



A Prototype of High Rise Residential Management Systems in Malaysia: A Case Study for Seroja Apartment

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ABSTRACT

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Abstract—Residential high-rises are unique properties that differ from landed properties such as bungalows or terrace houses. They are unique insofar as, after the properties have been occupied, facilities must be jointly managed by residents. The continuous growth of high-rise residential buildings specifies that there is a need for effective ownership and property management system to instill a valuable living experience among high-rise residents in this country. Looking at this scenario, this research takes an initiative to develop a mobile application that supports streamline information with assistive features to improve communication and information sharing for high-rise residential management in Malaysia. This aim is achieved by answering three research objectives, including identifying user requirements, designing the application prototype and developing the artefact and evaluating the artefact. The study was conducted together with LT Sdn Bhd, the property management company responsible in managing and maintaining property related matters of Seroja Apartment. An adopted conceptual framework for property management based on the sustainable indicator dimensions for property management and applicable features from existing mobile application to develop the artefact has been proposed. The conceptual framework was proposed based on literature review and nature of work observed on site. Lastly, the study successfully validated the proposed adopted framework against the artefact, the MyLT mobile application

Keywords:

Property management,
mobile technology, mobile
apps, high-rise buildings

1. INTRODUCTION

Housing is a basic human need. This is because housing is a convenient place to live. Apart from being a connection medium with neighbors, it also can be an investment medium in income generation. Moreover, the newspapers and digital media reported that yearly demand for constructing high-rise buildings is higher in urban areas than in rural areas due to an increase in population growth rate [1]. This situation has led to the existence of a multi-storey building or known as a stratified residential building [2]. However, the housing price in Kuala Lumpur and Selangor was dramatically increased according to the news [3]. The scenario in which high-rise buildings are demanded in urban areas influence the outskirts areas

of Klang Valley, including Kajang, Bangi, Sungai Buloh, Klang, and Rawang, for the past few years. The same scenario also happened in other countries, including Australia (27.5%), Singapore (84%), and Hong Kong (95%), and has influenced the demand of high-rise residential buildings in these countries.

According to statistics revealed by the National Property information Centre (NAPIC), the residential sub-sector continued to guide the Malaysian property market, with a volume contribution of 62.7 % and a worth of 49.2 % compared to the full dealing [4].



Figure 1. Volume and Value of Transaction by Sub-sector for Q3 2017

Despite the spike in the number of new property launches especially for condominiums or apartments, the property management in Malaysia is still not expanded and no professional establishment exists to seriously develop the property management. This situation is dissimilar compared to Western and Asian countries such as Japan and Hong Kong. In the Malaysian society itself, the management and maintenance culture is still very low.

The current apply of property management in Malaysia poses on several issues touching all parties involved: developers, property managers, homeowners of parcels and residents of high- rise residential buildings. There are many reports on the problems of managing these complexes particularly in the provision of adequate services and the collection of maintenance fees.

The residential management office still practices conventional communication approaches in most cases [5] [6]. The everyday errands were taken care of physically, and all the work determined in meeting, support bills, and contact number of individuals was composed on the papers. Afterward, this data was put away through manual recording strategies. Accordingly, property managers have had an issue with keeping up and dealing with their clients and their own records.

In this manner, the possibility that the property administration wants to grasp computer and apply data innovation in the administration of the property is an issue which has pulled in a lot of consideration in property research. Property managers are looking into the benefits of leveraging technological advancements in managing their businesses to be more effective and streamlining operations. This would embody rental management, integrated accounting, reporting, web platforms, online portals, centrally managed databases, and upkeep.

In summary, this study intends to explore the problems of residential management at LT Sdn. Bhd. The study proposes a solution for the arising problems by providing a mobile application that supports streamline information with assistive features to help residents communicate better as well as to facilitate committee member manage the residential operations. This proposed solution is essential for the management and maintenance problems of high- rise residential buildings.

