

A Framework for Using Advanced Visualization Tools for Residential Property Management

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Abstract –

Traditional real estate business models are not able to attract young generation customers since they are used to acquire required information from digital apps and devices. This paper aims to develop a framework for application of advanced visualization technology in residential property marketing to offer a detailed 3D information model to customers through the real estate websites. The paper presents the result of a survey examining the experience of customers who were used one of the five selected real estate on-line platforms in Australia. The survey targets a sample of 120 participants, who are selected at the University of New South Wales covering different genders and nationalities. Based on the result of the survey, the framework is verified and shows how 3D scanners can be useful for on-line property management. The results would be useful for property managers to communicate with customers by providing visualized information, and customers can easily examine whether the property meets their requirement without any physical inspection. The application of visualization technologies to residential property marketing will provide customers with more reliable and credible property information by 3D modeling and pictures, which is beneficial to property owners, customers and other stakeholders as well as real estate agents.

Keywords –

Advanced Visualization Technologies, 3D Models, 3D Scanners, Real Estate On-line platform, Residential properties

1 Introduction

Traditionally, the methods of real estate marketing are simple and direct - property owners sold or leased their properties by asking people around them, or

advertised their properties on newspaper and TV. Later, real estate agencies are popularized to meet the needs of the constantly expanding and developing real estate market. Real estate agencies help properties owners or developers to do the promotion and advertisement for their properties, as well as provide buyers or renters with a large amount of housing information and other relevant services. With the development of Information Technology, Internet offers a more convenient and effective approach to real estate marketing by E-Commerce. According to Matthew Hinton and Yan Tao, currently agents are the important focus point in e-commerce applications in real estate industry. and real estate websites, as a real estate marketing tool, are widely used in residential property market in Australia [1].

The emergence of the real estate websites allows users in different places to browse the information of properties in different areas on the websites, which greatly expands the scope of real estate marketing. However, one of the key issues in current real estate websites is that the housing information provided by these websites is not detailed enough for customers who cannot take part in the property inspection.

The adaptation of the new technology is viewed as an opportunity to attract new buyers and reduce marketing and customer acquisition costs [2].

With this in mind, this paper analyses and compares most popular real estate websites in Australia, identifies their important options by customers' interview. In addition, there is some suggestion to apply visualization technologies, especially 3D Modeling Technologies and Indoor Scanning Technologies, to these real estate websites to improve their online property marketing. In this part, this paper focuses on 3D Modeling Software, as well as 3D Scanners. It compares the effect of the products produced by different 3D Modeling Software on the building modeling aspect. In addition, it describes characteristics of different 3D Scanners in the current market, and gives real estate websites suggestion

to improve their work by these new technologies. The next section states the background of real estate marketing and 3D visualization technologies.

2 Literature review

2.1 Real estate marketing and E-commerce

Anja Rassmann stated that the real estate marketing owns its special characteristics which come from real estate's features [3]. Real estates, as a kind of capital intensive goods, need long term building and marketing processes. Besides, Bettina Knirsch added that properties are also the most long-lived economic products and hard to change. And the basis of real estate marketing involves different people's needs & wishes, the properties and customer's benefits & Satisfaction. Thus, marketing should analyse, shape and form the properties market to make the products attractive. In addition, Knirsch listed marketing measures in Practice, including Advertisements (in printed media), Relationship Advertising or Networking, Internet, Direct Mail, Public Relations and so on. However, due to the limitation of Internet development at that time, this paper did not talk much about Internet real estate marketing [4].

With the E-Commerce popularizing, the Internet is quickly becoming the first place for buyers and sellers to find the transaction information. The study in 2000 showed that the information, about properties themselves and their surrounding environment, offered by the websites is steadily going up because of the advancements in technologies [5]. The properties' information provided by the websites at that time is simple and not comprehensive.

As e-commerce developed, companies thought that the intermediaries could be cut out, because they could do business directly to customers by computers. However, later companies found that it is not easy for them to do everything by themselves – Middleman is still needed. According to Anderson, P. and Anderson, E (2002), the role of intermediaries has been changed due to the development of e-commerce. Traditionally, in scale economies, intermediaries aim to meet the same needs for Sellers A to D and the same needs for buyers 1 to 4. On scope economies aspects, intermediaries focus on variations across buyers and sellers with similar needs[6].

