

PAPER 7

**DEVELOPING THE ANDROID AND IOS PROCESS
OF REAL TIME PAPERLESS,
INTELLIGENT DATA GATHERING FOR REAL
ESTATE APPLICATION**

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ABSTRACT

Accurate and adequate data collection during property inspection is fundamental and a vital part for property valuation process. During the inspection process many elements will become apparent that may have an impact on the property value. Through proper inspection we can capture information about the conditions and state of maintenance of the property, the type of furnished, the quality of finishes, whether any renovation has been carried out, any extension, and other relevant factor whether physical or non-physical, that can affect the value of the subject property. However, in the age of technological advancement, conventional inspection techniques are tedious and not cost effective anymore. The aim of this study is to Utilise the state of the art technology in property inspection amongst valuers by reducing time, costs, and manpower within a paperless while providing their services. The study focused on the details of a paperless property inspection system using smart phones (androids apps only) under a mobile-computing based environment since iOS apps requires fee for the service. Methodology used starts with proposed conceptual framework for paperless inspection prototype development. Software Configuration for System Development includes: Operating System - Windows / Linux / Unix; Netbeans with JAVA SDK 1.2- Programming Language used to develop the Paperless Inspection System; MySQL version 5.0 - Database to store and retrieve the records and AutoCAD - to create the building layout in CAD digital format to be stored in the database. Hardware Configuration to run the System includes: Operating System - Android Smart phone with minimum 2 GB free Memory; Network Configuration to run the System: Operational hours WiFi Accessibility. The system runs the application in Tablet Hyperlink to the database for online updating. Testing and verification have been carried out on 25 properties which are randomly selected to validate the Paperless Property Inspection. The result showed that the present valuation parameters are adequately transformed to assist manual valuation knowledge with provided data. The developed prototype known as SmartInspector can be enhanced further to suit with the requirements from industries.

EXECUTIVE SUMMARY

1.0 INTRODUCTION

Accurate and adequate data collection during property inspection is fundamental and a vital part for property valuation process. During the inspection process many elements will become apparent that may have an impact the value of that property. Through proper inspection we can capture information about the conditions and state of maintenance of the property, the type of furnished, the quality of finishes, whether any renovation is carried out, any extension, and other relevant factor whether physical or non-physical, that can affect the value of the subject property. Hence, the study proposed the details of a paperless property inspection system using smart phones (androids & IOS) under a mobile-computing based environment conducted by a team of researcher from the Universiti Teknologi Malaysia. The overall information about the research namely, the issues, objectives, the scope, the milestone (used as a benchmark to measure rate of project completion) and other essential information are explained under this chapter.

1.1 Research Background

In arriving at a fair value for a property, the role played by valuers during property inspection is important. It is important that a checklist should be prepared making a inspection of a subject property. This is to ensure that the inspection exercise the valuer is expected to conduct is adequate and properly done.

The inspection also should cover external and internal environment of the subject property. These includes details such as use, building construction, installations, state of repair of buildings and such installations, amenities, services, accommodation, accessibilities, location are appropriately noted in the inspection checklist. The RICS and the Malaysian Valuation Standards, *Standard 8*, publish by Board of Valuers, Appraisers and Estate Agents Malaysia requires Valuers to carry a proper inspection and referencing document of the subject property to the extent necessary to produce a quality valuation which is professional, adequate and not misleading. (*Malaysian Valuation Standards, 2006*).

1.2 Problem Statement

Nowadays, in the age of Technological Advancement improvement in the use of technology to capture information should be a high agenda. This because conducting property inspection and recording the information manually takes much time and also human error occurs such inspecting the wrong property, or forgetting to take pictures, forgetting the details on the furnished, unable to identify the right coordinates for the subject property, description of the subject property insufficiently collected and others.

Once the valuers return to the office he or she has to spent time digitising those information that were collected manually into the system. With limited time frame to produce the valuation report, inadequate information or loss of information will cause a delay.

Conducting the valuation job manually is going to be an issue particularly if the number of cases increases. An alternative to that would be to perform the activities related to valuation of the property from inspection to value is by using technology either during inspection, filing of information identifying location and conduct valuation. The benefits of using inspection applications for example are several and this include time saving, costs reduction, as well as avoiding loss of information.

1.3 Research Goals

The rational for conducting this research is to develop an inspection device suitable for Valuers in Malaysia. Once developed valuers in Malaysia can capture field information more effectively and efficiently. How can available application such as Smart phone, GIS be efficiently adapted and combined with a web based system used to capture property information, identify location as well as other features which is important to produce a reasoned valuation.

The goals of this research are therefore to advance the use of technology amongst Valuers by reducing time, costs when providing their services within a paperless environment.

1.4 Objective of The Study

The reason of proposing this study is to satisfy the Research Goals. By identifying the process and developed the application, to assist property valuers during inspection, the study set forth the following objectives:

- 1) To explore property inspection methods and formats on property valuation parameters of annual and market valuation.
- 2) To develop a model that assists the property valuers with existing Information Technology using smart phones (Android & IOS).
- 3) To develop a system that assists the property valuers adopt a paperless working environment using smart phones (Android & IOS).

1.5 Scope of Study

The scope of this study is focusing on the development of android and ios mobile based application system for paperless real time property inspection. The paperless inspection application system will able to support property inspection data dictionary, geotagging, onsite & offsite physical data entry, property layout sketch, inspection report, and inspection verification report module. Consequently, the knowledge transfer of paperless property inspection in terms of how to build the skills, the required knowledge for the property Valuers will be transferred.

1.6 Significance of study

In response to the increasing use of technology in valuation inspection, a research is set up to investigate the issue further. The purpose of this research is to engage information technology to assist property inspection for valuation purposed. When a Web system developed and successfully applied to mobile Android or iOS, the user is able to access the property data easily which only requires an internet connection to reach the website web system that has been developed anywhere and at any time.

With the development of this technology, all the work of conventional practices will change to a fully automated work practices. Access GIS, photos, building plans all of which are easily accessible and visible on android and iOS application. Other benefits includes:

- i. Digitising manual process (paper based) into paperless;
- ii. Monitoring and co-ordination between valuation department office and site inspection;
- iii. Reduced property inspection period may help JPPH officer to conduct more property inspections within the required timeframe;
- iv. Speed-up the property inspection performance;
- v. Ease in identifying property location;
- vi. Ease in navigating towards a particular property;
- vii. Ease in planning for inspection;
- viii. Adopt new technology in property inspection;
- ix. Improves the data quality, enhances the integrity and authenticity as with property inspection at the right time.

2.0 METHODOLOGY

2.1 Research Design Phases

The overall process of the research methodology in the form of ICOM (Input, Controls, Output, and Mechanism) following the IDEF0 method is illustrated as shown in Figure 2.1.

