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The Adoption of Virtual Reality Technology in Real Estate Marketing: A Review

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ABSTRACT

Real estate marketing has traditionally relied on physical visits to properties to showcase their features and appeal to potential buyers. Property viewing is an important step in the sales process in the real estate industry, and it frequently takes a lot of time and effort from both buyers and agents. Traditional methods of property viewing, such as physical visits or two-dimensional (2D) photos, may not always provide an accurate representation of the property, leading to dissatisfaction and lost sales opportunities. However, the emergence of virtual reality (VR) technology has created new opportunities to offer immersive and engaging experiences to prospective customers, even when buyers are unable to physically visit the properties. VR technology enables potential buyers to explore properties from different angles, customise virtual settings, and interact with different features in real-time, creating a more dynamic and memorable experience. This paper reviews the adoption of VR technology from the perspective of real estate marketing to enhance the marketing of properties. Five prominent databases were utilised to conduct the literature study, focusing on data published between 2018 and 2023, and several inclusion criteria were established for the literature search. The main finding concluded that the use of VR technology in real estate marketing could substantially provide competitive advantages by allowing potential buyers to explore properties at their convenience and making the buying process easier. It is also important to note that the use of VR technology in real estate marketing could substantially provide competitive advantages by allowing potential buyers to explore properties at their convenience and making the buying process more efficient. However, the readiness to optimise VR technology is hindered due to a lack of awareness and perception of its complexity. Therefore, significant investment should be considered by real estate practitioners to provide training for the extensive integration of VR technology within the industry. By identifying the benefits and challenges of using VR technology, this study will help guide the development of effective marketing strategies for the Malaysian real estate industry.

1. Introduction

Real estate marketing has traditionally relied on physical visits to properties to showcase their features and appeal to potential buyers. However, the emergence of VR technology has created new opportunities to offer immersive and engaging experiences to prospective buyers, even when they

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are unable to visit the properties physically. VR technology enables potential buyers to explore properties from different angles, customise virtual settings, and interact with different features in real-time, creating a more dynamic and memorable experience. This groundbreaking technology is characterised by the core principles of digitalisation and enhanced integration of value chains, digitalisation of products and services, and the implementation of novel digital business models facilitated by comprehensive integrated solutions [1]. As such, VR technology has the potential to revolutionise the way real estate marketing is conducted. Another benefit of employing virtual reality in laboratories is the substantial cost reduction compared to traditional physical setups [2].

In Malaysia, the real estate market is highly competitive, and real estate agents and developers are constantly seeking new and innovative approaches to distinguish themselves from their competitors. Furthermore, the advancement of technology has transformed the marketing communication strategies employed by companies when reaching out to their intended audience [3]. However, incorporating VR technology into marketing strategies can be challenging due to the relative newness of the technology in the context of real estate marketing, potential cost barriers, and possible technological limitations. Nevertheless, it has been noted that conventional offline marketing may not offer prospective homebuyers comprehensive details and images of the properties that they are interested in, primarily due to the constraints of the marketing channels utilised by property developers [4]. Therefore, the importance of using VR technology in real estate marketing could provide a significant competitive advantage by allowing potential buyers to explore properties at their convenience and making the buying process more efficient.

1.1 Problem Statement

In the real estate industry, property viewing is crucial for sales; however, conventional methods such as physical visits or 2D photos may not accurately represent properties, thus leading to lost opportunities. VR technology offers a better solution; however, its adoption in the industry, particularly in Malaysia, remains limited. The problem statement outlines several key challenges in the adoption of VR technology within the real estate industry. One major hurdle is the lack of understanding and familiarity with VR technology. As a relatively new innovation in the field, there is a hesitancy to embrace something unfamiliar, and this reluctance often deters real estate professionals from venturing into new technological territories.

The impact of the coronavirus disease (COVID-19) pandemic further underscores the importance of VR technology. During the lockdowns and restrictions imposed by the pandemic, conventional property viewings became challenging. However, with VR technology in place, it could have been an advantageous tool for real estate companies. This technological solution would have allowed potential buyers to explore properties from the safety of their homes, aligning with social distancing measures and government incentives such as the Home Ownership Campaign (HOC). The marketing landscape experienced a significant shift during the COVID-19 pandemic, prompting an exploration of the efficacy of VR in real estate marketing [5].

Additionally, the accessibility of VR technology itself presents a challenge. While there are free VR software options available, they might compromise quality. On the other hand, purchasing VR tools can be costly, creating a barrier for both buyers and sellers. This further emphasises the importance of addressing the accessibility and affordability of VR tools in the real estate market. Seeking innovation is another driving force behind the need to adopt VR technology.

Real estate is a competitive industry, and staying ahead often requires adopting innovative strategies that set a company apart from its rivals. Incorporating VR technology can differentiate a real estate company by offering a unique experience to potential buyers and streamlining processes, thereby enhancing customer engagement and satisfaction. A significant benefit of VR adoption is its potential to attract serious and committed potential buyers. When VR is used for property viewing,

it tends to attract buyers who are more inclined to make a purchase decision. This is because VR allows them to virtually experience the property, making their decision more informed and confident.

Thus, the objective of this study is to investigate the potential of VR technology in real estate marketing in Malaysia. In order to accomplish this goal, the study will commence with a brief overview of VR technology and its potential applications in real estate marketing. Following that, a literature review will be conducted to scrutinise the existing research on the effectiveness of VR technology in real estate marketing, encompassing both international and local studies. In addition, the current state of VR technology in Malaysia will be evaluated, and any potential barriers or limitations to its widespread adoption in the real estate industry will be identified.

1.2 Research Gap and Significance of The Study

By investigating the potential of VR technology in real estate marketing in Malaysia, this study aims to contribute to the growing body of knowledge on the topic and provide insights that could benefit real estate agents and developers in improving their marketing strategies. Smart real estate plays a crucial role in smart city initiatives, which are regarded as the upcoming paradigm for urban development [6]. By identifying the benefits and challenges of using VR technology, this study will help guide the development of effective marketing strategies for the Malaysian real estate industry.