2. LITERATURE REVIEW

2.1 High-rise Residential Building

In Malaysia, development programs of high-rise residential are achieved by way of each the public and the personal sector. According to 9th Malaysia plan, the public area concentrates especially on public-housing (40 percentage on public housing flat and apartment) packages while the non-public sector other than complying at the 30 percent low-cost housing unit concentrates on medium and excessive-value housing applications (60 percentage on the condominium and apartment development). Currently, living in a high-rise residential is now turning into a way of life or trend some of the city professional community in Malaysia. One of the motives folks favor to live in a high-rise residential is that the facilities provided within the housing compound. Homes of high-rise residential encompass separate more than one housing devices that share the equal lot of land [7]. This sort of building provides basic amenities, together with enclosed parking, garbage chute, elevators, 24-hour security system, and swimming pool. Citizens who stay in high-upward thrust residential buildings are required to proportion the entire primary services supplied by means of the control corporation and are anticipated to observe guidelines and rules to hold the good circumstance of facilities [8].

2.2 Management of High-Rise Residential Buildings

Management may be a core part of each organization. Flourishing property management may be a tightened activity which needs relevant understanding, ability and applicable technical and structure skills similarly as resources to triumph maintain and improve property worth through to its degeneration. On paper, in managing a high-rise residential, all parties, such as the Management Corporation (MC) and therefore the residents should reach associate degree agreement on entirely management-related matters. One of each facility offered shall be managed along with the residents through a mechanism by the MC to make sure effective and flourishing management. As for MC of the high-rise residential, it's the foremost vital consider crucial the success and excellence of the organization. There are three major management factors that require to be self-addressed by MC, classified as Monetary Resource Management, Human Resource Management, and Human Capital and Building and Facility Management.

2.3 Classification of High-Rise Residential Building Facilities

There are many common facilities provided in high-rise building theme that may be enjoyed by the residents. These facilities should be maintained to make sure its practicality. All the value of maintenance works has returned from the upkeep fees. These maintenance fees are obligatory on the resident's responsibility. [3] has classified all provided the high-rise residential building facilities at theme into nine groups. These facilities were subsequently divided into three factors, namely basic facilities, exclusive facilities and support. These classifications are essential to a better management system for residential high-rise buildings.

2.4 Overview in Malaysia Context

The usual Malaysian high-rise residential management life cycle is divided into three periods namely, before the institution of the MC, throughout the initial institution of the MC, and when the whole institution of the MC, when that the developer hands over management responsibilities fully to the residents. Since April 2007, the upkeep and management of buildings and customary property in Malaysia are enforced below 2 Acts: Strata Titles Act 1985 (Act 318) and Act 663. Housing Development Act 1966 (Act 118) 1989 - P.U. (A) 58/89 Schedules G, H, I and J additionally gazette specific clauses referring to the upkeep and management of buildings and customary property. Act 663 is that the law to produce maintenance and management of buildings and shared property geared toward preservation the interest of patrons of stratified development before the registered strata title, whilst, when the registered strata title, Act 318 are going to be in effect. Act 663 introduced three entities, which are the Commissioner of Buildings (COB), the Joint Management Body (JMB) and the Management Corporation (MC). Additionally, Act 663 introduces interim periods wherever maintenance and management of buildings and customary property are placed below JMB before the registration of the strata title and therefore the MC is established. From the date of receipt of the vacant possession till when the strata title is issued, the joint building and property are going to be maintained and managed by three management bodies which are developer (initial period), JMB (interim period) and MC (end period). The Strata Management Act 2013 extends the powers, responsibilities and management periods of those 3 management bodies and COB.

2.5 Issues in Residential High-Rise Management

Most of the housing systems have not been effectively managed in this study. Residents complained about poor management of facilities, such as dysfunctional lifts, garbage not collected in accordance with the work schedule, property destruction, abuse of sinking funds and conflicts between residents. In simple terms, the problems raised by the residents focused on three elements needed to manage a facility effectively, namely finances, maintenance and people, i.e. the residents themselves. All these three aspects are, in essence, the indications for determining the performance of high-rise residential management. The development of property in this context suggests that the implementation of housing schemes provides the same balance of satisfaction between the maintenance, financial and people.

