

## DEVELOPING A REAL ESTATE SALES APP FOR MOBILE DEVICES

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*ABSTRACT.* Enabling users to find locations and search for information, mobile information services have become a prevalent tool in daily life. This study developed a real estate sales app by using the Unity software to incorporate all the necessary information required by home buyers. Through this app, home buyers can expediently search for information on housing construction projects to ensure that the home meets their specifications. After viewing a presale model home, these buyers can further research housing construction information, ask questions about it, or request interior design services. Therefore, the app users are more likely to purchase the ideal home and avoid mistakes caused by a lack of information. Through this app, real estate agencies can also save time on marketing housing construction projects, boost sales growth, and minimize required human resources.

**Keywords:** Building information modelling, Mobile device, Smartphone, Real estate sales system, 3D perspective image

### 1. Introduction.

1.1. **Background.** Currently, mobile information services enable users to access digital information through various mobile platforms. To most people, these services are indispensable in daily life. Advances in technology have changed the method and speed of transmitting information. Smartphones and tablets have become increasingly light, thin, and large in screen size. Current smartphones can be easily used to perform work that could only be completed on computers in the past. Suki has revealed that social needs and social influences significantly affect people's dependence on smart phones [1]. Zhou et al. indicated that smart phones have been developing rapidly over the past decade, and more and more people love to use its mobile application to process the day-to-day affairs [2]. The construction industry has played a critical role in Taiwanese economic development. In earlier periods, the construction industry registered substantial growth in 7 year cycles [3]. However, because of market internationalization, investment channels have increased and large amounts of capital have flowed to China. Moreover, because of the saturation of the housing market in recent years, the construction industry has become more competitive. Therefore, to achieve sustainable development in a demanding environment, companies in the construction industry must maintain their competitive edges. Among the types of methods to increase competitiveness, information technologies have become a crucial means of gaining an advantage.

**1.2. Motivation and objectives.** In Taiwan, most people desire to own their own home. However, buying a home is an arduous task for the average family because their income primarily relies on salaries. Thus, young people must typically work many years to earn enough money for the down payment of their home. Therefore, finding a suitable home is extremely crucial to a home buyer. By using AutoCAD and 3ds MAX images and a software platform called Unity, this study developed a real estate sales app for mobile devices to help customers quickly search for relevant information such as housing construction projects and home listings, keep abreast of related housing construction project information during their search for a home, and thus reduce the time spent on information searching and viewing homes. The objectives of this study were as follows.

- A. Compile housing construction project and sales information and determine buyers' requirements and the most critical factors affecting their willingness to purchase a home to best design the functions of the proposed app.
- B. Collect images or documents related to housing construction projects, import digital files into Unity, and create a real-time app for home buyers.
- C. Develop a response system for app users, verify its functions, and collect feedback from users to modify the system.

Literature reviews of this article, such as mobile real estate agency apps, data mining technologies, space visualization system and BIM in real estate sales studies, are discussed in Section 2. The research methods are presented in Section 3. The system development of the study is investigated in Section 4. The conclusion of the essay is discoursed in Section 5.

## 2. Literature Reviews.

**2.1. Mobile real estate agency apps.** Over recent years, real estate agencies have extended sales services to smartphones to enable users to browse housing listings. However, because they are generally small in size, smartphones can only perform limited browsing functions. Wang incorporated the necessary information for home buyers into a human-machine interface and improved the browsing interface on a real estate agency app to increase its usability [4]. The redesigned interface displays information (including the total price of the listing, listing size, address, building age, and building structure), photos, and 360-degree street view images to serve as references for real estate agencies to develop their own mobile app.

**2.2. Data mining technologies.** Because of the rapid development of information technologies and databases, large enterprises have accumulated vast data collections on clients, consumer behaviors, and transaction records. Therefore, data mining technologies, which are used to find commercially valuable patterns from within the massive quantity of information in databases, have become valued by these enterprises. Currently, the primary operational model of real estate agencies is to provide a platform for real estate deals and charge a service fee when a deal is performed. Therefore, the critical mission for real estate agencies in maintaining operation is to recommend appropriate listings to the clients and ensure the success of the deal in the shortest amount of time. Lee applied the Apriori algorithm, developed from association rule learning, to creating an association rule between home buyers and home purchase, identifying the relationship between home purchasing and the characteristic of the buyers, and thereby constructing a comprehensive model for real estate sales and recommendations. In addition, Lee's study analyzed the results of the model, proposed relevant suggestions on the basis of the analysis results, and served as a reference for real estate agencies to find sales targets [5]. Shi et al. have indicated that these rules represent some universal rules and can provide reference for enterprises [6].

