# Development of House Selling System for Construction Industries

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**Abstract –**

**Mobile information service can provide positioning, query, text, drawings, video and other browser interfaces. It is an indispensable object to most people. Advanced technologies have changed the manner and speed of information delivery. People need to work for a long time for buying a house. Choosing a suitable house is a very important task for homebuyers. This study discusses related important information during housing transactions which are foremost concerns of home buyers. The system analysis is performed to fulfill demands of home-buyers in house transactions. House selling system is developed by using Unity in this study. The basic house data, aerial 3D perspective, site information, plan drawings, hall schematics and landscape are compiled in this system. Real estate agents can communicate with customers by using this system on smart phones, tablet PC and other advanced communication platforms. Home buyers can examine interesting objects at home to handle future affairs such as interior decoration and furnishings. Careful preparations and discussions can prevent human mistakes and render a decent house buying experience through the help of this system. Through the development of this project, real estate agents can prevent lengthy explanation procedure; speed up project sales pace and save considerable manpower expenses.**

**Keywords –**

**BIM; Mobile Devices; Smart Phones**; **House Selling System**; **3D Perspective**

## 1 Introduction

### 1.1 Background

Currently digital information can be fetched on variety platforms. It is an indispensable object to most people. Advanced technologies have changed the manner and speed of information delivery. The screen size becomes bigger and screens are thinner for smart phones and tablet PCs. Some works that can only be executed on the computers can be performed smoothly in smart phones. 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, more and more people love to use its mobile Application to process the day-to-day affairs [2]. Construction industries have played an important role in the process of economic development in Taiwan. Approximately every seven years, there are considerable gains for real estate prices in the early stage [3]. Since the internationalization of economic market and diversification of investment channels, plenty of money moved outside of Taiwan. The construction industry has very much been challenged since the demand for housing is becoming saturated. In order to survive in this unfavorable environment, using ICT application to promote the service and competitiveness is a key issue for construction industry.

### 1.2 Unity 3D Software

This study use Unity 3D Software [4] to develop house selling system. Unity 3D is a game development software which provides multiplatform development and exhibits simple operability. It consist of a powerful engine to develop games executable on various products such as Android phones, iOS, tablet PC, PC, Mac, PS3,

Wii, XBox360, and other gaming supports. Unity provides a user-friendly interface, support the PhysX physics engine and particle system, as well as multiplayer features in internet environments. This significantly reduces the game programming threshold, because users do not need to learn complicated languages. This tool decreases the game-designing time and reduces costs of game production. The major features of Unity include:

1. An editor which supports constructing terrain effects efficiently, producing natural-looking displays.
2. Provides NVIDIA PhysX physics engine that offers photorealistic corporeal effects.
3. Offers OpenGL and DirectX illustrations optimization practices.
4. The capability to publish games to various platforms such as Androids, iOS, PC, and Mac.
5. Supporting synchronized multiplayer online games over internet.

### 1.3 Motivations and Objectives of the Study

In Chinese culture, to buy a house is a major goal for any family. Young people need to work for a long time to pay the down payment for a house. Choosing a suitable house is a very important task for homebuyers. System analysis and software development were used in this study to establish mobile construction house selling system by applying AutoCAD and 3D drawing on Unity platform. The house buyer can rapidly fetch related information such as project profile to make appropriate decisions during the process of buying a house. This can help the buyers to effectively grasp the relevant construction information, shorten time consuming information inquiring process and save the time for house inspection on site. The objectives of this study include:

1. Through literature review and questionnaire to aggregate related information concerning building construction and sales process. The system analysis can then be performed to fulfill demands of home-buyers in house transactions.
2. Collect relative construction drawings and documents and use Unity 3D to develop house selling system.

Input construction project data into system to verify the functionality of the software. Feedbacks from users are consulted to revise the system function.

## 2 Investigation on Current Studies

The realtors in Taiwan have expanded service that allows users to browse housing item via smart mobile devices. Since the browse interface on smart phone is limited, the provided functionality is inadequate. Wang has discussed related information and introduced human-computer interface design to improve the browsing interface for homebuyer [5]. The provided message include price, square footage, address, house age, and structure types of building. The photos and 360-degree surrounding views are added as reference for realtors to develop the system.

### 2.1 Interactive Interface

Information asymmetry is a common phenomenon in various trading activities. This trading environment may cause high trading expense. When consumers cannot evaluate the quality of products and services before transactions, they are exposed to certain risks. Hsieh has explored the effects of introducing digital facilities and designing consideration upon the trading environment of information asymmetry in the housing industry [6]. This study has established an interactive interface and designing model as reference for related services.