However, when co-opting with the Web, intermediaries could add value for the products by creating opportunities and changing the importance of nine generic functions of intermediaries. Thus, this article revealed the importance of intermediaries creating value with the help of the web. But it did not mention relevant aspects about real estate and

visualization technologies [6].

In order to find the key source of competitive benefits from E=Commerce applications in Chinese, Matthew Hinton, C. and Tao, Y. did an investigation about 5 Chinese real estate companies. The findings offered evidence of how real estate companies acquired competitive benefits from applications of e-business. However, compared with my research, this paper did not provide technologies aspects research [1]

2.2 Visualization technology

The visualization technologies can cover the whole process in AEC (Architecture, Engineering and Construction), from the initial concepts to the final steps [7]. It has mentions 3D models of design stages during the construction and other steps. But there is not much about the 3D visualization applying to residential property marketing. And one other paper focused on integrating 3D laser scanning and BIM Technology to assist in faster and better real estate services. It analysed the potential of BIM by 3D laser scanning to produce as-is building information and mentioned that there would be more advantages within the real-estate sector in the future [8].

Ku et al explained the problems in the collaboration on 3D Model and analyzing 3 case studies to find that collaboration approaches on 3D Model is different from the architects' approaches on geometry control [9].

In addition, based on increasingly applications of 3D geometric information modelling technologies, the article considered to use the visualization technologies as a tool on urban components, urban planning purposes, as well as real estate aspects. This study researched the possibility to use the 3D modeling technology for simulating the inaccessible places in geopolitically conflict zones, which cannot be accessed because of restrictions of law or physical factors [10].

3D scanners are the important tools in the research. Several types of 3D scanners have been compared by using a scanning specimen for their accuracy. They found that the scanners which use white lite are more accurate than the other types of 3D scanners [11].

The recent trends of scanners are turning 3D scanners into Mobile Phones. An effort was made to increase the accuracy of the interactive systems when turning it into mobile phone devices, and developed an more effective and efficient scheme to integrate multiple stereo-based depth hypotheses into a more real 3D model at the technical level [12].

As a new technique for quickly getting three-dimensional information, 3D laser scanning technology has been widely used in many fields such as acquiring landslide data and to compute earthwork volume, to obtain precise measurements from experimental lithic reduction sets, to present a methodology to combine the

technology of the terrestrial laser scanner with the techniques of digital image processing to study damage on stony materials that constitute historical buildings. In addition to preserve and document osteological material in museums, develop research ideas in the subfields of biological anthropology, and increase the potential for scholarly collaboration [13].

The above literature reviews just cover few research factors in this research. Some of them are related to real estate marketing, E-Commerce and real estate websites, whereas the aspects of modern technologies were missed, such as 3D visualization, 3D scanners and 3D modeling technologies. Some other studies focused on technology development, but they did not mention the applications on residential property marketing. This paper addresses the gap in the knowledge how a modern technology can be widely used in the property management business. This is critical to property managers to find out how they can facilitate the implementation of modern technologies in their business to be survive in the future market.

3 Research methodology

This study will be conducted in three main phases as follows:

- Phase 1: analyze five real estate websites in Australia, including realestate.com.au, domain.com.au, realestateview.com.au, homely.com.au and allhomes.com.au;
- Phase 2: Identify influential figures of the web sites according to customers' previous experience;
- Phase 3: Implementation of modern technologies.

Firstly, this research analyzes and compares the current five selected real estate websites in Australia. It mainly focused on the residential proprieties information provided by each website, such as the property photos, property description, floor plan, surrounding environments, infrastructures, comparable sales and so on. This analysis is helpful to explain why there are major differences among these real estate websites in Australia in terms of functionality and online visitors. Next it identifies the existing information and attractive services provided by current real estate websites in Australia to find the parts that should be improved using modern technologies.