2. Methodology

2.1 Database and Literature Search

For this study, five databases were utilised to conduct the literature search: Google Scholar, Science Direct, Authorized Journal Publication, IEEE Xplore and Semarak Ilmu (ARASET). These databases were selected due to their comprehensive coverage of academic publications from various disciplines, particularly within the scope of the subject being studied.

2.2 Inclusion Criteria

2.2.1 Research data date

The scope of the literature search was limited to articles published within the timeframe of 2018 to 2023. This range was chosen to ensure that the study included the most recent and relevant research related to the adoption of VR technology in real estate marketing.

2.2.2 Keywords

The following keywords were used to search for articles in indexing database

- Virtual reality
- Real estate marketing
- Property viewing
- VR technology
- Adoption
- Real property
- Developed country: this keyword was used to focus on studies conducted in developed countries such as the United States of America (USA) and the United Kingdom (UK).

2.2.3 Specific area of study

This study specifically focused on the adoption of virtual reality technology in the real estate industry. The emphasis is on real estate marketing, its potential and barriers.

2.2.4 Selection of country

The methodology and results sections of this study focused on research conducted in developed countries as well as in Malaysia. By considering research from both developed countries and Malaysia, the study aimed to gain insights into the adoption of VR technology in real estate marketing in both mature real estate markets and emerging markets like Malaysia.

2.3 Procedure

The literature review procedure is presented in Table 1. This is set out in order to obtain a clear direction for the overall reviewing process.

Table 1
 Literature Review Procedure

Type	Interview	Questionnaire	Data Analysis
<i>Research question</i>	To what extent does the implementation of virtual reality (VR) technology in real estate marketing encounter challenges and limitations in the Malaysian context?	How effective is virtual reality technology in providing a property viewing experience compared to traditional methods in the real estate industry in Malaysia?	What is the most effective approach to optimising the use of VR?
<i>Research objective</i>	To investigate the challenges and limitations faced in the implementation of virtual reality (VR) technology in real estate marketing in Malaysia.	To assess the effectiveness of virtual reality technology in providing property viewing experiences in comparison to traditional methods in the real estate industry in Malaysia.	The objective is to provide practical recommendations and strategies that can enhance the implementation and utilisation of VR technology in the industry.
<i>Research method</i>	"Interview" the construction player about three developers: website, brochure, design, and others. With a specific focus on gathering insights through interviews with key stakeholders in the construction industry.	"Questionnaire" to the client based on the VR experience developed by the developer and the market trend of the property. Or from the public.	Mix method, based on data from interviews and questionnaires (%). To suggest an effective approach for optimising the use of virtual reality technology in real estate marketing in Malaysia.
<i>Output</i>	Summary analysis of VR. The data obtained from interviews can be included in the report as authorised and proven knowledge in the industry of VR.	The % (number). This will be accomplished through a questionnaire. Collects feedback from clients who have experienced VR-based property viewings.	Detail data analysis (%) and summary analysis of VR. Based on the findings and insights obtained from the interviews and questionnaire data.

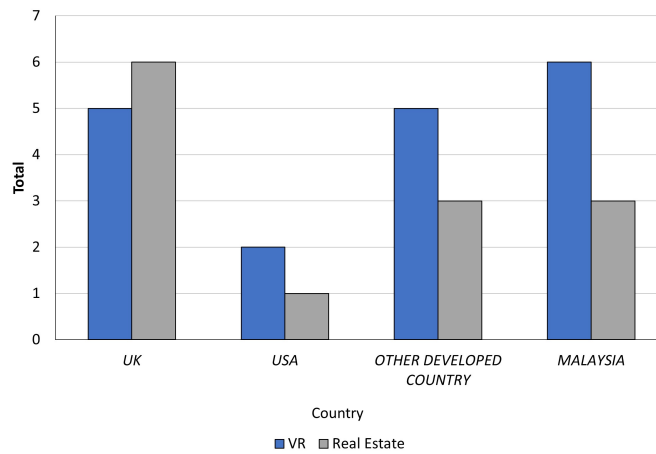


Fig. 1. The publication in VR Technology and Real Estate Aspect

Figure 1 shows the UK leads in VR adoption in real estate, while the USA and Malaysia have lower VR usage. Other developed countries also show a higher interest in VR compared to traditional real estate practices. This is likely due to their advanced level of digital technology as well as their well-established infrastructure.

Developed countries have the capability to invest significant financial resources into research and training for the integration of VR technology within the real estate industry. Furthermore, the developed countries emphasise environmentally friendly approaches as well as supporting the Sustainable Development Goals (SDGs) agenda which aligns with VR technology applications.

As Malaysia is currently working towards Digitalisation to support the 4IR (Industrial Revolution) policy, many industries are beginning to make changes for a better future. Consequently, the movement has also reflected the focus of the research conducted at higher educational institutions.

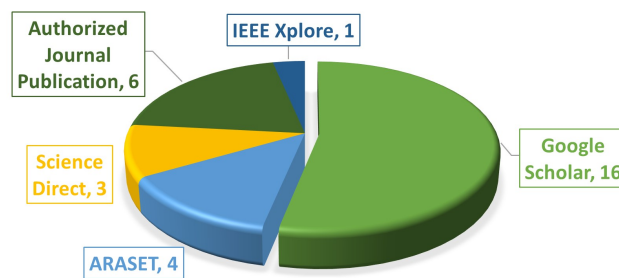


Fig. 2. The total publication with VR and Real Estate content

Figure 2 illustrates the distribution of publications related to VR technology in the context of real estate marketing across different types of journals. Google Scholar stands out as the most prominent platform, hosting the highest number of publications which is seventeen (16). The ARASET and Science Direct follow with moderate representation, having four (4) and three (3) publications, respectively. Additionally, six (6) publications are found in the Authorized Journal Publication and one (1) in IEEE Xplore. The data highlights the significant interest and research efforts dedicated to exploring VR technology's impact on the real estate industry, with Google Scholar being the primary go-to platform for accessing scholarly articles in this domain.