### 2.2 Functions of House Sales Management System

House sales management system is an integral part of sales company [7]. Its content is critical for the company's decision-makers. It can provide an appropriate tool for house sales and customer management. It can also improve the quality of house sales service, avoid errors of the leakage of payments received, and improve the company's competitiveness. In this study, the house sales management system for construction industry has been divided into seven modules. It has been decomposition into thirty-three secondary module, and sixteen essential modules were verified through expert questionnaire. This can be used as reference for house sales management system development.

### 2.3 Data Mining Techniques

Since database and IT have been rapidly developing, many large enterprises have stored lots of data about customer profile, consumer activities and trading records. Using data mining techniques to fetch potential business information is an important issue for these enterprises. Data mining is the key process in which valuable information or knowledge is captured from huge data sets. The business model of real estate is to provide a trading platform that matches sellers and buyers of properties. They make certain profit from the service charges on

successful mediation. Therefore, presenting the appropriate properties to the right person in the shortest amount of time is a critical issue on the operation of real estate industries. Lee constructed a recommendation model by employing data mining techniques to predict potential properties trading of a house selling through characteristics of customers [8]. Apriori algorithm in Association Rule is applied on a real estate agency in Taiwan to construct this model. This model can provide managerial implications and improve the decisions making for real estate enterprises. Shi et al. have indicated that these rules represent some universal rules and can provide reference for enterprises [9].

### 2.4 Space Visualization

The construction companies in Taiwan have provided service of changing the design when consumers buy presale house. Although sample house is provided for customer to catch the possible appearance, it is not an easy task for house buyer to precisely catch the real looks for different building material combinations. There are some relevant design software for interior decoration, such as Space Magician and 3ds MAX. It is inconvenient for consumers and home builders to use these tools. Tsai indicated that a simple and convenient visual system is essential for users to select appropriate materials for presale houses [10]. Photoshop is utilized to cut out visual object such as furniture and bathtub. The system combines database to change visual objects, produce building materials list and building materials confirmation form. The software will show the simulation related to selected decoration material selected by house buyers.

### 2.5 Implementation of BIM

To use BIM as a tool is an irreversible trend for the construction industry in Taiwan. Many related implementation in the planning, design, construction and maintenance phases utilizing BIM environment for construction projects. 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 [11]. BIM has been used throughout whole life cycle of a building except in the house selling stage. Construction project usually entrust realtor agency to sell the subjects in Taiwan. By applying BIM environment, the information exchange between realtor agency and construction company will be altered from traditional 2D Cad drawing into 3D model. Tseng has established a guide to perform BIM execution for real estate agency [12]. The guide was formulated based on “Facility Owner’s Guide for Preparing BIM Guidelines” which is published in 2014 by NTU BIM Center. The simulation result proved that the guide can help real estate agency to establish a BIM execution plan. The team members should be chosen from sales department since these staffs can combine practices and execute information transmissions effectively. Although the investments, such as training and software, for using BIM is relatively low in early phases, the advantages of import BIM can be achieved such as gaining new business and obtaining higher customer satisfaction.

## 3 Methods

### 3.1 Functional Analysis

This study has divided the function of the system into following categories (Figure 1):

1. Aerial 3D Perspective

This feature will provide users to view 3D perspective views for all buildings of the project. This study divides this menu into sub-function from Building A to Building F.

2. Site Location

This feature provides related information for users to examine some environment data such as “Soils and Geology”, “Neighborhood Traffic” and “Geographic Environment”.

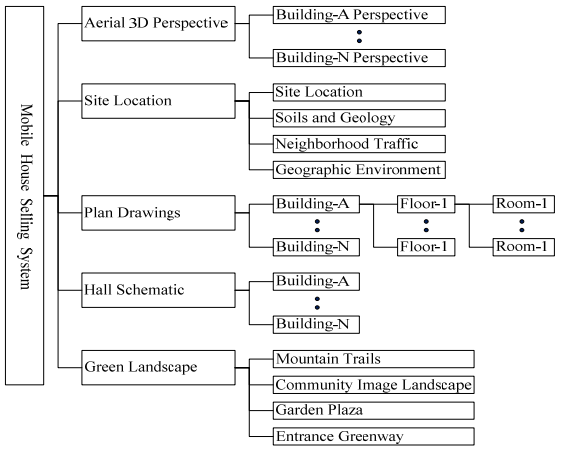



Figure 1. System framework

3. Plan Drawings

This feature allows users to view the plan drawing of interesting objects. The hierarchy of this function includes Building, Floor and Room. When related

"Building" is clicked, all floors belonged to the building will be displayed for further selection. When certain floor is clicked, all rooms belonged to the floor will be displayed for users to select for viewing the plan drawing.