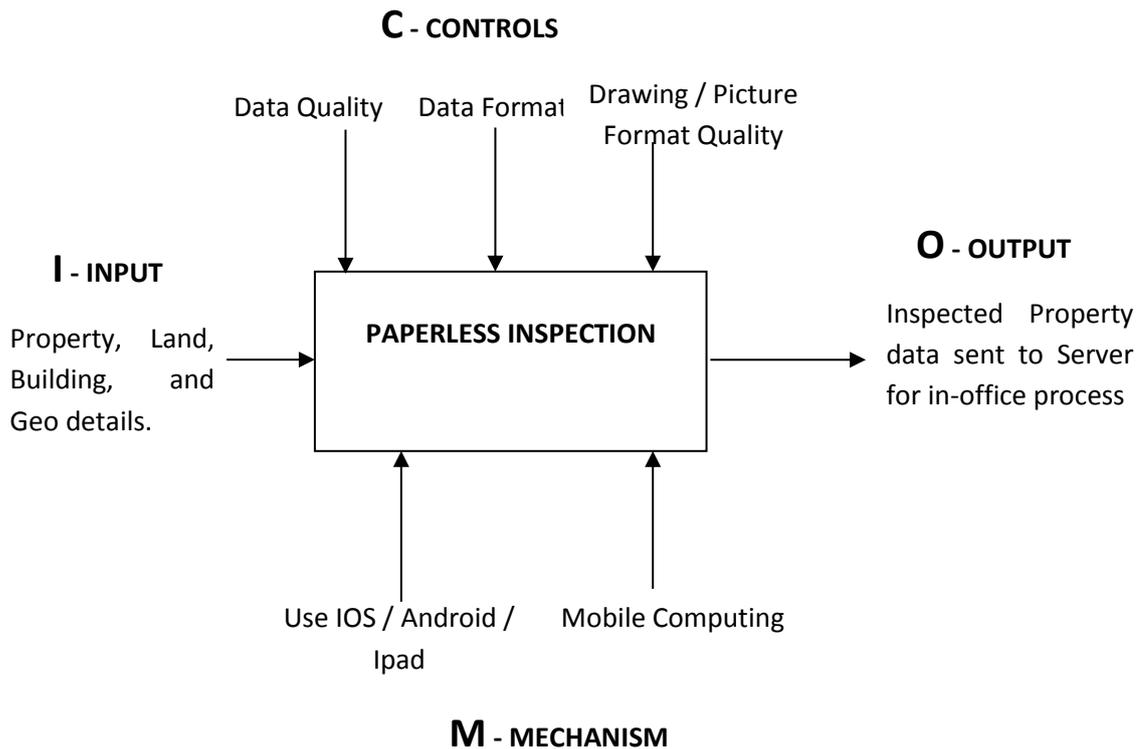


Figure 2.1: The overall process Paperless inspection (IDEF0 Method)

The overall research design is highlighted into four phases in which each of its phase core efforts employed here are namely:

- (i). **Phase I:** Problem Formulation (Domain Knowledge Technical Analysis),
- (ii). **Phase II:** Paperless inspection Algorithm & Framework Development,
- (iii). **Phase III:** Paperless inspection System Development, and
- (iv). **Phase IV:** Testing and Reporting

Each phase contributed to research design and the relevant work accomplishment according to the aim and the objectives of this study is discussed as shown in Figure 2.2.

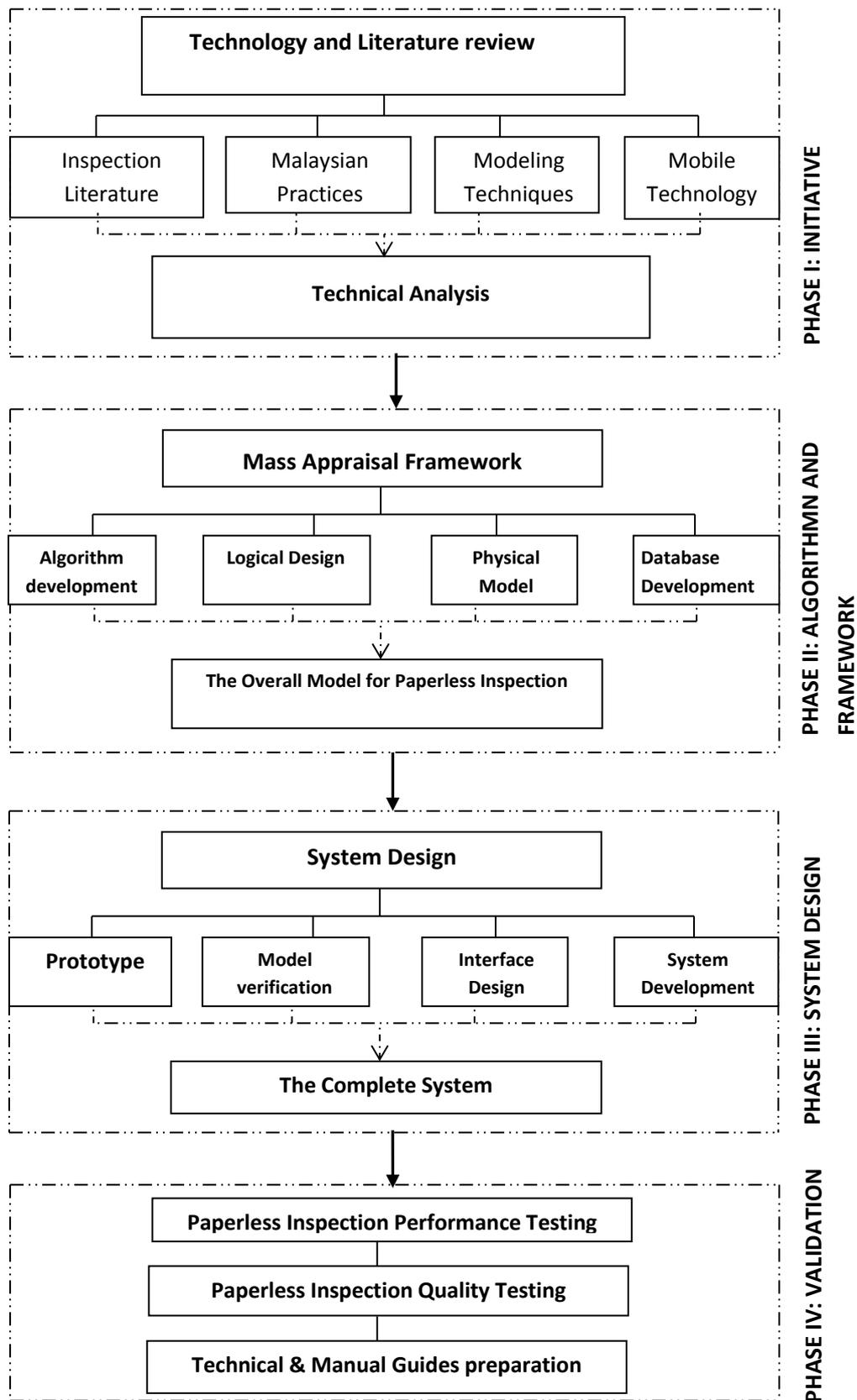


Figure 2.2: Research Methodology

3.0 PAPERLESS INSPECTION ALGORITHM AND FRAMEWORK

3.1 Introduction

The logical conversion of manual process into automation is called algorithm, and the pictorial representation of the algorithm is called the framework. Basically, the framework gives a conceptual understanding of the aim. The framework needs to be elaborated into a prototype for a clear understanding of the framework. Once the prototype interpreting the manual process is very clear, a model should be developed and tested. The deficiency free model will be further developed into ultimate product called system. The logical conversion of manual process flow into automation called algorithm, the conceptual framework of the algorithm flow are also explained.

3.2 The Paperless Inspection Algorithm

The Significant features of properties must be preserved over time in the form of digital object to remain accessible and meaningful. The digital object of a properties may be categorised as content, context (metadata), appearance (eg. layout, colour), behavior (eg. interaction, functionality), and structure (eg. pagination, sections). The paperless inspection is a sequence of logical processes called algorithm that implement the manual property inspection processes and procedures into machine learning process namely digitization. In order to digitize property inspection, the manual processes are divided into 3 categories namely inspection proof details, inspection details, and geographical details.

The process flow of paperless inspection algorithm is as follows:

- Step 1: All the authenticated property inspector's details are recorded in the server.
- Step 2: The inspector is asked to authenticate and verify with the server.
- Step 3: IF the Property is old then **Go to Step 7**. Hence the property is new and informs the inspector to key in the property information as follows:
- a) Property info namely Zon, mukim, kawasan, lorong, building number, etc.;

- b) Ownership info namely Property owner, the postal address, ownership status, Ownership, etc. ;
- c) Land info namely Bumiputera status, Land classification, strata title, area, etc, ; and
- d) Building info such as building classification, building category, no. of level, building structure, etc.

Step 4: Ask the inspector to sketch the layout of the new property with the measurements

Step 5: Invokes the global positioning system (GPS) and request the inspector to point the position of the building.

Step 6: The new property information are stored in the server. **Go to Step 11.**

Step 7: IF old property, then the system connects to the server, access the property details and will show on the mobile.

Step 8: The inspector verify, and modify / update the property details according to current property inspection.

Step 9: the Geotagging request can be invoked by the inspector to tag the geo details if necessary.

Step 10: The modified / updated will be send to the history of the property under a History table in the server.

Step 11: the store / update status (success / failure) of the property in the server.

Step 12: To continue for other properties, **Go to Step 1** else **Step 13.**

Step 13: End.