Additionally, Management's main difficult problem in managing a high-rise residential facility was the assembly of the monthly maintenance duties necessary to conduct facility management activities [5]. The upkeep dues, or charge, are fees obligatory on all the residents that are accustomed maintain the facilities. For high-rises residential, the quantity charged relies on the unit size facilities [9]. Some residents argue that the amount charged is above what they had expected, and they refuse to pay so. Some residents provided rather unconvincing reasons to avoid paying dues; for instance, some affirm that the facilities provided were not fully used [10] or that the charge was not cheap considering to the standard of service [5].

2.6 The Framework of Sustainable Indicators for Property Management

The frameworks of property Indicators for property management are classified beneath three (3) constructs, namely finances, maintenance and residents whereby each construct has its own features.

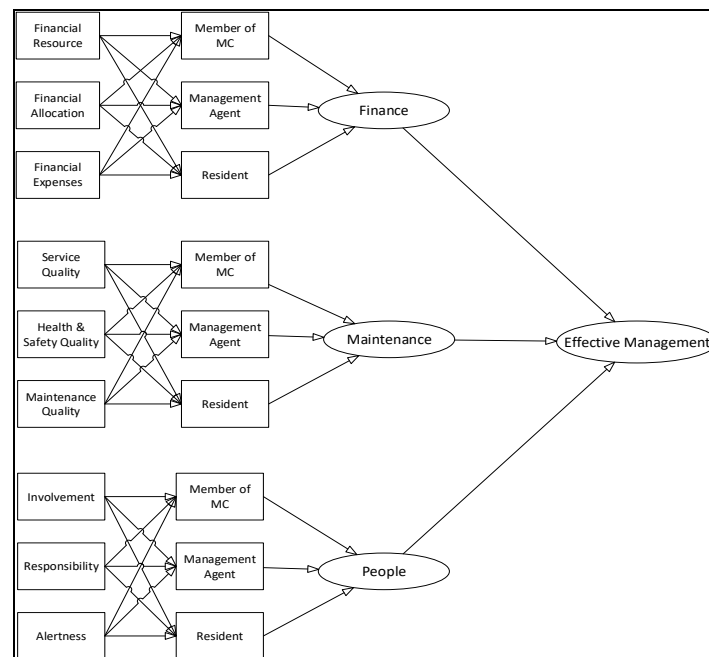


Figure 2. The Framework of Sustainable Indicator for Property Management

As portrayed in Figure 2, the framework shows the relationships among 12 variables in mensuration the management gap. Every variable may be a property indicator for residential high-rises. They are three classified constructs, namely, finances, maintenance, and resident. Every one of those constructs has its own dimensions. In between these constructs and dimensions, there are the various classes of respondents which are member MC, management agent and resident. The finances construct has three dimensions, namely, money resources, money allocation, and money expenses. In medium and high-cost residential high-rises, the number of collected maintenance charges was only enough to run the facilities. Therefore, finances ought to be planned via wise allocation and observance of expenses. As an example, allocations for cosmetic recovery ought to be the last agenda in housing maintenance activity [11]. Effective management is not just supported the gathering of funds itself however conjointly on the capability to effectively manage restricted resources in line with would like [12]. The second construct, i.e., maintenance, also has three dimensions, namely, service quality, health and safety quality, and maintenance quality. Building maintenance is one in all the crucial tasks in facility management. It conjointly plays a serious role in providing property housing. On paper, maintenance will be seen from a ‘hard’ or ‘soft’ perspective. The ‘hard’ perspective refers to the upkeep output or product in so far because the resident will see and feel the impact of maintenance work. As an example, landscaping provides well-kempt scenery that the resident will directly read and luxuriate in. The ‘soft’ perspective considers the service quality with relevance affecting the actual work. This angle focuses additionally on the human response, that is, client service. With relevance health and safety quality, maintenance is usually undertaken to safeguard residents’ health. In alternative words, they must feel secure and cozy living among their compounds.