4. Hall Schematic

This function allow user to view the hall perspective for all buildings.

5. Green Landscape

This feature allows homebuyers to watch relative outdoor views of the project such as "Mountain Trails", "Community Image Landscape", "Garden Plaza" and "Entrance Greenway".

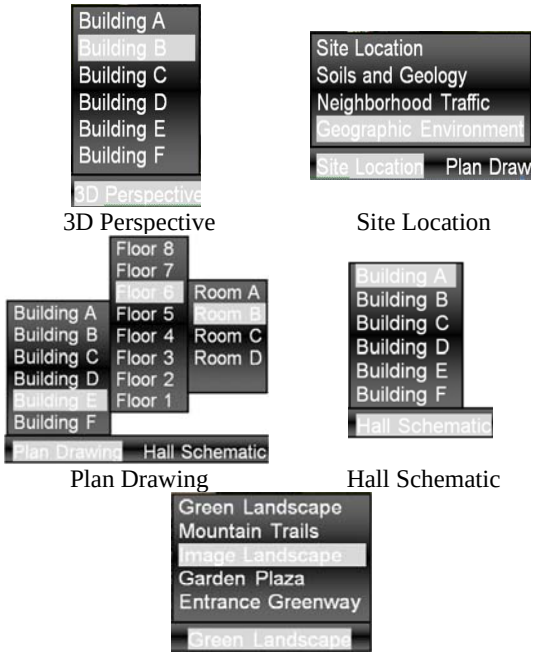
### 3.2 Development of the System

This study uses a construction project as example to develop the mobile house selling system on Unity environment. The AutoCAD drawings are imported to the system to construct the BIM module. The execution display of smart phone is shown in Figure 2. In order to clearly present the program functions, tablet PC version of the system are demonstrated as shown in Figure 3.

Function examination is to confirm that all design functions performed properly. Feedbacks from users should be considered to assure that system can fulfill all needs of the homebuyers. Figure 4 shows the popup menus of the system. A sample construction project was used as an example to implement the system. Figure 5 is the close view of the exterior wall of the building. Figure 6 to Figure 13 is part of the execution display of the system.


Figure 2. Execution display of the system for smart phone version


Figure 3. Execution display of the system for tablet PC version




3D Perspective

Site Location

Plan Drawing

Hall Schematic

Green Landscape

Figure 4. Popup menus of the system


Figure 5. Close view of exterior wall


Figure 6. Soil and geology display


Figure 7. Neighbor traffic display


Figure 8. Plan drawing display


Figure 9. Hall schematic display 1

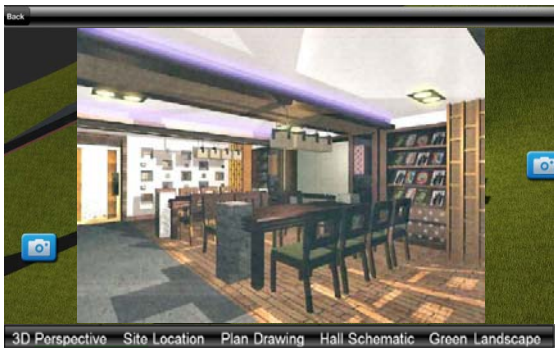



Figure 10. Hall schematic display 2


Figure 11. Green landscape display


Figure 12. Image landscape display 1


Figure 13. Image landscape display 2

## 4 Conclusion

This study uses Unity environment and BIM to develop mobile house selling system. This can bring the following contributions for homebuyers and construction industry:

1. Homebuyers can instantly search information related to the target building and reduce data fetching time through smart mobile applications.
2. Real estate agents can promote business image, endorse transactions and enhance product values by using smart phones, tablet PCs and other advanced communication platform.
3. This system can provide related object information of the house being sold. Staffs of real estate agents can rapidly fetch relative data for customers to reduce unnecessary resources and promote services efficiency.
4. Home buyers can examine interesting objects at home to handle future affairs such as interior decoration and furnishings. In general, employees may have to work several decades to have the opportunity to buy a house. Careful preparations and discussions can prevent human mistakes and render a decent house buying experience through the help of this mobile house selling system.
5. Through the development of this project, real estate agents can prevent lengthy explanation procedures; speed up project sales pace and save considerable manpower expenses.
6. The software can be installed on most smart phone platforms such as IOS, Android, Windows Phone, etc.

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