3.3 The Conceptual Framework

The conceptual framework of the paperless inspection following the algorithm representation is illustrated (Figure 4.1). The web server is connected through cloud computing namely i) the Drawing Element Recognition and BQ which performs the

drawing element recognition into bills of quantities where the main essence of this study exists, ii) the Application Packages that integrate with CAD and Ms-Excel for extraction and documentation, and iii) the Relational Database that serves as a virtual database for temporary storage. The purpose of demonstrating the conceptual framework is to provide a clear idea about the overall process flow of prototype.

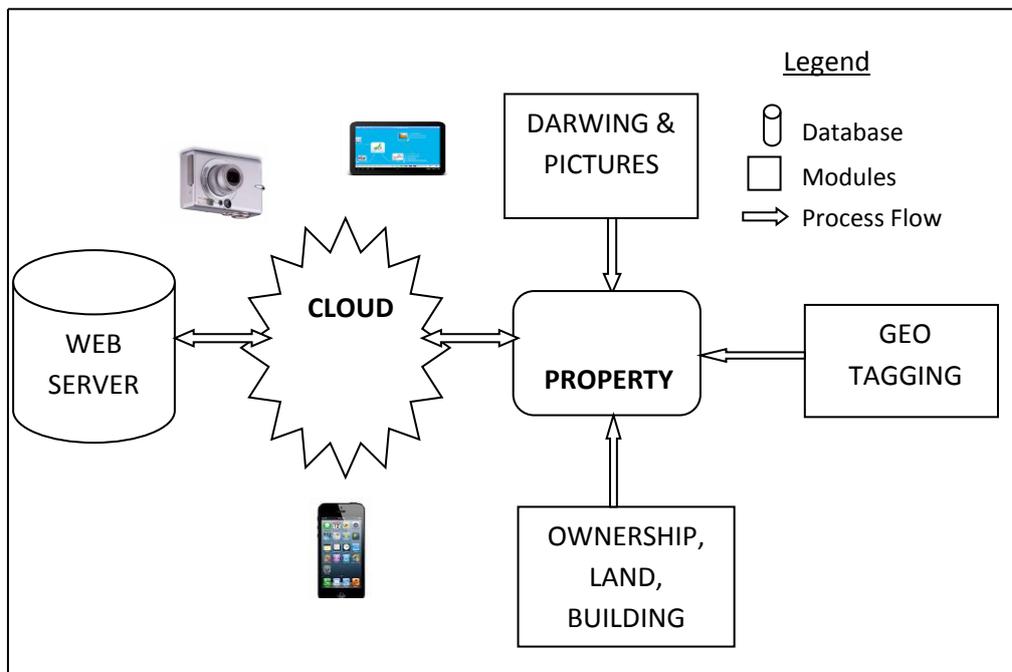


Figure 2.1: Conceptual framework representation of paperless inspection

3.4 The Framework's Components Architecture

An overview of the components and its' Technology details related to property in paperless inspection develops the conceptual frame to formulate an integrated environment is illustrated (Figure 4.1). Every component associated with Figure 4.1 to formulate the architecture is clearly briefed.

3.4.1 Ownership, Land, and Building Info

The Ownership, Land, and Building module is interconnected with the existing system called iASSET (Figure 4.2). The architectural framework design of iASSET as in figure 6 consists of seven (7) modules namely. However, the mobile computing is designed to access only four modules within iASSET.

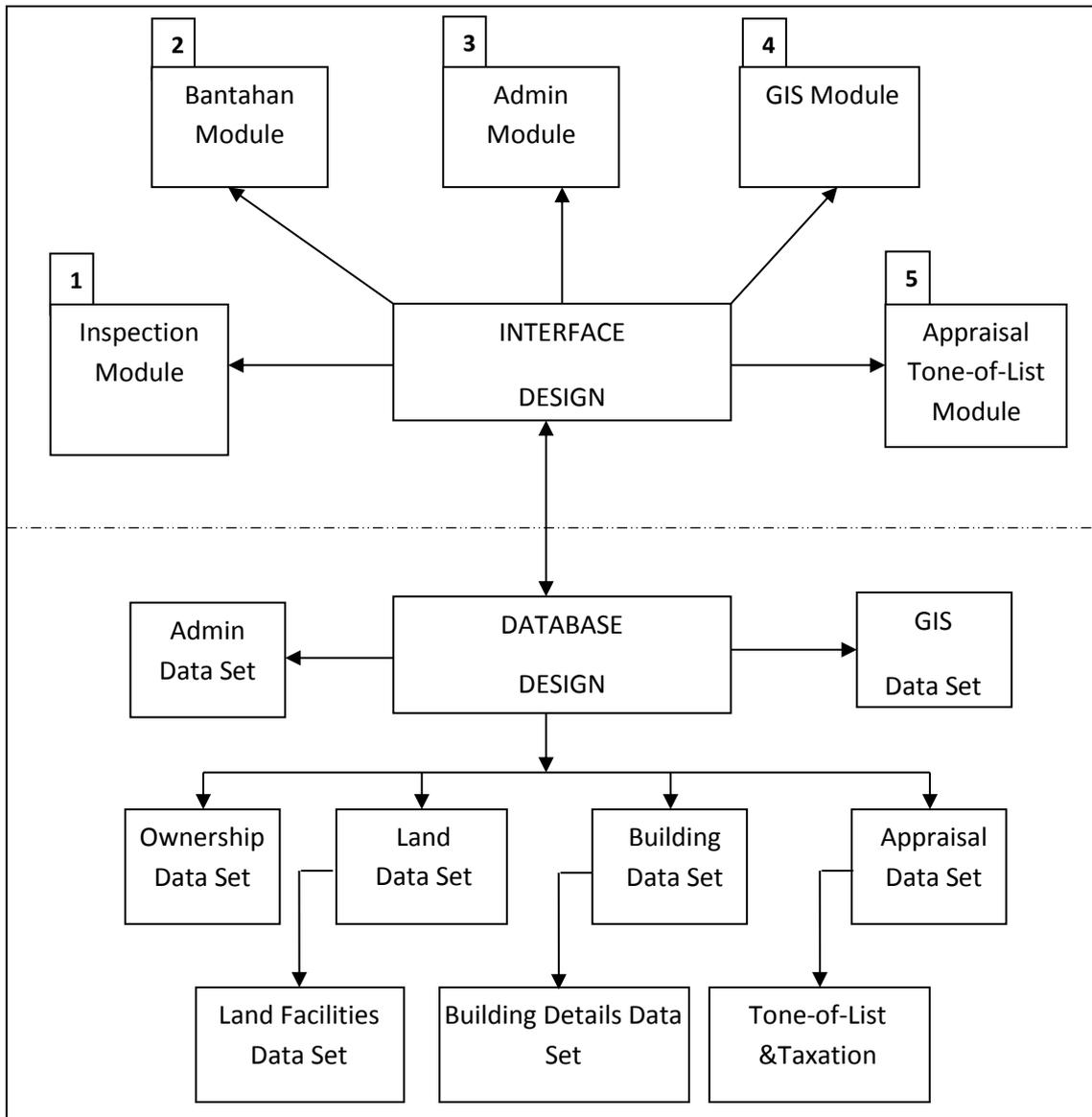


Figure 4.2: Property, Land, Ownership, and Geotagging Server Framework

Source : iASSET System Design

- a) *Admin module* → limits the users for property data accessibility under five (5) levels (to add / edit / delete records) according to their job position.
- b) *Search Module* → allows search / add / edit and update / delete a property's details.
- c) *Key in Module* → Allows the inspector to key in the land, building, and ownership details using IPAD, Tabloid, and Androids.
- d) *GIS Module* → is a sub module attached under Data Management Module and provides the property's geographical information through an embedded GIS locator.

- e) *Picture / Drawing sketching Module* → processes that allows the picture and the layout sketch of that binds with the property.

3.4.2 Drawing & Picture

AutoCAD is the CAD package (latest 2007 version for Windows XP and 2008 for Windows.NET) introduced by Autodesk® Inc. AutoCAD 2007 comes with Multi Document Interface (MDI) application. This multi document facility allows the user to open many drawings of each drawing in a separate document inside AutoCAD environment. Each document has the layers and layering specifications facility. These layers and the layering specifications assist the draftsman to place specific elements under specific layers to manage the consistency of the drawing content.