**2.3. Space visualization system.** In Taiwan, housing construction projects typically provide interior design modification services and offer a variety of building materials for buyers to choose from. Although these projects offer presale homes for buyers to view, buyers can only see a few set designs in the presales, rather than the different possible combination of applying various building materials. Interior design software, such as Space Magician and 3ds MAX, are typically too complicated for layman use and are primarily used by professionals. Thus, this type of software is inconvenient for both real estate developers and buyers. The use of a simple and convenient building material visualization system to display 3D perspective drawings or images has become a necessary means for customers to choose their favored building materials. Tsai indicated that a simple and convenient visual system is essential for users to select appropriate materials for presale houses [7]. Photoshop is used to isolate visual objects (such as floor plans, cooking utensil, vestibules, and bathtubs) and incorporate these objects into an interior space simulation system developed using Visual Basic 2008 and various databases. This system performs several functions, including altering the visual objects on display, processing orders for building materials, and generating forms for customers to use to ask for installation services or confirm the building materials to be used. Thus, these functions can be applied in the proposed app to show customers what their homes would look like when different building materials are used.

**2.4. Building information modelling in real estate sales studies.** Building information modeling (BIM) has recently become a trend in the construction industry. Bansal indicated the use of BIM to create the simulation of construction process by linking execution schedule with the 3D model is an important trend [8]. Numerous research studies and case studies have discussed real estate in the phases of design, construction, operation, and maintenance, but have rarely focused on software use for real estate sales. In Taiwan, real estate is typically sold by brokerage companies. When BIM started to become a common practice in the real estate industry, real estate agencies and construction companies began to use 3D information visualization models, rather than 2D computer-aided design floor plans to communicate with each other. On the basis of the Facility Owner's Guide for Preparing BIM Guidelines, published by the Research Center for Building and Infrastructure Information Modeling and Management (known as the BIM Research Center) at National Taiwan University, Tseng proposed a set of guidelines for incorporating BIM into real estate sales to assist real estate agencies in formulating and implementing strategies [9]. Tseng also showed that, when in the visualization stage of development, the investment costs for developing BIM (including the software and personnel training costs) are relatively lower than the costs in other stage are. In addition, BIM enables real estate agencies to develop more sales opportunities and increase the satisfaction level of their clients. Overall, in the visualization stage, incorporating the concept of BIM can positively influence profitability.

### 3. Methods.

**3.1. System analysis.** This study divided the functions of the proposed real estate sales app into the following categories, as illustrated in Figure 1.

#### A. Aerial 3D Perspective

Users can adjust and view the housing construction projects (Building A to F) by using an aerial 3D perspective.

#### B. Site Location Information

Users can search for information related to the project that they are interested in. The information includes local soil and geological conditions, neighboring traffic information, and neighboring sights and facilities.

### C. Plan Drawings

Users can view the plan drawings of the projects, which are divided into several levels: community, building, floor, and household. For example, when users select the level of household, they can view the floor plan of that household.

### D. Hall Schematic

Users can view 3D images of the lobby hall for each building.

### E. Green Landscape

Users can view the related landscape of the projects, including local mountain trails, the landscape of the community itself, garden plazas, and community entrance gardens.