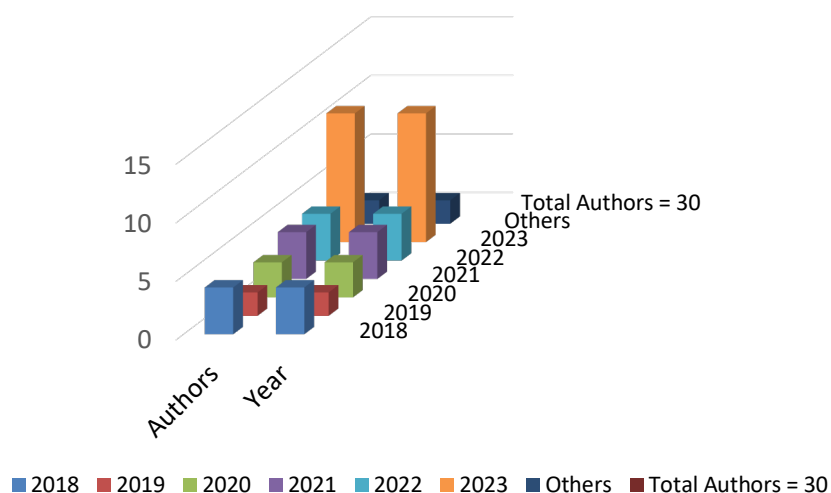


Fig. 3. The total paper VR and Real Estate content

The data presented in Figure 3 is the distribution of publications across different years from 2018 to 2023, along with a category label as "others." The total number of publications involved in these studies is 30. In 2018, there were four (4) publications contributing to the studied area. This indicates a modest level of involvement during that year. The following year, in 2019, the number of publications decreased to two (2), suggesting a potential decline in research activity or a smaller number of studies conducted in that period.

However, in 2020, the number of publications increased to three (3), indicating a resurgence in research involvement compared to the previous year. This trend continued in 2021, when the author count rose to five (4), reflecting a growing interest in the subject matter during that year. The current condition might contribute to these trends during the COVID-19 pandemic, where this area is being explored to seek better advancement in providing potential buyers considering various movement restrictions. The subsequent year, 2022, maintained a relatively high number of publications at four (4), implying consistent research participation. Notably, in 2023, the number of publications substantially increased to eleven (11), which could signify a significant surge in research activity, potentially due to increased attention or advancements in the field.

The provided data outlines the distribution of publications and their contributions for each of the mentioned years. However, there were two (2) publications where specific years of contribution were not detailed within the given data. It is possible that their involvement was spread across different years that were not explicitly listed, making it challenging to attribute their contributions to a single year. They were considered mainly to deepen its underlying principles. It is essential to mention that the shortlisted publications are presented and discussed due to their relevance to the studied area.

3. Results

3.1. VR

3.1.1 Definition

In VR, the participant-observer is fully immersed in an entirely artificial world, resembling or deviating from real-world properties [7]. VR technology is a computer-generated simulation that enables users to interact with a three-dimensional (3D) environment using specialised equipment such as a headset and hand controllers. By wearing a VR headset or using other specialised devices, users are able to explore and interact with virtual spaces in a highly realistic and engaging manner. VR has been used in a variety of industries, including entertainment, education, and healthcare.

In recent years, VR has gained attention in the real estate industry as a tool for marketing properties to potential buyers. Low *et al.*, [8] assert that the future trend of marketing will revolve around smart and sustainable digital technology, considering millennials' familiarity with such innovations. According to Kamil *et al.*, [9], while VR technology itself is not new, it has become a novel approach in the luxury real estate market, enabling potential buyers to virtually tour properties without the need for physical visits. It could also be used for a luxury property that is still under construction. Halim and colleagues [10] initially established the sequence of the two selection methods, touchscreen (TS), and freehand (FH), for the experiment setup workspace.

At the core of VR technology are three key principles: immersion, interaction, and sensory stimulation. First, immersion creates a sense of presence, transporting users into a virtual environment that feels authentic and believable. Second, interaction enables users to engage with and manipulate objects within the virtual world, providing a sense of control and agency. Third, sensory stimulation involves stimulating multiple senses, such as vision and hearing, to enhance the realism and immersion of the experience. Kamil and co-researchers [9] are taken from a previous study assert that virtual reality serves as a pedagogical tool in an interior design foundation course.

VR technology allows potential buyers to explore a property remotely, providing a more immersive and realistic experience than traditional photographs or videos. Moreover, potential buyers could navigate through a property and view it from different angles, giving them a better sense of its layout and features. Additionally, VR could facilitate a more efficient and convenient buying process by reducing the need for in-person visits and allowing buyers to make more informed decisions. Furthermore, according to Marten *et al.*, [11] VR has also demonstrated effectiveness in desensitising the fear of heights and addressing other phobias and mental health issues.

Several studies have investigated the effectiveness of VR technology in real estate marketing. A study conducted by Ibrahim *et al.*, [3] revealed that the utilisation of VR technology resulted in an enhanced perceived value of properties and an increased willingness among potential buyers to pay.

Similarly, research by Juan *et al.*, [12] taken from a previous study discovered that incorporating VR technology in real estate marketing led to elevated levels of customer satisfaction and a greater intention to purchase. Furthermore, according to Pinhão [13], the introduction of virtual reality in the customer purchase process for real estate resulted in homes being sold 87% faster than usual.

In terms of theoretical frameworks, the Technology Acceptance Model (TAM) has been widely used to understand the adoption of new technologies in various contexts, including real estate. According to Low *et al.*, [8], websites and social media platforms such as Facebook are user-friendly and widely regarded as being very advantageous.