An alternative for reading the standard DXF (Drawing Exchange Format) could have been done through different libraries using Java 3D by Sun Microsystems or Heidi Toolkit from AutoCAD. However linking different libraries may be problematic for the programming integration whenever different languages are used. Hence Autocad.dxf will be used for storing the layout of the building.

In order to show the physical condition of the building, the digital picture using digital camera will be used. Since there are JPEG, .JPG, .PNG, .BMP, .TIFF, etc formats are available to store the pictures. Since .JPG and .JPEG formats use less storage (bytes) and the terms of clarity is high, faster in cloud computing, .JPEG and .JPG formats will be used in paperless inspection.

3.4.3 Geo Tagging

Geotagging (also written as GeoTagging) is the process of adding geographical identification metadata to various media such as a geotagged photograph or video, websites, SMS messages, QR Codes or RSS feeds and is a form of geospatial metadata. This data usually consists of latitude and longitude coordinates, though they can also include altitude, bearing, distance, accuracy data, and place names.

Geotagging can help users find a wide variety of location-specific information. For instance, one can find images taken near a given location by entering latitude and longitude coordinates into a suitable image search engine (Figure 4.3). Geotagging-enabled information services can also potentially be used to find location-based news, websites, or other resources. Geotagging can tell users the location of the content of a given picture or other media or the point of view, and conversely on some media platforms show media relevant to a given location.

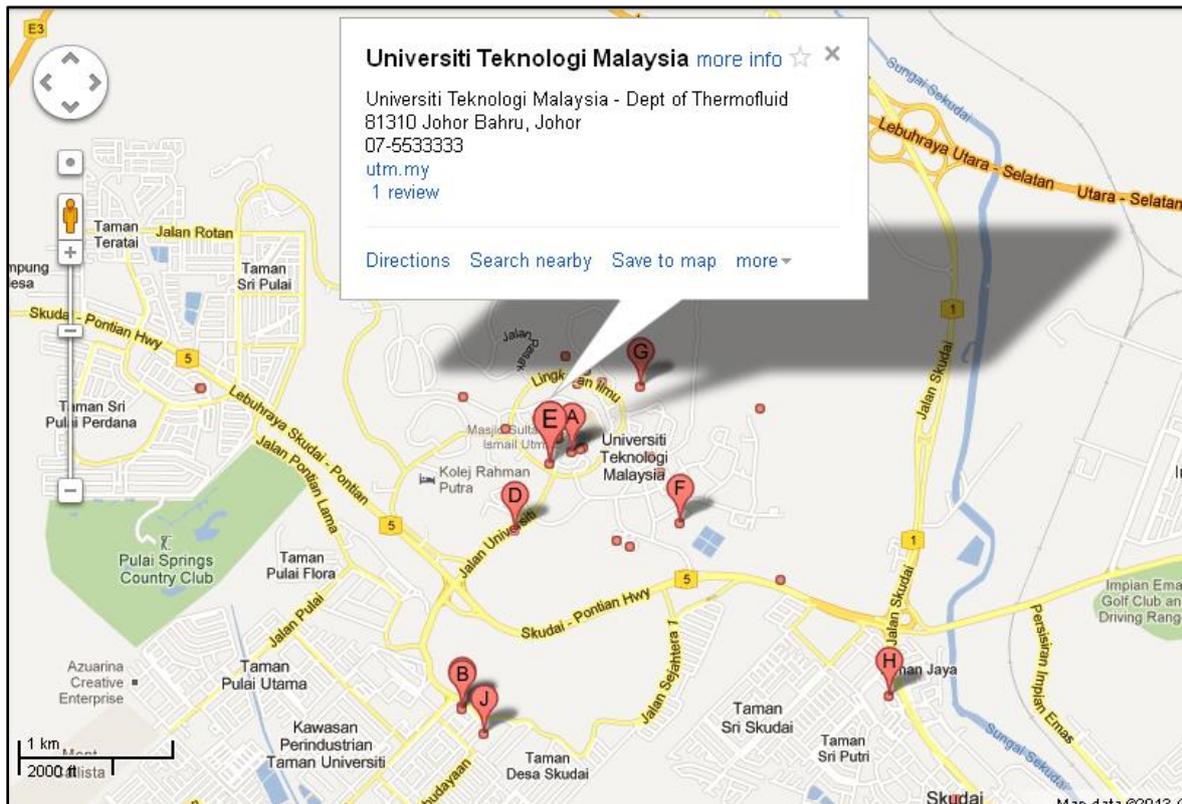


Figure 4.3: Geo tagging of UTM

Source : Google Map

Since geotagging of each and every property is storage consuming and there is no need to geotag all properties as they provide messy look in the digital form. Hence the important places like public building, direction icon building, special properties, religious building and specific properties will be geotagged.

3.5 Summary

The algorithm and the framework for paperless inspection has been developed to a) attach the content data such as texts and numbers, b) attach the meta data namely the

picture, and sketch layouts of the building, c) meta data namely the geospatial data, and d) data store and retrieve modul to add and update the server through mobile computing. The system model and the developments are explained in the following Chapter.

4.0 SMARTPHONE PLATFORM FOR PAPERLESS INSPECTION

4.1 Introduction

The various mobile application platforms namely Apple/iOS, Android, Blackberry, WebOS, Windows, Symbian and Bada are discussed to select the appropriate mobile platforms for implementing the paperless inspection framework's prototype. The rational selection of smartphone platform and Smartphone application development environment to develop and demonstrate the paperless inspection are overviewed.

4.2 Smartphone Platforms

The rapid growth of smartphone across multiple operating platforms let each and every user to allocate some time to choose the right operating platform based smartphone upon his/her functionality expectations. At present available platforms include Apple/iOS, Android, Blackberry, WebOS, windows, Symbian and Bada.

For every mobile application on any platforms, there are three types of coding structure available are as:

- i. Native application development – developing custom native applications targeted at some or all of the major mobile platforms;
- ii. Mobile application development – developing application that is optimized for mobile access; and
- iii. Middleware application development – developing application to run on multiple platforms.

4.3 Paperless Inspection's Smartphone Platform Selection

Technically both native application and mobile application are having advantages and disadvantages due to smartphone version, platform usage, internet speed, highest level of quality and performance. Middleware applications are somehow

5.0 PAPERLESS INSPECTION SYSTEM DESIGN

5.1 Introduction

The conceptual idea of paperless inspection into a logical approach called as framework is yet intangible as the idea into logic is the next level of development. A model / prototype is the next level of framework. The paperless inspection's framework has been explained in Chapter4. To demonstrate the paperless property inspection, the development of a user friendly system in terms a mobile application also called SMART INSPECTOR is explained under this Chapter. The Android application development requires several features to run the system with and without internet environment. Further, the data integrity is the most important matter as the framework need to work with AutoCAD drawing file, GIS digital Map, and many secondary tabular data in an integrated environment.

5.2 Smart Inspector System Development Environment

The whole SMART INSPECTOR mobile application has been developed under SDK environment using Eclipse - Java ADT as development tool and Samtablet Android 4.2.2 as Android Virtual Simulator.

5.3 SMART INSPECTOR System Interface Design

The whole SMART INSPECTOR system has been designed and developed using conceptual model as shown in Figure 5.1.