Third, the analysis considers the resident construct that conjointly has three dimensions, namely, resident involvement, resident responsibility, and resident alertness. For facility management to be effective, the end-user should be able to respond effectively to management. The participation of residents is crucial since all management activities are designed for and dedicated to them. Additionally, residents pay the upkeep charges. Residents ought to be concerned at the Annual General Meeting accustomed founded the megacycle per second, since this can be once the quantity of the monthly fee is decided and agreements are created in line with the STA (Strata Title Act). Aside from involvement, the residents ought to conjointly perceive their responsibilities as members of their residential communities. Therefore, they must embrace a neighborly spirit and avoid selfishness; the extent to that residents do therefore seems for the most part obsessed on the residents' background and standing which referring to the owner or tenant. Finally, residents ought to even be alert relating to on-going changes, like housing rules, community activities among their housing theme, environmental conditions, and maintenance service standards, particularly routine maintenance work. (Refer Table 4 for the Mapping Property Indicator to the Mobile Application Features).

2.7 Related Works

Technology is used in a wide variety of innovative ways to connect residents and property managers, facultative mobile phones as a brand new methodology of communication. The adaptation of mobile applications will build property management easier and manageable, whereas facultative standards and quality to be maintained. In Malaysia, there are many property firms are seeking the initiatives in the incorporation of mobile technology as envision a two-way communication tool between management and residents. Several property-related mobile applications that obtainable within the market are Landlords, Graaab JagaApp, ADDA, ApnaComplex.

2.8 Gap Analysis

There are several techniques out there for data sharing and communication among the community. This study focuses on streamlining communication and data sharing in residential living accommodations community. Table 1 represents the comparison of the prevailing property management mobile apps worldwide. As summarize, the study tends to sort the options into four main classes specifically data, communication, charge, and society.

Table 1. A Comparison of Existing Property Management Apps

App Name	Country	Features
Landlords	Malaysia	<ul style="list-style-type: none"> • Delegate internal team to perform daily work • Perform daily works such as record payment, booking, complaint etc • Recording defect on building and solving defect & complaint
Graaab JagaApp	Malaysia	<ul style="list-style-type: none"> • Advise those who matter that the majority, neighbour-hood guards, members of the family and friends • Entail help, or report a scenario immediately with decision guard perform • Receive advance notifications on poignant matters • Pre-register visitor for a quicker entry while maintaining privacy and security • Engage directly on various problems with the committee or management. • Book communal facilities • Permits all community forms like renovation forms and access card requests to be crammed up in-app • Shop around for the most effective qualified professionals and online services
ADDA	India	<ul style="list-style-type: none"> • Real-time notifications so that residents do not miss important information • Connect with neighbours with similar interests • Participate in polls created by other owners, residents or association • View society maintenance dues and make payment • Maintain all maintenance due payment history • Lodge any complaint related to the apartment and track the progress to closure.
ApnaComplex	India	<ul style="list-style-type: none"> • Collaboration tools such as notice boards, discussion forums, and photo galleries

App Name	Country	Features
		<ul style="list-style-type: none"> • Facility management tools such as asset tracker, inventory tracker, vehicle and parking lot management • A complaint box enabled with service level agreements and auto-escalation • Broadcast SMS Notifications to all Owners / Residents of the Apartment Complex

3. RESEARCH METHODOLOGY

This study has been used Creswell's analysis style [13]. As the focus of this study is on streamlining communication and data sharing, design thinking was used to control the style of analysis. Design Thinking could be a method that uses innovative, creative, analytical and empathic skills to create long- term and understood disadvantage solutions.