Additionally, as reported by Kamil *et al.*, [9], a significant 73% of realtors utilise Facebook for their professional activities. The four guiding concepts of community, content, discussion, and transparency made it simple for the majority of users to get information and specifics about the homes offered by the agent online. User friendliness and usefulness are the two primary indicators of users' acceptance, according to the conceptual model of technology acceptance. It is believed that usefulness ease of use are key factors that influence users' attitudes and intentions to adopt new technologies. Mao *et al.*, [14] are taken from previous study employed TAM in their studies to investigate potential buyers' attitudes towards VR technology in real estate marketing. They found that perceived usefulness and perceived ease of use were positively correlated with the intention to use VR technology.

3.1.2 History and evolution

The history of virtual reality dates back several decades. Low *et al.*, [8] argue that VR is an outcome of the continuous succession of technological advancements, many of which are associated with cinema and the exploration of novel simulation techniques. Early pioneers like Ivan Sutherland

and Morton Heilig laid the groundwork for VR technology in the 1960s and 1970s. However, it was not until the 1990s that commercial VR systems started emerging, although they were limited in functionality and accessibility. Similarly, Nacher [15] pointed out that the clearest example of a VR-like experience in cinema is the sequence in *Alice in Wonderland*, where the protagonist's sister enters the same world that Alice had just left. Over the years, advancements in computing power, graphics processing, and motion tracking have propelled VR technology forward. Industries that are embracing cutting-edge technologies such as VR are witnessing substantial advancements as reported by Shaharruddin *et al.*, [16]. More recently, Sherman and Craig [17] are taken from previous a study provided a definition of VR, encompassing elements such as the virtual world, immersion, interactivity, and the involvement of individuals on both the creating and receiving sides of the medium. These technologies continue to progress and evolve.

Key milestones in the evolution of VR include the invention of immersive apparatuses like the Sensorama, which provided multisensory experiences, and the introduction of commercial VR headsets like the Oculus Rift and HTC Vive. The Sensorama Machine was invented in 1957 and patented in 1962. According to Mandal [18], the first attempt to create a virtual reality system with all the features of such an environment was made by Morton Heilig in 1957. However, it was not interactive. These advancements have significantly improved the visual quality, responsiveness, and overall user experience of VR. Additionally, the development of specialised software tools and game engines has made it easier to create compelling and realistic VR environments.

3.1.3 Components (hardware/software)

Virtual reality hardware consists of various devices that enable users to experience virtual environments. In addition to being referred to as the first attempt at a virtual reality system, it is also known as the "Window on World" (WoW) as mentioned by Kamil *et al.*, [9]. Headsets, such as the Oculus Rift, HTC Vive, and PlayStation VR, are worn on the head and provide visual and auditory immersion. These headsets feature high-resolution displays with a wide field of view, and integrated headphones, delivering realistic and immersive visuals and sound.

Hand controllers play a crucial role in enabling user interaction within the virtual space. These controllers, equipped with sensors and buttons, allow users to manipulate and interact with virtual objects. They provide a natural and intuitive way to navigate and engage with the digital environment. Additionally, tracking systems, such as external cameras or sensors, capture the movements of users and ensure accurate tracking within the virtual space.

On the software side, developers use specialised software tools and game engines to create virtual reality experiences. Unity and Unreal Engine are popular game engines that provide a framework for developing interactive and immersive VR applications. These tools offer features for designing virtual environments, implementing user interactions, and integrating audio-visual elements. Ibrahim *et al.*, [3] are taken from a previous study investigated channel attributes and potential buyers' purchase intentions through a within-subject design involving 100 prospective house buyers.

3.2 Real Estate

3.2.1 Overview

Brodeur *et al.*, [19] stated that the real estate realm is a web teeming with complexity where various stakeholders, including investors, banks, households, and developers, are interconnected. Real estate marketing is a dynamic field that involves various strategies and techniques to promote and sell properties. It encompasses both traditional methods and emerging trends. According to Pinhão [13], real estate stands as the most substantial form of capital stock, underscoring the utmost

importance of defining the factors that influence it. Traditional methods include print advertisements, signage, direct mail, and networking events. These methods have long been used in the industry and can still be effective in reaching a specific target audience. However, with the advancement of technology, emerging trends in real estate marketing have gained prominence. These include online listings, social media marketing, virtual property tours, and interactive property websites. These digital platforms have significantly expanded the reach of marketing efforts and provided new avenues for engaging with potential buyers. According to Kamil *et al.*, [9], 93% of people visit websites when searching for homes. In Malaysia, real estate professionals have embraced digital marketing strategies, leveraging popular online platforms and social media to connect with a broader audience in the local market. Low *et al.*, [8] reported a similar trend, where Malaysian statistics showed a considerable growth in web users between the years 2004 and 2016, going from 2.9 million to 5 million. Many sectors are embracing the internet as a crucial component of their marketing as a result of the quick expansion and rising trend in online and internet usage.

3.2.2 Challenges

Real estate marketing faces several challenges that real estate professionals must navigate to effectively market properties and reach potential buyers. According to Kamil *et al.*, [9], 41% of buyers select a real estate agent based on recommendations. One common challenge is the highly competitive nature of the industry, with numerous properties vying for buyers' attention. This necessitates the development of unique selling propositions and effective differentiation strategies. Another challenge is effectively reaching the target audience and generating quality leads. The topic gained significant traction following the COVID-19 pandemic, which had a global impact and brought various activities to a halt. This situation prompted shifts in marketing approaches and techniques. According to Sulaiman *et al.*, [5], with the vast amount of information available online, standing out from the crowd and capturing the interest of potential buyers requires innovative marketing approaches.