Secondly, this study used questionnaire to do customers interview about using real estate websites to rent or buy residential properties in Australia. The questionnaire analysing the real estate websites in Australia, included questions about real estate websites selections, users' satisfaction, the sufficiency vividness and reliability of properties information offered by these websites and users' attitude to real estate websites. This

questionnaire can identify customers' important options about the existing real estate websites

Finally, based on studies aforesaid, this research gives suggestion to real estate websites in Australia about implementation of visualization technologies, especially 3D modeling technologies and 3D indoor scanning technologies, on their websites. On the one hand, it compares several 3D modeling software in current market and the 3D models created by this software. On the other hand, this research focuses on 3D scanners which are suitable for indoor scanning. The purpose of analysing these new technologies is to collect characteristics of existing 3D visualization technologies, so that it helps to provide feasible suggestion to applying these new technologies to online real estate marketing on these real estate websites in Australia.

3.1 Initial results

The real estate websites in Australia developed quickly in recent several years and increasingly become the major method to find the information of residential properties for sale or for lease in Australia so that they are the existing and popular real estate digital marketing. Real estate website is making the process of searching housing information easier and cheaper. It allows buyers to search the properties within the designated areas by properties location or zip code and narrow the searching results by adding features, key words and price range. These websites also provide basic information about housing transaction process, loan qualification, communities (tax rates, crime rates school test scores, etc.), links to other services providers' websites and some tools such as home loan calculator. These services offered by real estate websites are free. Usually, the real estate websites earn income by providing links to other websites, as well as selling advertisements [14].

The initial review of the home page of every real estate websites could largely determine users' first impression to the website - professional or unprofessional, reliable or unreliable, easy to use or hard to use. However, compared to other websites, realestate.com.au and domain.com.au have presented more options on search category on their home page, which can help users narrow the search results at the first steps. For instance, realestate.com.au offers 'retire' options in the search category on its home page which specializes in retirement villages, retirement homes & lifestyle communities. While for other four websites, users who want to find a residential property for retirement life would spend more time to find their ideal property.

In addition, the detailed information of residential properties on real estate websites is also important. All websites present basic property information, such as

address, images, maps, email and mobile phone number to connect the agency, property description, as well as the Inspection and Auction time (if there is an auction). Comparing with Domain, Realestate not only has more detailed property information, but also made the page of specific property information more convenient for users. For example, there are suburb profiles on real-estate specific property information page. Users can directly

look through suburb profiles on the specific property page. However, on domain.com.au, if users want to refer to suburb profiles when they look through specific property information page, they have to return the Home Page to find the suburb and search for the suburb profiles. Thus, property information on realestate page is more efficient (See Table 1).

Table 1. Comparisons of Search Engines on Five Real Estate Websites [Authors]

Websites	Service Category	Search Property Type	Search Refinements	Search Result Presenting
realestate.com.au	<ul style="list-style-type: none"> Buy, Rent Agent Sold Share; New Homes News; Invest; Retire; Home idea 	<ul style="list-style-type: none"> House Apartment/Unit Townhouse Rural Land Villa Acreage Block of Units Retirement living 	<ul style="list-style-type: none"> Price(range) Bedrooms Bathrooms Parking Features (indoor and outdoor: pools, air conditioning) Land size New or established Eco Friendly Keywords 	<ul style="list-style-type: none"> List/Map/Inspection & Auctions Sort by: recommended; Price(Low-High); Date; Suburb(A-Z)
domain.com.au	<ul style="list-style-type: none"> Buy; Rent Agent Sold Share; New Homes News; Advice and Article (Buying, investment, Design) Auction Result; Home loans Home Price Guide; Suburb Profiles Research & Data (linked to Price finder) 	<ul style="list-style-type: none"> House Apartment Rural New Apartment Land New house & Land 	<ul style="list-style-type: none"> Price(range) Bedrooms Bathrooms Parking Features (pets, pools, air conditioning) Land size Keywords 	<ul style="list-style-type: none"> Sort by: recommended; Price(Low-High); Date; Suburb(A-Z); Earliest inspection
realestateview.com.au	<ul style="list-style-type: none"> Buy, Rent Agent Sold News Article (Top tips to prepare you for Auction Day) HolidayVIEW 	<ul style="list-style-type: none"> House Unit Apartment Studio Townhouse Land Villa 	<ul style="list-style-type: none"> Price(range) Bedrooms Bathrooms Parking Keywords (floorboards, pools, garage) 	<ul style="list-style-type: none"> List/Map Sort by: Price/recommended Date; Suburb(A-Z); Bedrooms; Upcoming Auctions and Inspections
homely.com.au	<ul style="list-style-type: none"> Buy, Rent Agent Suburb Reviews 	<ul style="list-style-type: none"> House Apartment/Unit Townhouse Villa Land Acreage Rural Block of units 	<ul style="list-style-type: none"> Price(range) Bedrooms Bathrooms Parking Features (Indoor, outdoor and Eco features) Land size Frontage(range) 	<ul style="list-style-type: none"> List and Map together Sort by: Price(Low-High); Date;
allhomes.com.au	<ul style="list-style-type: none"> Buy, Rent Share; New Homes 	<ul style="list-style-type: none"> House/Land Investment Property Studio/Unit/Duplex Rural Retirement living 	<ul style="list-style-type: none"> Price(range) Bedrooms and Bathrooms Parking Block Size Dwelling Size Listing Age 	<ul style="list-style-type: none"> List/Map Price/recommended Suburb(A-Z); Date/Upcoming Auctions and Inspections