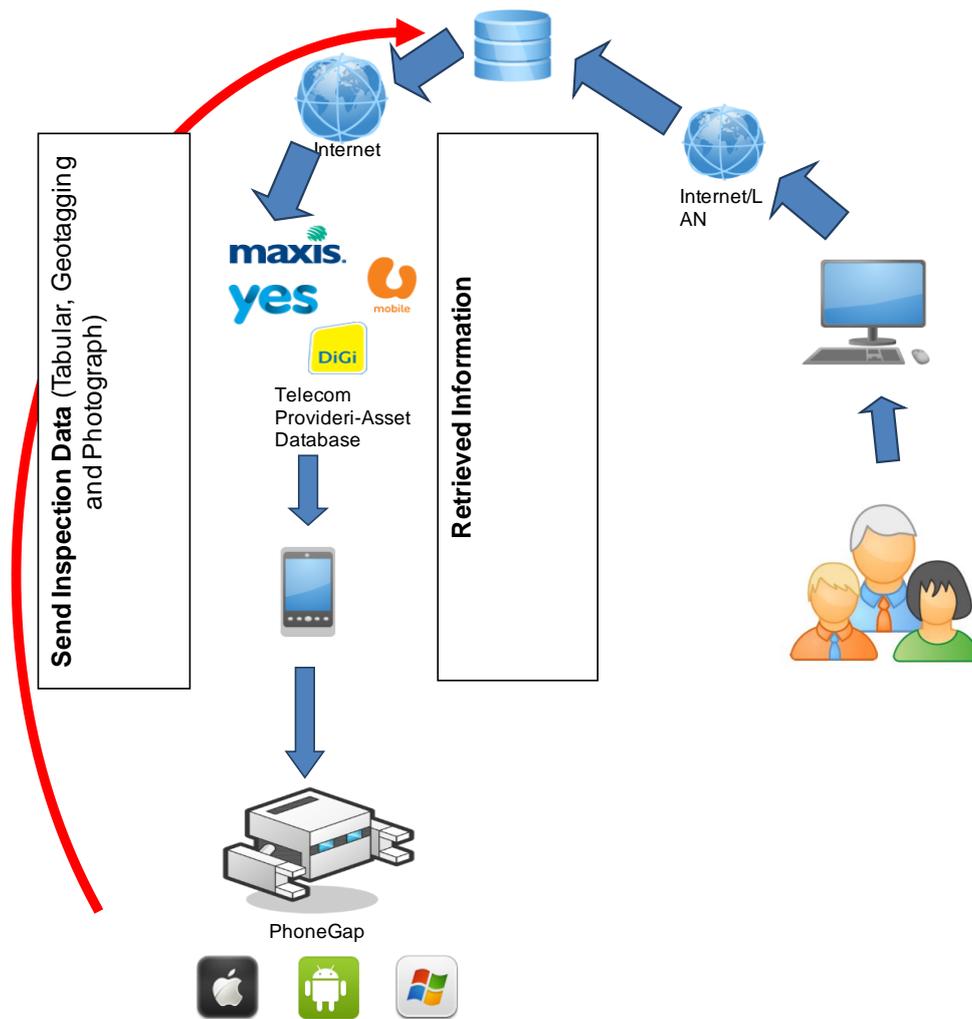


Figure 5.1: Graphic illustration of Paperless Inspection System Design

The development involved with three programming modules which are well explained under sub-sections of this Chapter. The three modules of SMART INSPECTOR are as follows:

1. Authentication module
2. New Property Module
3. Old Property Module

5.3.1 Authentication Module

Authentication is important to identify the user type at the time of login and perform their job within their authorization. Authentication module allows to access the SMART INSPECTOR to authorised staff and also to retrieve the information about which property inspected by whom, when, etc.

The process flow of Authentication module is shown as Figure 5.2. Once the authorised person login, then the interface let the user to select either old or new property to be inspected. If old property selected, then the existing details of the old property will be displayed to make the job easier. For new property, all the information required should be filled by the inspection personnel. Figure 5.3 shows login authentication and Figure 5.4 shows Main Menu of SMART INSPECTOR.

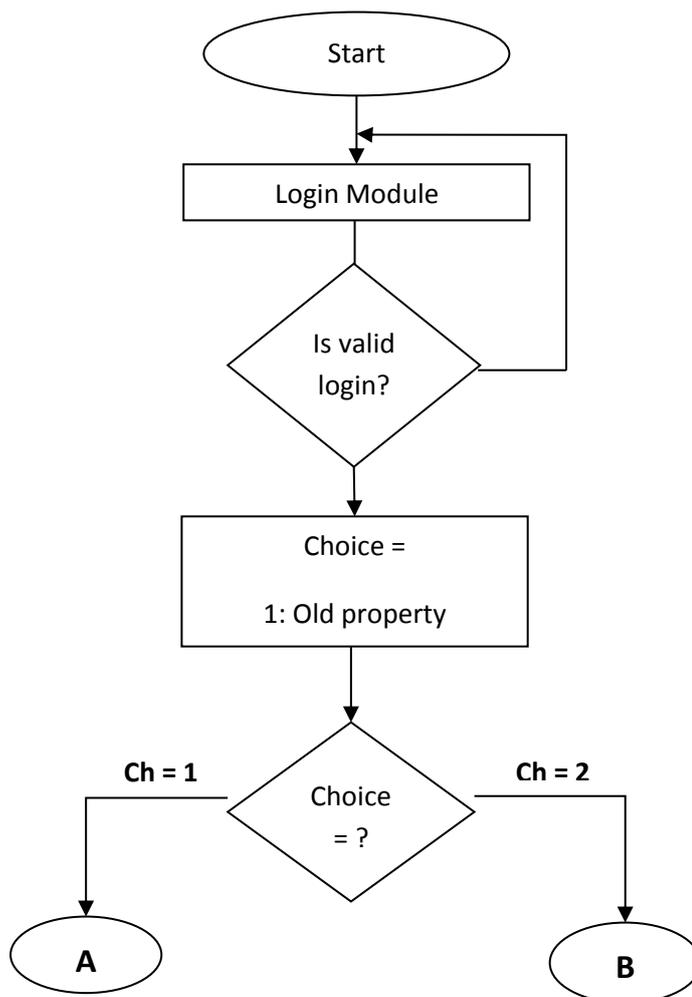


Figure 5.2: Login & Property type selection

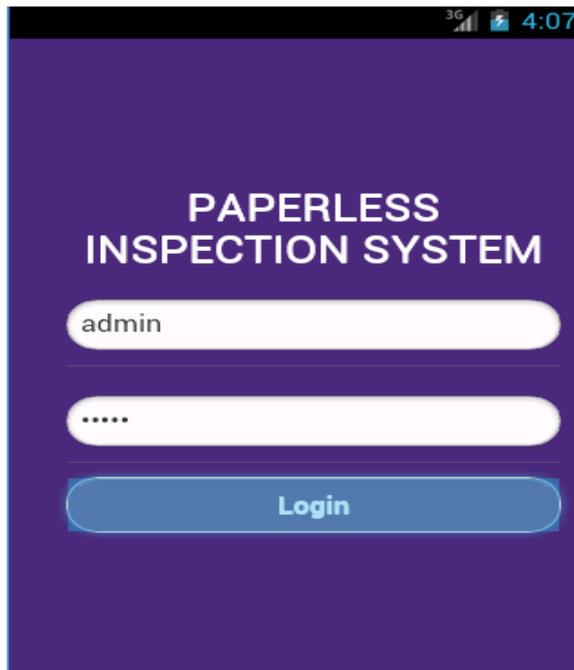


Figure 5.3: Login authentication of SMART INSPECTOR

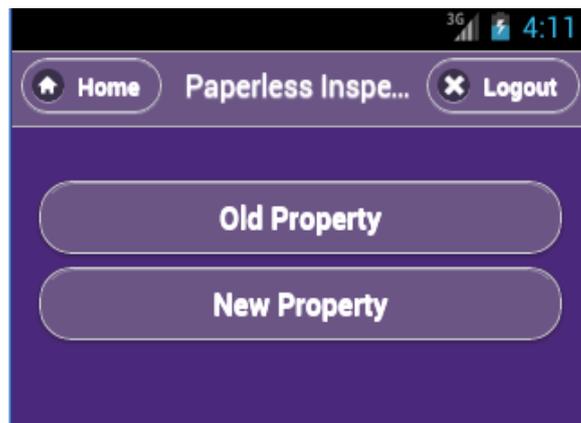


Figure 5.4: Main Menu of SMART INSPECTOR

5.3.2: Old Property Inspection

The Server has already holds the property information. Hence, the inspection of this kind of property is time consuming and needs verification of property condition against the stored data and update the parameters which has been modified after last inspection. Thus, the property account is necessary to locate the property details. This can be done by the Search menu. The user is strongly recommended to use the existing account number of that specific property (See Figure 5.5).