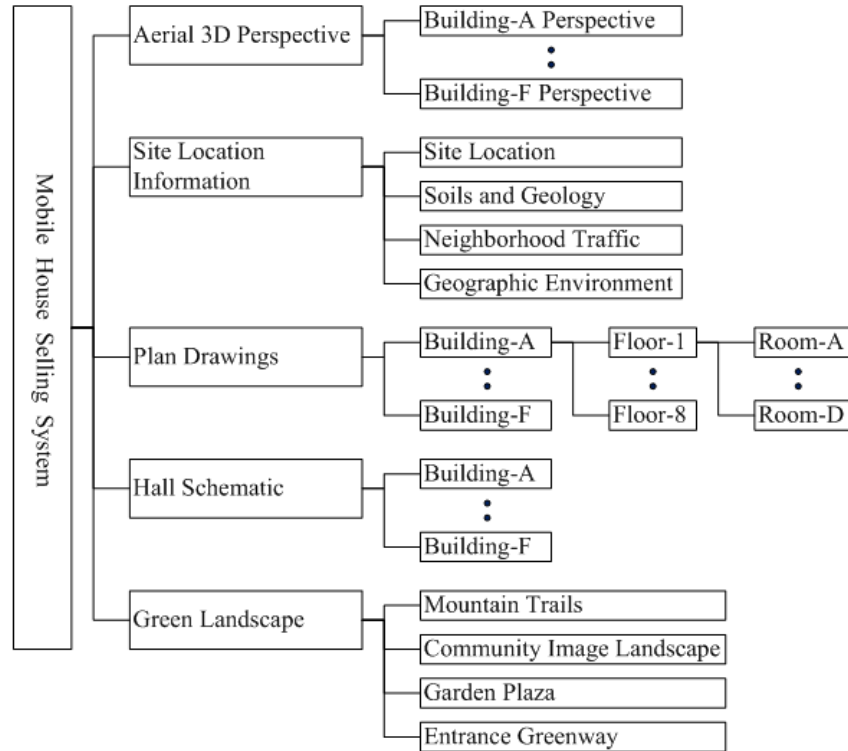


FIGURE 1. App architecture

**3.2. Development tool.** This study developed a real estate sales app by using the Unity 3D platform, which is a cross-platform game engine that can be used to develop PC and Mac operating system offline games, or games on iOS or Android cellphones and tablets. With a user-friendly interface, Unity supports the PhysX physics engine and particle system, as well as multiplayer online games. Unity 3D features elements are as follows.

- A. Terrain editor: Images of lush plant landscapes and mountain terrains can be displayed smoothly.
- B. A built-in NVIDIA PhysX physics engine: Life-like physical effects can be generated.
- C. Image optimization: Image optimization technologies that support the DirectX and OpenGL interfaces are incorporated in Unity 3D.
- D. Cross-platform publishing: Games can be published across various platforms, such as PC, Mac, iOS, and Android.
- E. Multiplayer online games: Unity 3D features RakNet, which is a game networking engine that enables multiple players to simultaneously play online games.

**4. System Development.** Using a housing construction project in Taiwan as an example, this study developed a real estate sales app by using the Unity 3D software and importing AutoCAD images and modeling 3D images of the housing construction project.

Figure 2 displays an example of a 3D image generated from the system as viewed on a smartphone. To demonstrate the functions and clear images of the app, the following figures (except for Figure 2) are screenshots taken from a tablet, such as that is illustrated in Figure 3.

This study tested whether this app performed all of the designed functions. In addition, the feedback collected from users can be used to modify the app to provide an adequate mobile app that meets the needs of real estate agencies. Figure 4 shows all of the pull-down menus designed in this study. The items on the menus were designed according to the features of the housing construction project examined in this study. Figure 5 exhibits a close-up façade image of a building. Figure 6 shows the soil condition of the project site. Figure 7 is the traffic information of the proposed construction position. Figures 8 and 9 are the floor plans of the project. Figures 10 and 11 are the hall schematic drawings of the building entrance of the project. Figure 12 shows the green landscape of the community. Figures 13 and 14 are the view displays of the project.