3.2 Results of questionnaire

The questionnaire with the topic “A framework for using advanced visualization tools for residential property management” was developed in three parts. The survey targets a sample of 200 participants, who are selected at the University of New South Wales covering different genders with different nationality. Table 2 shows the familiarity level of the five Australian websites.

Table 2 Familiarity level of the five Australian websites between participants [Authors]

Australian real estate website	Participants Familiarity
www.alhomes.com.au	4%
www.domain.com.au	21%
www.homely.com.au	4%
www.realestateview.com.au	5%
www.realestate.com.au	66%

In the first part participants have been asked to select one of the five Australian real estates the second part of survey was about participants' background that would be useful for further researches. Finally, the participants were asked to answer the third part that was the main part of the survey. This part was in eight different

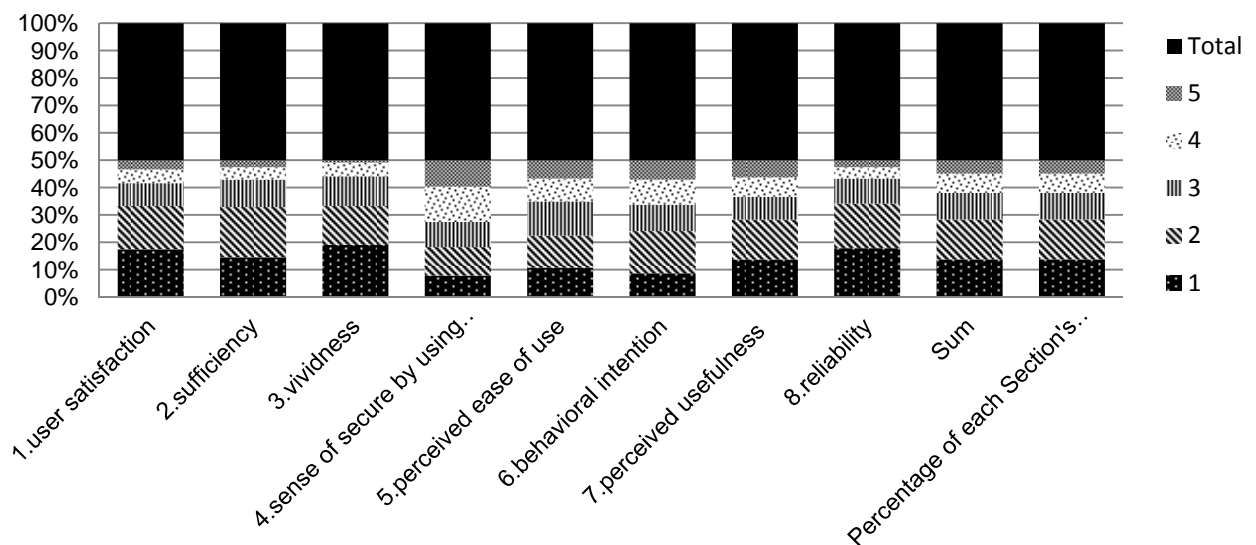
sections such as 1. user satisfaction, 2. sufficiency, 3. vividness, 4. sense of security by using the website, 5. perceived ease of use, 6. behavioral intention, 7. perceived usefulness and 8. reliability of properties information offered by these websites. There were five scales for participant to choose (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