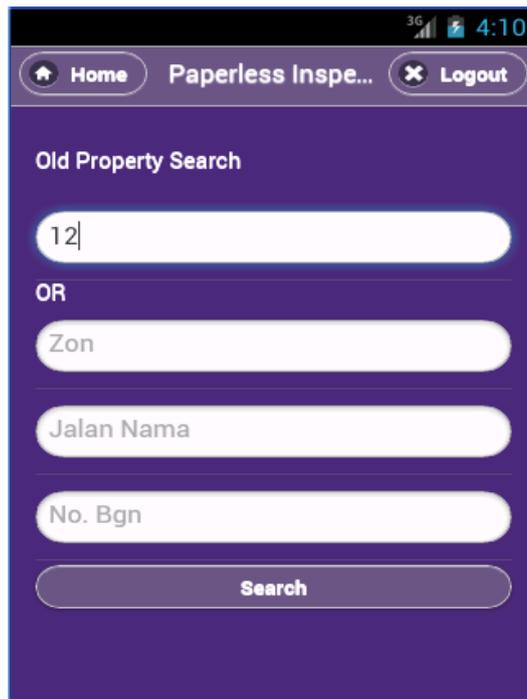


Figure 5.5: Old Property Search Menu.

Once the existing property is identified, then the PLIS App will display the menu as in Figure 5.5 to update the existing property according to the data classification namely General, *Tanah* (Land), *Bangunan* (Building), and *Ukuran Bangunan* (Building Measurements). The user needs to choose one by one and update according to the present condition of the property. Each of this menu updating is explained as the followings.

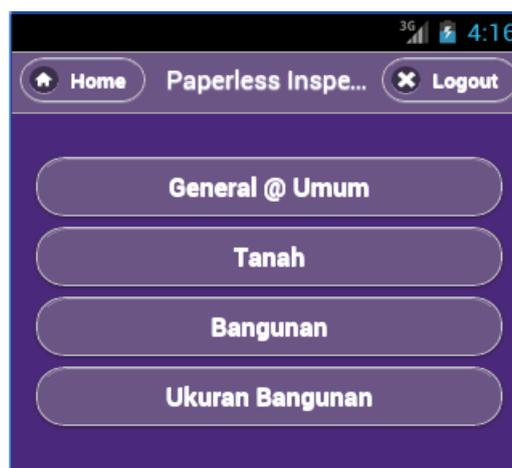


Figure 5.5: Property Details Classification for Updation.

5.3.3 General / demographic Information

The General Information module displays demographic information namely Zon, Subzon, Taman, Mukim/Kawasan, Address, Property Active Status, Property type (CBK / State / Federal / Majlis), Longitude and Latitude as Geotagging and allows the inspection personnel to change and update only in Property Active Status (Figure 5.6).

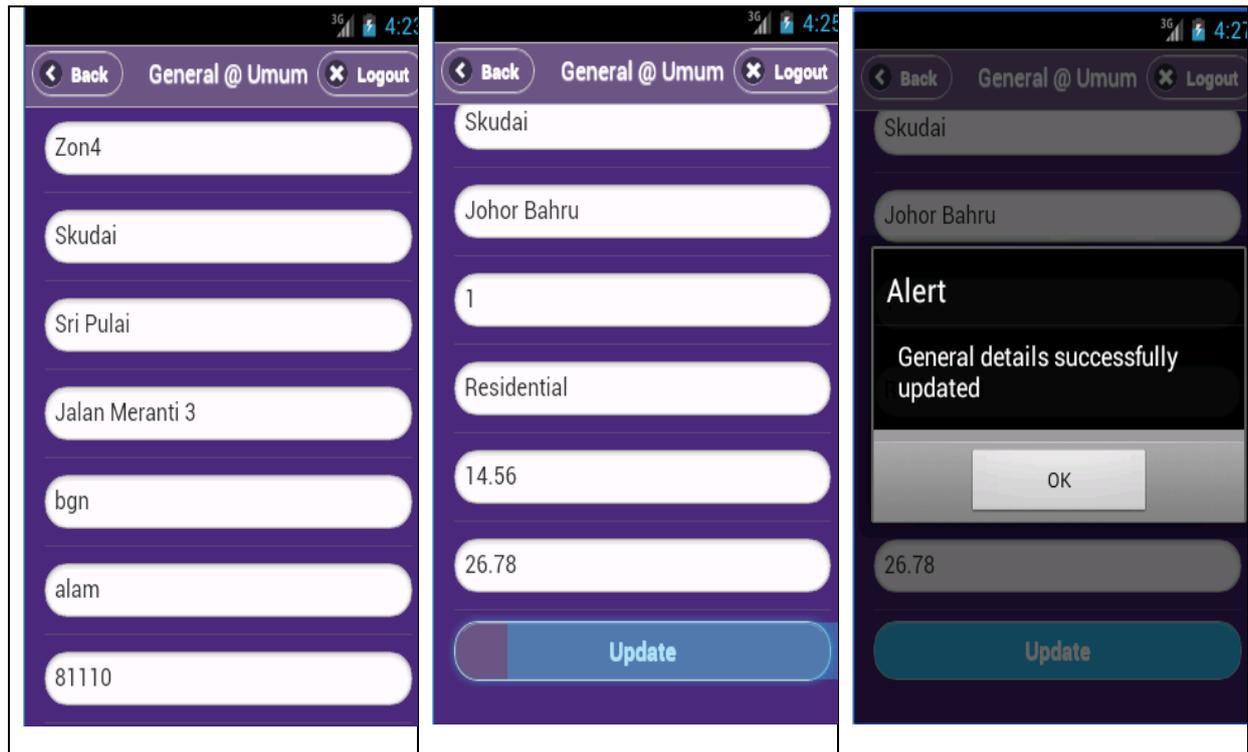


Figure 5.6: General information of Property for key-in or update.

5.3.4 Land Information

The Land information module displays the Kod, Lot type, Land type classification, Land status, Land title status, schematic land position, standard area, additional area measurements, and land use. If land use is vacant land, then the proposed land use will be displayed (Figure 5.7).

Whatever the updating under the displayed land information will be stored in a separate database. By comparing existing info and new updated info, updating on that property's land can be recorded separately under that particular property's development history.

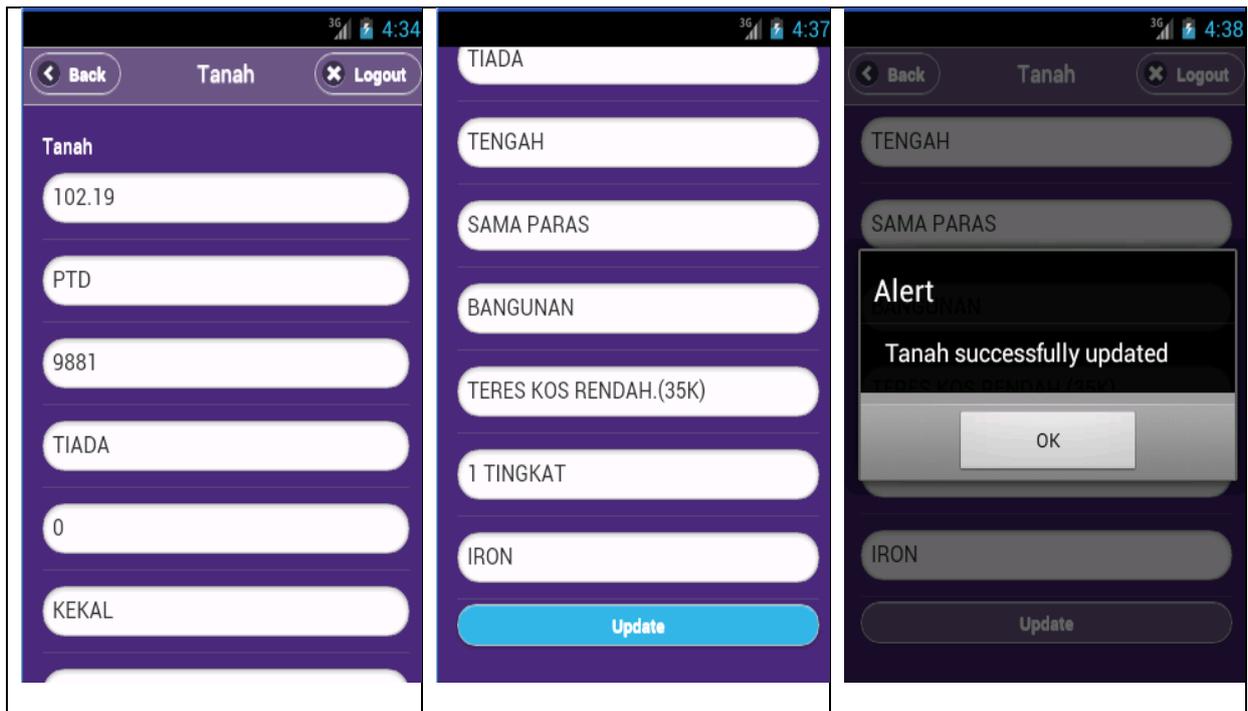


Figure 5.7: Property's Land parameters for key-in or update

5.3.5: Building Information

The building information displays the existing information about building quality namely, the building number, building structure, building condition, etc., and updations under the displayed building information will be stored in a separate database (Figure 5.8). By comparing existing info and new updated info, updating on that property's building's maintenance on quality can be recorded separately under that particular property's development history.