Additionally, managing client expectations, ensuring accurate property information, and adapting to changing market trends are ongoing challenges in the real estate marketing landscape. Pinhão [13] highlighted that accessibility is a critical factor contributing to the rise in real estate prices. The increase in accessibility through improved roads, transportation, and other factors has been a significant driver of this phenomenon. In the Malaysian context, specific challenges may include navigating cultural diversity, understanding local market dynamics, and complying with relevant regulations and policies.

3.2.3 Role of technology in real estate

Technology has revolutionised real estate marketing practices, transforming the way properties are showcased and marketed. The adoption of digital tools and platforms has played a crucial role in enhancing marketing strategies. Online property portals and listing websites have become the go-to resources for property searches, allowing buyers to access a wide range of property information and listings. 73% of realtors use Facebook for their work. Statistics from real estate agents indicate that most licenced agents rely on Facebook for their marketing and property mobility requirements, as highlighted in the study conducted by Kamil *et al.*, [9].

The role of technology in real estate marketing extends beyond online platforms. The integration of VR technology has provided immersive experiences for potential buyers. VR allows users to virtually explore properties, visualise spaces, and experience properties remotely with a high degree of realism. In Malaysia, technology has become increasingly integrated into real estate marketing

strategies, with developers and agencies embracing digital tools, online platforms, and VR experiences to effectively engage with buyers in a highly competitive market.

3.3 Integration of Virtual Reality in Real Estate Marketing

3.3.1 Application of virtual reality

Virtual reality technology offers a range of innovative applications in the real estate industry for marketing purposes. One of the key applications is "Virtual Property Tours". According to Sultan [20], virtual tours in real estate represent the latest trend that can be employed to attract more visits to your properties. These tours provide potential buyers with an immersive and realistic experience of exploring properties from the comfort of their homes. By wearing a VR headset, buyers can virtually walk through properties, examine details, and get a sense of the space's layout and design. This allows them to experience a "sense of presence" as if they were physically present on the property. Moreover, it enables them to "explore the space at their own pace," spending more time in areas of interest and getting a comprehensive view of the property.

Another significant application is "Immersive Experiences." Through VR technology, buyers can be "transported" into a digitally rendered environment that accurately replicates the property. Brenner [21], which was taken from a previous study, asserts that to create a virtual tour effectively, it is essential to film a property using 360-degree cameras. They can experience properties with "accurate proportions, textures, and lighting." This high level of realism enhances the buyer's ability to visualise and connect with the property, helping them to form a stronger emotional connection and make more informed decisions.

"Virtual Staging" is another valuable application of VR in real estate marketing. It allows properties to be customised and furnished virtually, giving buyers the opportunity to "envision different design possibilities." By placing virtual furniture and decor in empty spaces, buyers can see the potential of the property and better understand how it would look with their preferred style and aesthetic. This enhances their ability to visualise the property's potential and increases their engagement and interest. Lane's study (cited in Brenner [21]) involved surveying 820 homebuyers. The study utilised a 3x2 between-subjects experimental design, incorporating three variations of virtual staging, ranging from a fully furnished home to an empty home, and two types of wall colour, namely purple and neutral.

Lastly, "Interactive Property Visualization" is a powerful tool enabled by VR technology. It empowers users to engage with the virtual environment and interact with various elements of the property. Buyers can modify interior elements, "experiment with different layouts," and even experience architectural features firsthand. According to Brenner [21], this interactivity offers a distinctive and captivating experience, enabling buyers to personalise the property based on their preferences and evaluate its suitability for their requirements.

3.3.2 Benefits

Incorporating VR technology into real estate marketing offers a myriad of advantages and potential benefits. The primary advantage of using virtual reality for any real estate agent is that it enables them to easily visualise and comprehend a project, even before the construction takes place, as highlighted by Ganapathy and Apoorva [22].

One of the primary benefits of utilising VR in real estate marketing is the enhanced customer engagement it provides. VR technology captivates potential buyers by offering an immersive and interactive property viewing experience. Through VR, buyers can virtually explore properties, navigate through rooms, and even visualize architectural details, fostering a stronger emotional connection and increasing their level of engagement with the property. This heightened engagement

often translates into deeper interest and commitment from buyers, ultimately leading to more successful property transactions. According to Low *et al.*, [8], clear messages provided through virtual reality can assist in reducing, and possibly even eliminating, the regret experienced by real estate consumers concerning their decisions to rent or purchase properties.

Furthermore, VR technology brings increased accessibility, particularly for remote buyers. Malaysia is a country with diverse geographic locations, and VR can bridge the gap between buyers and properties across different regions. Ganapathy and Apoorva [22] highlighted that through the use of virtual reality, prospective buyers can experience a location without physically travelling to the property, and they can virtually tour the space with the assistance of realtors. Potential buyers can remotely access and explore properties from the comfort of their homes or offices, eliminating the need for extensive travel. This accessibility expands the market reach for real estate professionals, enabling them to attract a wider audience and generate interest from buyers who may have otherwise been limited by geographical constraints. Another advantage of employing VR in real estate is the reduction of costs and the increase in efficiency, as emphasised by Miljkovic *et al.*, [23].

Improved property visualisation is another key benefit of incorporating VR technology in real estate marketing. Traditional marketing methods, such as photographs or videos, may not effectively convey the spatial characteristics and ambience of a property. Marketers leverage Augmented Reality (AR) to create interactive property models that effectively showcase construction or remodelling plans in a way that blueprints and photos cannot achieve, as mentioned by Ganapathy and Apoorva [22] are taken from previous study. VR technology, on the other hand, provides a realistic and immersive representation that allows buyers to experience the property as if they were physically present. By virtually walking through rooms, examining details, and assessing the overall layout, buyers gain a comprehensive understanding of the property's features and can make more informed decisions. According to the report by Ganapathy [22], 52% of renters and 51% of homebuyers expressed regret regarding their purchase decisions.