A total of 120 participants contributed to the study, therefore the research is ongoing. The results show 37% of participants were male, 63% were female. Regarding to participants' age groups 12% were under 18 years old, 66% were 19-30 years old, 9% were 31-40 years old, 7% were 41-50 years old, 7% were 51-60 years old. At this stage, the data analysis showed that the percentage of each scale answered by 120 participants: 13% strongly Disagree, 24% Disagree, 34% Neutral, 14% Agree and 10% Strongly Agree. Appendix I shows a part of questionnaire as a sample. As the participants were in different level of education, also were doing in different field of study or career, therefore in each section we have developed subset of questions to clear the aim of questionnaire.

Figure 1 shows the data analysis of answering each section of the questionnaire. It proved that 57% of participants did not agree or strongly disagree particularly with the sections about virtual realistic and 3D visualization.

The data analysis showed there is a considerable gap in virtual realistic especially in detailed 3D information model to participants through the real estate websites.

Figure 1. The Analysis of answering each section of the questionnaire [Authors]



4 Discussions

The finding of this paper is different than previous studies which mainly focuses on technology development. This study is the first step forward to investigate how modern technologies can be used and managed in the property business. Currently, there are two main aspects of residential property marketing, namely, forward delivery housing and existing properties. The increasing number of transaction of forward delivery housing in Australia make both developers and agencies try to find more effective marketing methods to present housing before the construction process is completed. Practically, 3D modeling pictures and 3D Modeling videos of forward delivery housing have been widely used by property development companies, but the real estate websites, such as realestate.com.au, domain.com.au, realestateview.com.au and so on, have not provided this kind of services for users, which greatly restricted the residential property online marketing.

On the other hand, the transaction of existing homes in Australia still occupies the important position in residential property market. Because of the long distance, it is very inconvenient for people, who want to buy or rent a property far away from their location, to attend the property inspection. Under this circumstance, a convenient and low cost approach to inspect the objective residential property is essential. This research suggests two types of 3D scanners to real estate websites to scan indoor details of existing properties, and present 3D model of the objective property on the real estate website as real as possible.

The first one, named Scanner A, is a hand-held scanner that could be attached on an iPad. It can create 3D maps of interior spaces and measure entire rooms all at once. This hand-held scanner is able to capture dense 3D models with the push of a button and create new mixed reality experience that does not happen in the reality.

Another scanner, called Scanner B, is heavier and more complicated. Users should carry it to the scanned area to collect spatial data. However, this tool can scan target rooms in a way to be converted to Virtual Reality and created 3D models accessible to customers. Customers can straightly see the model via the web. What is more, the scanner 'enables anyone to digitally reconstruct real-world spaces for use in VR, AR, web, and mobile applications with ease' and 'offer clients immersive experiences that give viewers a realistic sense of actually being there'.

5 Conclusion

This paper is a result of an ongoing study to evaluate five popular real estate websites in Australia from customers point of view. The investigation also identifies key web figures by conducting a survey in Australia. The application of digital technologies, especially 3D modeling technologies and indoor scanning technologies were also investigated in terms of functionality and compatibility with the real estate websites to improve their online property marketing. This study also shows that how customers could receive rich information from various aspects of a property by online visiting as well as real physical inspection. The application of visualization technologies to residential property marketing will provide customers with more reliable and credible property information by 3D modeling and images, which is beneficial to property owners, customers and other stakeholders as well as real estate agents. The next step of this study is to further develop the application of modern technologies in this business and recruit more participants to the modified questionnaire.

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Appendix 1: An extract of the questionnaire completed by a participant

Section 2 - Sufficiency	1	2	3	4	5
7. This website offers enough real estate options and information that I need.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8. I found a satisfactory amount of information that I needed on this website.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. This website provides sufficient information that I need.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. The housing information that this real estate website provided is sufficient for me to make decision.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11. The specific property information on the property page is sufficient for me to make decision.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Section 3 - Vividness	1	2	3	4	5
12. The procedure instructional content on this real estate website is animated.	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. The procedure instructional content on this website is lively.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. This website provides sufficient information that I need.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>