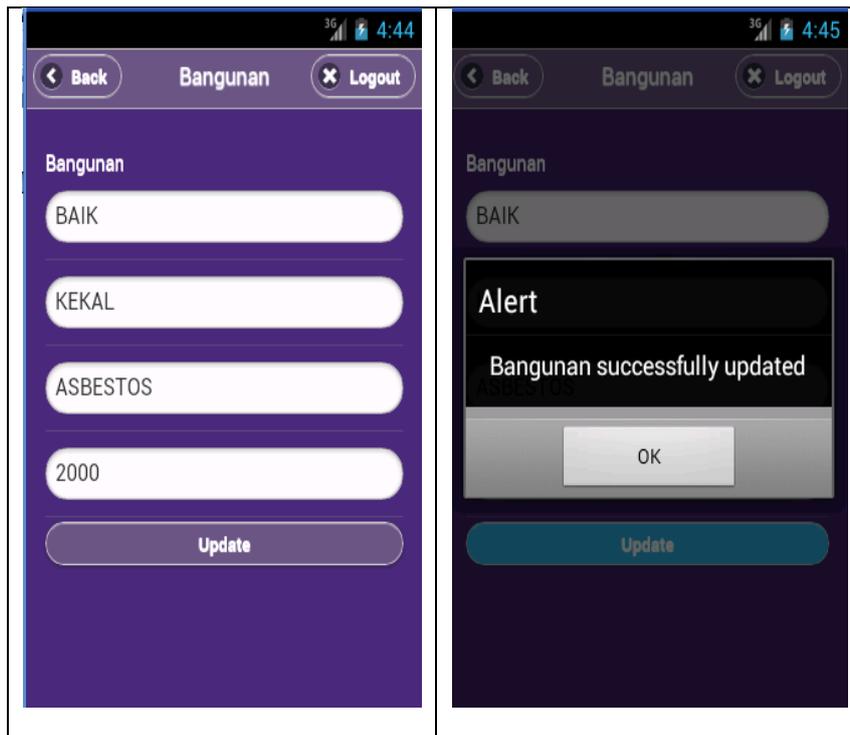


Figure 5.8: Building parameters of property for key-in or update

5.3.6 Building Measurements Information

The building measurements module displays the existing information about building measurements namely the main built-up area, the extended area, the ancillary areas according to its building levels, building layout, and building picture (refer to Figure 5.9). Updating under the displayed building measurements will be stored in a separate database. A new picture of that building is mandatory in this module as inspection evidence. By comparing existing info and new updated info, updating on that property's building's renovations can be recorded separately under that particular property's development history

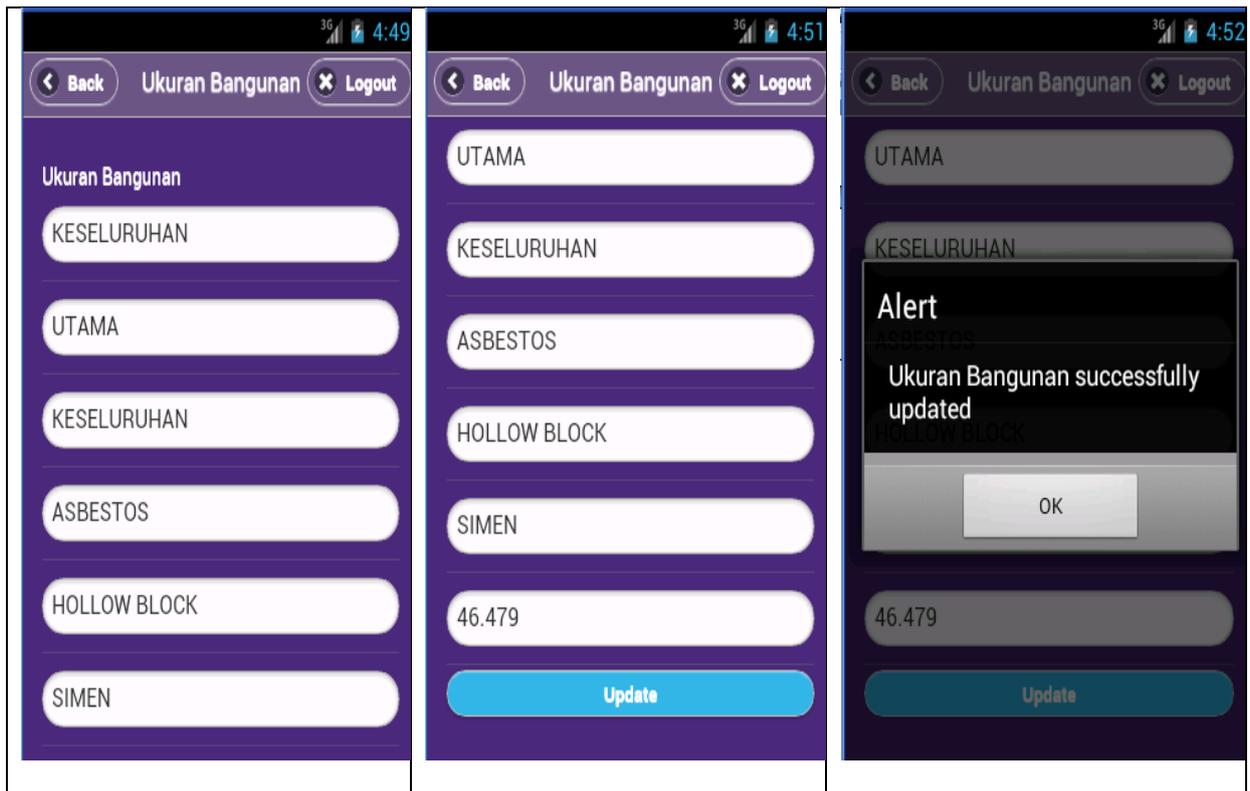


Figure 5.9: Building condition and measurement for key-in or update

6.0 TESTING AND VALIDATION

6.1 Introduction

It is imperative to test and validate the performance of the Paperless Inspection System to verify and coding development processes. The “Unit Testing” has been conducted during the system’s prototype development to identify the android coding over the manual logical process structure. To test the performance, the property inspection checking was conducted. The results of such testing are presented in this chapter while the discussion of the results is in the following Chapter 8.

6.2 Personnel Computer Configuration

The Paperless Inspection System development and testing has been conducted using an Android tablet with the following hardware configuration.

Hardware Configuration:

Operating System: Android OS with minimum 2 GB free Memory

Software Configuration for the System Development:

1. Operating System → Windows / Linux / Unix.
2. Net beans with JAVA SDK 1.2 → Programming Language used to develop the Paperless Inspection System.
3. MySQL version 5.0 → Database to store and retrieve the records.
4. AutoCAD → to create the building layout in CAD digital format to store the database.

Network Configuration to run the System:

1. Operational hours Wi-Fi Accessibility.

6.3 Validation Test Bed

To validate the paperless inspection system, 25 properties were randomly selected in Taman University, Johor Baharu area. All these 25 properties were recorded in source database. Each property's details, its building layout design, the Geographical location position are inspected and recorded in paperless inspection system's database.

6.4 Testing Aspects

Three major aspects are defined for testing and validation for the newly developed Paperless Inspection System. These three aspects are:

- (1) Paperless Property Inspection: test the implementation process of paperless property inspection.
- (2) The Performance Feasibilities: involves the system performance feasibilities such as time, man power, and economic. This performance feasibility measures the industry practice on individual calculation over manual property inspection.

- (3) Property Inspection History Development: beside paperless property inspection performance testing and feasibility, the property inspection history can be recorded in digital form to provide the development history of properties after construction to till date.

