home buyers. However, this can only be achieved if all the relevant parties inclusive of the policy makers in Bangladesh and the Real Estate Industry owners themselves provide these opportunities for the customers to be exposed to these technologies to make a smart purchase of their dream home. On the other hand, based on the findings, the research can be further strengthened by having a more extensive and varied sample. For instance, the size of the sample can be increased and further diversified by incorporating more than one city in Bangladesh to ensure that the sampling is more balanced.

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