FIGURE 2. The app on a mobile phone

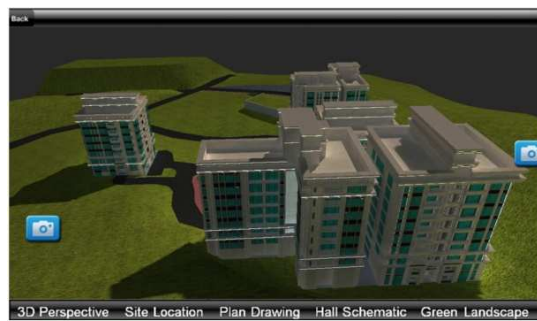


FIGURE 3. The app on a tablet

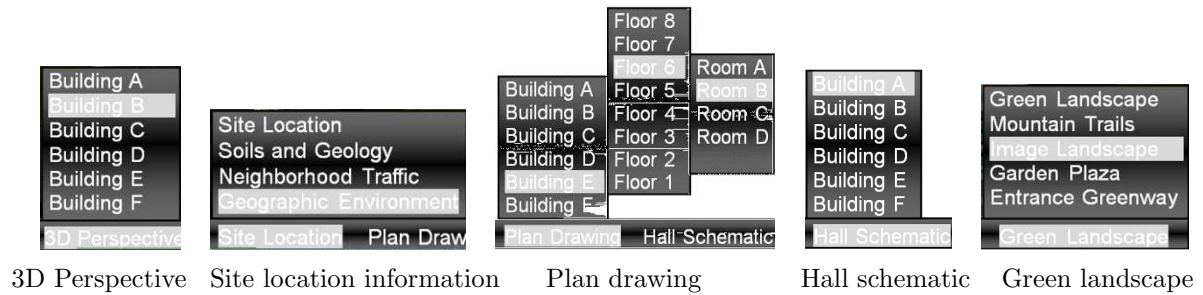


FIGURE 4. Pull-down menus



FIGURE 5. Close-up image of the façade of a building

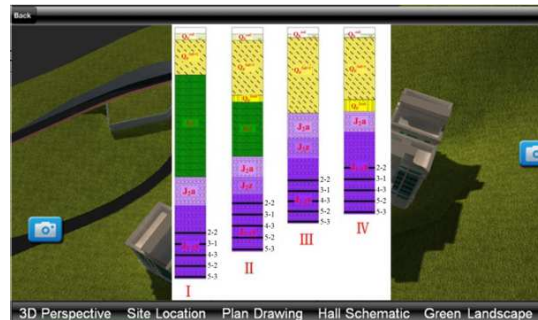


FIGURE 6. Soil and geological conditions



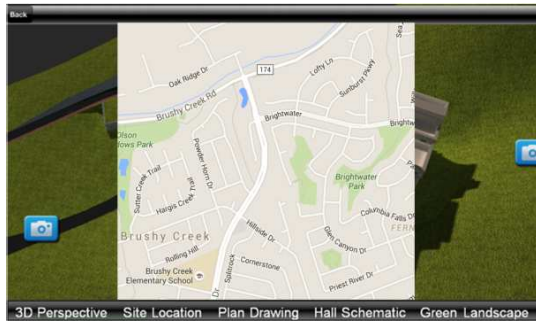


FIGURE 7. Traffic information



FIGURE 8. Floor plan 1



FIGURE 9. Floor plan 2



FIGURE 10. Hall schematic 1



FIGURE 11. Hall schematic 2

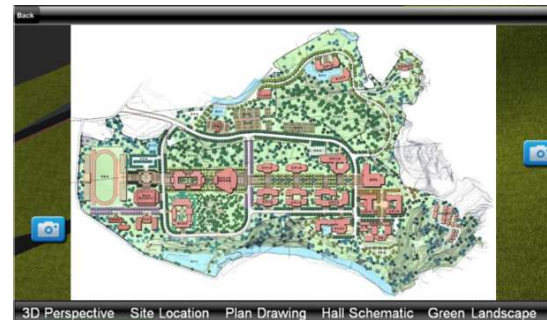


FIGURE 12. Green landscape design



FIGURE 13. Drawing of community 1



FIGURE 14. Drawing of community 2

5. **Conclusion.** With a housing construction project in Taiwan as an example, this study developed a real estate sales app by using Unity 3D that can assist home buyers and real estate agencies in Taiwan in the following aspects.

A. Through this app system, buyers can quickly view housing information and save time on accessing the information or searching for details.

- B. This app system can be accessed through various advanced communication platforms, such as smartphones and tablets. Thus, this cross-platform system can assist in exposing housing construction projects to the maximum amount of potential consumers, increase the sales growth of real estate agencies, and increase the added value of housing construction projects.
- C. This real estate sales app enables real estate agencies to manage their housing construction projects and helps buyers quickly search for basic information on housing construction projects and be informed about certain real estate listings. In other words, this app facilitates real estate operations for both buyers and real estate agencies.
- D. This app can be installed on any type of platform (including iOS, Android, and Windows Phone) and is applicable on any smart mobile device.
- E. By reducing the time required of real estate agents to introduce the properties or related services, this app facilitates sales effectiveness and minimizes human resource costs.
- F. Through this app, construction companies can keep track of construction progress, collect feedback from home buyers, and compile the information for future reference. After leaving the presale model home, buyers can further view information of the housing construction project, ask questions about the project, or request interior design services. Therefore, buyers are more likely to obtain an ideal home and be content with their purchase.

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