6.5 Property Inspection Validation

To test the paperless property inspection, 25 properties are randomly selected to validate the property inspection between manual and technology assisted. Registered property valuation professionals were asked to value the property range of the same properties and compared in order to verify with the paperless inspection. The research result showed that the present valuation parameters are adequately transformed to assist manual valuation knowledge with provided data.

6.6 Paperless Inspection Performance Feasibility

During paperless inspection validation, the indispensable feasibility constraints - such as i) Time, ii) Manpower requirements, and iii) Economic factors that are enhancing the system viability are considered.

Nevertheless, it is necessary to perform the feasibility validation of Paperless Property Inspection System to demonstrate its performance and assistance in property valuation. In other words, Paperless Property Inspection System should be evaluated on the performance of property inspection as a technology-assisted rather than a system. The performance of Paperless Property Inspection System is compared with the traditional Paper Based Property Inspection System (PBPIS).

6.6.1 Time Factor

Time is one of the significant constrain that determines every project's success. Time in property inspection is a major issue in local administration as thousands and thousands of properties need to be inspected within short period to value and enforce the new property tax on the latest valuated properties for the succeeding fiscal year. It is

expected that the Paperless Property Inspection System would reduce the inspection processing time tremendously.

The average of paper based inspection time is compared over paperless property inspection time (Table 5.1). Table 5.1 shows that automation and technology implementation in property inspection reduce the manual valuation processing time surprisingly.

Table 5.1: Comparison of Paper-Based and Paperless Property Inspection Time

No.	Property Nos	Paper-Based Property Inspection Time (in Hours)	Paperless Property Inspection Time (in Hours)	Average Productivity
1.	25-30 properties	4 hours/property	7 hours/All properties	57%

6.6.2 Manpower

The manpower requirement of Paperless Property Inspection System and PBPIS are tabulated as Table 5.2. The manual process requires a property inspector to inspect and record it on a paper.

Table 5.2: Man power requirement for Paperless and Paper based Property Inspection

No.	Description	Paperless Inspection	Paper-based Inspection
1.	Manpower requirement	Property Inspector with an Android – 1 Staff	Property Inspector – 1 Staff Key - in Staff – 1 Staff

6.6.3 Economic Factor

Economic is the most important factor that reduces that competitiveness and saves the project cost (Pilcher 1992). The paper based property inspection needs professionals

and considerably high quantity of stationaries to inspect and records within the required schedule. Alternatively, Paperless Property Inspection needs a property inspector and an android to carry on inspection.

The economical cost effectiveness of Paperless Property Inspection against PBPIS is measured (Table 5.3).

Table 5.3: Comparison of Economic Factor between Paperless and Paper-based Property Inspection

No.	Economic Factor	Paper-based PIS		Paperless PIS		Cost savings of PLPIS over PBPIS
		Description	Cost (RM 7)	Description	Cost (RM 7)	
1.	Manpower	7 hrs / 2	RM 98	4 hrs / 1	RM 28	70 %
2.	Paper Reports	-	RM 50	-	RM 0	100 %
3.	Equipment's			1 Android	RM 1200	
Average time Value						-

For test bed 25 properties, the stationary seems to be high investment on paperless. But when it comes to huge number of properties like 100 thousands, the stationary expenses are very huge and the investment on android will be very little.

6.7 Property Inspection History and Data Sharing

Previous data tracking is the major issue in paper based processes as it needs many paper references which may not kept in at one place, time consuming, man power requirement to do the job. Digitisation of property inspection helps to record all property inspection related data and kept digitally in single database. Comparison between two consecutive property inspections can be done Just-in-Time using digital data. Moreover, data sharing is possible to share the inspected property information by various departments such as CAD, GIS and Quality department to find the differences between old and new property information of the same properties.

6.8 Summary

The Paperless Property Information System has been tested for its technology assistance. To validate Paperless Property Information, implementation of paperless property information; The Performance Feasibilities; and Property history development are conducted. Thirty properties at Taman Universiti and Taman Sri Pulai in Johor Baharu Tengah district(MPJBT) are taken as sample data.

The same test bed properties were given to valuers and get their knowledge on property inspection on time, manpower and other constraints to validate performance. The performance feasibility factors such as i) time, ii) manpower, iii) economical effectiveness, and iv) quality has been evaluated.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

A new system that holds the general, owner, land, and building details on property inspection has been developed. The developed system has been tested with twenty five properties in Taman Universiti (MPJBT), Johor. A holistic approach to investigate the matters related to formulate a system for paperless property inspection led to the establishment of the objectives (Section 1.4).

To achieve this aim, four major phases has been undertaken namely:

- (i) A detailed literature reviews on technology assistance on property inspection and the property information storage database design
- (ii) A framework model of Paperless Property Inspection System having the manual valuation parameters designed;

- (iii) The Paperless Property Inspection System's architecture prototype using UML and the system has been coded using Net bean tool using android programming language; and
- (iv) Testing and validation of the Paperless Property Inspection System's performance.

As a result of this study's literature review, the state of art in technology implementation in property inspection is explored. In practice, other factors such as man power, cost on stationary expenses, and time are overviewed with professionals and in the local authorities met the Objective 1 (Chapter 2). Out of this overview on state of the art in property inspection, a framework was designed to reflect the manual practice. The parameters of paperless property inspection are finalised based on the existing i-ASSET system.

The framework has been verified with technical aspects and a conceptual model that depicts the framework has been formed and met objective 2 as planned in Chapter 1.4. Objective 2 of this study is more emphasized on engaging technology in manual process. The model design, the overall architecture of the framework, the database design and the module relationship are also explained in Chapter 5. The model was developed into a Paperless Property Inspection System using the language JAVA and Android and the Database MySQL. Chapter 6 explains the development of Paperless Property Inspection System where the objective 3 has been carried and assists to accomplish the aim of this research.

In order to verify the performance on Paperless Property Inspection System, the performance and its feasibilities and also the test of the research output of this work, Paperless Property Inspection System has undergone a testing well addressed in Chapter 7. The findings, the lessons learned of Paperless Property Inspection System are discussed in this chapter. It has been demonstrated that the implementation of the i-ASSET- mass appraisal system is robust to achieve the objectives as outlined.

7.2 Discussion

During the development of the Paperless Property Inspection System, most of the technical errors were found while attempting to store the data in database using third party wireless internet connection. Another issue is the data list of property contents. Though it seems very small issue, when it comes to automation, the parameters plays major role in property inspection since the loading of many parameters are essential to be considered. Although i-ASSET parameters' are synchronised, the Paperless Property Inspection System currently using only selected data list.

7.3 Conclusions and Recommendations

The test results of this study and the discussions on the system development led to conclude that:

- (i) Technology engagement in property inspection will assist property inspection in large numbers.
- (ii) A minimum of 30 % economic effectiveness in manpower is measured by introducing the Paperless Property Inspection System.
- (iii) Investment on paper is fully eradicated with maximum 100% can be achieved using Paperless Property Inspection system.
- (v) Paperless Property Inspection System would assist local authorities to enforce the valuation act 172 which recommends every local authority to reinspect properties every 5 years.
- (vi) The property inspection in terms of digital data on property can be shared within the sub divisions of Local Authorities provides better environment for data sharing.

7.4 Contribution to the Body of Knowledge

During this study, the current practices in property inspection processes and its digital formats are appreciated. This research categorised the property information into general data, ownership data, land data, and building data. Primarily, this work has initiated the technology awareness on processes and parameter standardisation.

Designed a new framework to employ technology in Property Inspection enhanced this process smart phone application. Furthermore, the Property Inspection system is programmed using Android has been developed and validated on its performance over time, cost, economic and manpower factors as a part of implementing IT in Property Inspection.

7.5 Recommendations for future research

The ongoing acceptance by the industry of tested results of this study shows that the industry obviously needs this system to apply for its everyday process. At present this Property Inspection system has been developed to perform based on the structure of i-ASSET system. This system needs further development to assists the industry's need efficiently.

Since the current Property Inspection system is currently using limited parameters, the system should consider study the inspection processing time with maximum property inspection parameters.

Moreover, this system currently supports GIS integrated environment. The GIS location of properties using GPS application has been applied while inspection. Embedding this GPS location and accuracy of GIS environment parameters can be considered to design and develop a framework to employ GIS analysis also highly recommended.