According to Sultan [20], a significant number of additional smart features make it easy to enhance the buyer experience, such as mortgage calculators, adequate information provision leading to post-decision regrets, detailed descriptions of neighbourhoods and landmarks, and information about similar properties. Enhanced customer engagement, increased accessibility for remote buyers, improved property visualisation, and the ability to showcase properties realistically and immersively are some of the advantages VR brings to the industry. Embracing VR technology enables real estate professionals to deliver a unique and compelling property viewing experience that surpasses traditional methods, ultimately leading to increased buyer interest, faster sales cycles, and greater customer satisfaction.

3.3.3 Case studies

In the realm of real estate marketing, VR has emerged as a powerful tool that revolutionises the way properties are showcased and marketed. This section delves into real-world examples and case studies from Malaysia, illustrating successful implementations of virtual reality technology in real estate marketing campaigns. By examining these case studies, we can gain insights into the strategies employed and the remarkable outcomes achieved.

One notable case study showcases a leading property development company that incorporated VR technology into its marketing efforts. By leveraging immersive virtual property tours, potential buyers were able to experience a realistic and interactive walkthrough of properties without physically visiting them. This could help to increase sales and reduce marketing costs while also providing a more convenient and enjoyable experience for potential buyers and renters as reported by Butt [24]. The company employed high-quality VR headsets, accompanied by user-friendly interfaces and intuitive navigation controls. The captivating virtual experiences allowed buyers to

explore the properties at their own pace, fostering a sense of presence and generating excitement. (Miljkovic *et al.*, [23]: *Case Study 1*)

Another compelling case study focuses on a boutique real estate agency that adopted virtual staging techniques through VR. By utilising specialised software, the agency transformed vacant properties into visually appealing and fully furnished spaces, virtually. This enabled potential buyers to envision the property's potential and explore various design possibilities, enhancing their engagement and emotional connection to the space. The virtual staging approach proved to be cost-effective and flexible, allowing for quick modifications and customization to meet the preferences of diverse buyers. (Pinhão [13]: *Case Study 2*)

Furthermore, a renowned property developer embraced interactive property visualisation as a core aspect of their marketing strategy. Through VR technology, potential buyers could actively engage with the virtual environment, modifying interior elements, experimenting with different layouts, and experiencing architectural features firsthand. This interactive approach empowered buyers to personalise their property exploration and make more informed decisions, leading to increased satisfaction and a stronger connection with the properties being marketed. Six hypotheses are proposed that have their basis in the Technology Acceptance Model (TAM) and the Digital Marketing Technology Acceptance Model (MTAM). A comprehensive questionnaire survey is developed with at least one question each targeting the six hypotheses, to validate or reject these hypotheses. Data were collected from 279 respondents based in Malaysia who are working in the marketing and IT sectors of local property development companies. (Low *et al.*, [8]: *Case Study 3*)

In these case studies, the adoption of virtual reality technology in real estate marketing campaigns yielded impressive results. Enhanced customer engagement, increased buyer interest, and improved property visualisation were among the key benefits observed. The incorporation of VR technology provided a competitive edge, setting the real estate listings apart from traditional marketing approaches. The total from the analysis shows 90% of respondents strongly agree that interactive virtual reality walkthrough applications are effective for real estate purchase decisions as stated by Kamil *et al.*, [9]. The success stories from Malaysia highlight the immense potential of virtual reality in transforming the real estate industry and shaping the future of property marketing. (Kamil *et al.*, [9]: *Case Study Results*)

To conclude, these case studies exemplify the efficacy of virtual reality in real estate marketing, shedding light on the strategies employed and the outcomes achieved in the Malaysian context. The assimilation of VR technology has opened new avenues for captivating potential buyers, enabling them to explore properties in immersive and interactive ways. By leveraging the lessons learned from these success stories, real estate professionals in Malaysia can devise effective VR-driven marketing strategies to harness the full potential of this transformative technology.

3.4 Consumer Perception

3.4.1 Consumer Attitudes

Understanding how potential buyers perceive and respond to virtual reality-based property viewing experiences is crucial for real estate professionals. Pizzi *et al.*, [25] are taken from previous studies that delve into this subtopic, examining the attitudes, preferences, satisfaction levels, and perceived value that potential buyers associate with virtual reality in real estate marketing. Xiong *et al.*, [26] put forth a similar suggestion, stating that employing VR technology as a marketing tool could lead to the creation of memorable shopping experiences and enhance consumer satisfaction. By investigating their perceptions, real estate professionals can gain insights into the effectiveness of virtual reality as a marketing tool and tailor their strategies accordingly. In the context of Malaysia, Azmi *et al.*, [6] highlight the significance of considering the cultural nuances and specific preferences of the local market. These factors may have an impact on consumer attitudes towards virtual reality

technology in the region. Pinhão [13] mentioned that the user or customer experience has become a highly relevant topic in recent years. Companies, including real estate agencies, are now not only focused on financial results but also prioritise the joy and experience of the customer throughout the buying process. This customer-centric approach is seen as a competitive advantage in the market.

3.4.2 Factors influencing consumer adoption

Consumer adoption of virtual reality technology in real estate marketing is influenced by various factors. This subtopic examines the key determinants that impact consumer adoption, such as perceived usefulness, ease of use, trustworthiness, and perceived risks. In their research, Azmi *et al.*, [6] utilised VR to assess the performance of individuals with personal disabilities on simulated physical tasks in a virtual built environment. This included activities such as manoeuvring around the house in a wheelchair. Understanding these factors can help real estate professionals identify the barriers to adoption and develop strategies to address them. Factors specific to the Malaysian context, such as cultural perceptions, technological infrastructure, and affordability, may also influence consumer adoption of virtual reality in real estate marketing. According to Pinhão [13], using virtual reality in real estate can lead to increased positive reactions from potential home buyers. By experiencing the virtual environment, buyers can envision themselves living in the house and interact in a way that goes beyond their usual experiences. This immersive approach enhances their engagement and interest in the property. Another advantage that can be a strategy in real estate marketing is communication. Intercultural communicative competence (ICC) is the ability to interact and communicate appropriately with people from different cultures. DeWitt *et al.*, [27] conducted a study suggesting that VR has the capability to engage students in both the cognitive and affective domains of learning.

3.5 Barriers and Challenges

3.5.1 Technological constraints and limitations

Implementing virtual reality in real estate marketing is accompanied by several technological challenges. According to Wang *et al.*, [28], traditional real estate companies face a considerable challenge in their marketing efforts due to the use of a single sales channel and outdated marketing strategies. This subtopic explores the constraints and limitations associated with virtual reality technology, including hardware requirements, software development complexities, and content creation. According to Low *et al.*, [8], the property industry has been slow in adopting digitalisation, and it might take some time before this trend becomes widely popular in the sector. They also reported that the property industry faces several socio-legal challenges in property financing and marketing. Additionally, climate change poses a threat to property development. Imbalanced and slumping sales, as well as ever-increasing property prices and concerns about affordability and sustainability, are other major challenges in the real estate sector. Also, technical challenges can include hardware compatibility issues and software bugs. Butt [24] proposes that the solution to these challenges is to collaborate with experienced technology partners to develop custom VR solutions that are tailored to meet the specific needs of the real estate industry. Understanding these challenges is essential for real estate professionals to effectively navigate the technological landscape and make informed decisions regarding the adoption and implementation of virtual reality solutions. Considering the technological infrastructure and resources available in Malaysia is crucial, as it may impact the feasibility and practicality of implementing virtual reality in the local real estate market.

3.5.2 Cost considerations and return on investment

Virtual reality technology has financial implications for real estate professionals. This subtopic delves into the cost considerations associated with adopting virtual reality in real estate marketing, including the expenses related to equipment acquisition, software development, training, and ongoing maintenance. As per Musa [29], one of the primary costs related to property sales is advertising and marketing. Butt [24] pointed out that implementing VR can be costly, which might act as a barrier to entry for some real estate companies. However, according to the study conducted by Kamil [9], using data in VR applications requires fewer costs, reduced time, and little effort compared to traditional marketing methods. It also examines the potential return on investment and the long-term benefits that virtual reality can offer in terms of increased customer engagement, improved property visualisation, and competitive advantage.

According to the study conducted by Xiong *et al.*, [26], VR tours are found to reduce the marketing time of a property by 6.4% and narrow the bid-ask spread by 2%, all else being constant (*ceteris paribus*). Considering the financial landscape of the Malaysian real estate market is important, as it provides insights into the affordability and cost-effectiveness of implementing virtual reality solutions. The market analysis conducted by Miljkovic *et al.*, [23] revealed that the use of VR technology in the real estate industry leads to increased property engagement and interest. Moreover, VR assists in reducing the number of physical property viewings required, resulting in time and cost savings for both buyers and sellers.

3.5.3 User adoption and resistance

According to Pinhão [13], the real estate industry is a complex web where various parties, including investors, banks, households, and developers, are interconnected. User adoption plays a significant role in the success of virtual reality in real estate marketing. This subtopic addresses the factors that may hinder widespread adoption, such as user resistance, a lack of awareness, and the perceived complexity of virtual reality technology. According to Ong *et al.*, [30], most real estate agencies are still hesitant to invest in the utilisation of internet technology.

This is because most agencies believe that further investment is necessary for things such as courses and training due to the level of awareness of the need to integrate the latest technology in this industry. Understanding and addressing these barriers is crucial for real estate professionals to encourage user acceptance and facilitate the integration of virtual reality experiences into their marketing strategies. Considering the user demographics, preferences, and cultural factors specific to Malaysia is essential, as they may influence user adoption and resistance patterns in the local real estate market.

3.6 Summary

The summary of previous research on the adoption of virtual reality technology in real estate marketing is shown in table 2.

Table 2
 Summary of Review

No.	Reference	Component	Main Findings	Variable
Challenge and strategy				
1	Petrillo <i>et al.</i> , [1]	To identify the challenges of implementing VR technology in real estate marketing in Malaysia	Fourth industrial revolution: current practices, challenges, and opportunities	To offer recommendations for addressing these challenges.
2	Mohamad Kamil <i>et al.</i> , [9]	To investigate additional measures a real estate agent can undertake in readiness for the demanding new market	Development of virtual reality technology: home tours for real estate purchase decision-making.	The result of a virtual tour in customer decision-making
3	Martens <i>et al.</i> , [11]	To identify how VR and people can get along to create strategy	It feels real: physiological responses to a stressful virtual reality environment and its impact on working memory	Can gain more strategy for the benefit of understanding the VR
4	Shaharruddin and Musa [16]	To identify the effectiveness and current strategy	A Future Malaysian Banking Landscape Embracing IR4.0: A New Leadership Model	Knowledge about the strategy has been gained.
5	Mandal [18]	To investigate the challenge faced in doing real estate	Brief introduction of virtual reality and its challenges	Study the challenge and make it into an advantage or avoid it in the future.
6	Chuyi Xiong <i>et al.</i> , [26]	To identify the role that virtual reality can play in research strategy	The effect of virtual reality on the marketing of residential property, housing studies.	Add information, note which tactics require improvement, and make a list of what needs to be improved.
7	DeWitt [27]	To investigate the error or lack and improve or develop the strategy to make it suitable	Virtual reality for developing intercultural communication competence in Mandarin as a foreign language.	Research knowledge gaps and demonstrate how using VR can benefit real estate
8	Musa [29]	To identify the strategy that virtual reality can do	'Imaging Amman through Real-Estate Advertising Discourse'	Research knowledge gaps and demonstrate how using VR can benefit real estate
Add understanding information about VR and Real Estate				
9	Ibrahim <i>et al.</i> , [3].	To investigate the implementation of VR in real estate marketing	The influence of augmented reality on purchase intention in the housing industry. Human behaviour and emerging technologies	The % (numbers)
10	Azmi [6]	To investigate the implementation of VR in real estate marketing	Smarter real estate marketing uses virtual reality to influence potential homebuyers' emotions and purchase intentions	The % (numbers)
11	Loureiro <i>et al.</i> , [7]	To investigate the adoption of VR	Understanding the uses of virtual reality in	Gain a deeper understanding of VR

			marketing: A text mining-based review	and how it relates to real estate.
12	Sheen <i>et al.</i> , [8]	To find the uses of technology for sustainable property	Smart digital marketing capabilities for sustainable property development	Explanation, summary
13	Ibrahim <i>et al.</i> , [3]	To learn more about the need for VR in real estate	Attributes of virtual reality attractiveness in influencing prospective home buyers' purchase intention	To make the advantages of the strategy
14	Melo Ambrósio Silva Pinhão [13]	To investigate the implementation of VR in real estate marketing	Department of Marketing, Operations, and General Management how the implementation of virtual reality technologies will influence the real estate market how the implementation of virtual reality technologies will influence the real estate market	The % (numbers), Explanation, summary
15	Sultan [20]	How virtual tours can help the real estate sector	5 important benefits of virtual tours in real Estate WordPress website	List the specific advantages of using virtual reality in the real estate industry.
16	Brenner [21]	To learn more about how virtual reality is staged and what it is capable of	Virtual reality: the game changer for residential real estate staging through increased presence	Describe the phase
17	Ganapathy [22]	Understanding the procedure for purchasers of real estate	Speech emotion recognition using deep learning techniques	Describe each stage and the buying process in detail
18	Butt [24]	To find the return on investment from using virtual reality in the real estate industry	Real estate investments and the future of virtual reality: opportunities and challenges	The data analysis about ROI, which has advantages and disadvantages
19	Ong and Azir [30]	To investigate the effectiveness of virtual reality technology in providing a realistic and immersive property viewing experience for potential buyers in the real estate industry.	Low-cost autonomous robot cleaner using a mapping algorithm based on the internet of things	The % (numbers), Explanation, summary
Advantages and Disadvantages				
20	Sherman and Craig [17]	To research the issue in order to improve it	<i>Understanding virtual reality interface application and design</i>	Knowledge about the strategy has been gained. Explanation, summary
21	Halim <i>et al.</i> , [10]	To research the issue in order to improve it	Summoning method using freehand interaction for occluded	Understanding the challenges that real estate may face in the

			object selection in handheld augmented reality	past, present, and future
Buyer Attitude				
22	Juan <i>et al.</i> , [12]	To investigate the effectiveness of virtual reality technology in providing a realistic and immersive property viewing experience for potential buyers in the real estate industry.	Developing and evaluating a virtual reality-based navigation system for pre-sale housing sales	A detailed analysis of the potential benefits and limitations of using virtual reality
23	Ji <i>et al.</i> , [14]	To identify the factors that affect the adoption of virtual reality technology in the real estate industry.	Public's intention and influencing factors of dockless bike-sharing in central urban areas: A case study of Lanzhou city, China	Comprehensive understanding of the factors that influence the adoption of virtual reality technology in real estate marketing.
24	Anna Nacher [15]	To investigate the participation of VR, people, and real estate	Reframing the participatory edge of virtual reality	The analysis and explanation improve efficiency, cost savings, and buying experiences
25	Miljkovic [23]	VR technology allows buyers to experience properties as if they were physically present	Real estate app development based on AI/VR technologies	The analysis and explanation improve efficiency, cost savings, and buying experiences.
26	Pizzi <i>et al.</i> , [25]	To investigate the customer attitude before, during, and after the negotiation process in real estate using virtual reality	Virtual reality, real reactions, and comparing consumers' perceptions and shopping orientation across physical and virtual-reality retail stores	Data on customer behaviour based on a study has been done.
27	Wang [28]	To learn more about buyers and their attitudes	Research on precision marketing strategies of real estate companies based on big data	Acknowledging that not all situations and people have the same attitude. Explanation, summary
Covid-19 Effect				
28	Alnagrat <i>et al.</i> , [2]	To research and prepare for the Covid-19 pandemic's negative effects on the real estate industry	The importance of extended reality (XR) technologies in education during the COVID-19 pandemic: implications and challenges	To create a plan, summary and idea
29	Brodeur <i>et al.</i> , [19]	To investigate the past, current, and future challenges and the preparation	A literature review of the economics of COVID-19. Working paper, IZA Institute of Labor Economics.	Written information about a past event and what research can do to improve and benefit from
30	Sulaiman <i>et al.</i> , [5]	To develop strategies for overcoming the challenges associated	A virtual tour as a new marketing approach in the real estate business	A set of strategies for overcoming the challenges associated

with the adoption of virtual reality technology for property viewing experiences in the real estate industry in Malaysia.	during the pandemic covid-19. Proceedings of the International Conference on Innovation in Media and Visual Design (IMDES 2020)	with the adoption of virtual reality technology for property viewing experiences in the real estate industry
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4. Conclusions

Reviews on the adoption of VR technology from the perspective of real estate marketing to enhance the marketing of properties have been conducted. This is done from various angles, considering the implementation between the developed countries and the context of Malaysia. It can be concluded that the use of VR technology in real estate marketing could substantially provide competitive advantages by allowing potential buyers to explore properties at their convenience and making the buying process more efficient. However, the readiness to optimise VR technology is hindered due to a lack of awareness and perception of its complexity. Therefore, significant investment should be considered by real estate practitioners to provide training for the comprehensive integration of VR technology within the industry. Looking forward, future research lies in extensive explorations of the long-term impact of VR technology on buyers' behaviour, preferences, and decision-making in real estate markets with the aim of enhancing overall purchasing experiences. This will indirectly contribute to shaping an effective marketing approach for the real estate market, thereby facilitating the expansion of the industry.

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