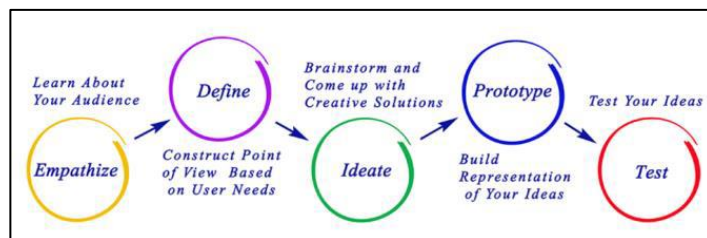


Figure 3. Design Thinking Process

Phase 1: Empathize

Empathize revolves around the matter, which must be perceived from the attitude of users in order to grasp the matter and to better understand what is required as a response to the matter [14]. During this part, this study has a tendency to know the management and maintenance processes and users' desires, likewise as challenges in every day's life as a community in high-rise residential.

The two primary activities in this section are the preliminary study and collection of data. The preliminary study involves exploring the field in order to identify the issue to be addressed. The collection of information for this study comprises literature review and semi-structured interviews. Several outcomes were outlined during this part of the study like analysis background, analysis queries, analysis objectives, and analysis scope.

The preliminary study consisted of articles from journals, books, articles, proceedings and the creation of observations to investigate the contrast between the prevailing mobile applications. Elements were developed to give this study a transparent understanding.

The literature reviews focus in mobile technologies that may supports in streamlining communication and knowledge sharing of high-rise residential community. Next, the interview was conducted to collect the corporate demand includes the technologies used, work flow and work procedures, routines, development needs likewise as future maintenance necessities and designing.

Phase 2: Define

The main issues in provisioning of adequate services towards managing and maintaining high-rise residential complexes were analyzed and exploit all the knowledge gathered within the previous part. The most important activity during this part is analyzing information collected from literature review and semi-structured interviews then synthesis them to outline the matter statement. Since the main focus of this study is real scenario of managing high-rise residential buildings by a property management company, qualitative analysis will be conducted through the cross-reference of the literature review with the meeting notes.

Cross- referencing the meeting notes with the comparative study results in this part as outlined drawback statement meaning of the study and therefore the Functional Requirements (FR) and Non- Functional Requirements (NFR) for the mobile app are then used as tips for further study phases.

Phase 3: Ideate

The Ideate part is conducted with the participants on the site. This part is completed when information is analyzed and knowledge from the previous part is gathered. A co-creation session was coordinated to urge engaged round the issues that want to unravel. Throughout this session, a brainstorming technique was accustomed perceive and range the management nature of works and envision mobile application to enrich their existing operating activities. This enables us to clarify their goals and values and to agree on the required outcome of the study.

The outcome of the group action session is associate Affinity Diagram. An Affinity Diagram is a tool that collects large amounts of language knowledge (ideas, viewpoints, problems) and arranges them into groups that support their natural interactions. Throughout this session, range ideas for application content and style were mentioned by using the tools like Microsoft electrical outlet, Whiteboard, Flipchart and Sticky Notes.

Phase 4: Prototype

In this phase, the study tends to make the planned resolution iteratively according to the most important themes unreal in the previous section. Our prototype has been constructed using Android Studio, the official integrated development environment (IDE) for the Android Google package and specifically designed for Android development.

This part requires to rework the flow diagram and the wireframes into the executable prototype by programming the codes using Android Studio and then customizing the prototype with the known Use Case Diagram.

Phase 5: Test

This part involves participant feedback for the prototype developed in previous part. The most purpose of this part is to validate the prototype developed in accordance to the adopted abstract framework and to simply accept or reject the quality of the property management components planned within the study.

The method used in this section is the Think Aloud Protocol, the participants were asked to use the prototype while constantly verbalizing their thoughts as they move through the prototype. Think Aloud Protocol was chosen to enable us to get what the participants think about the look of the prototype.

4. FINDINGS AND ANALYSIS

Phase 1 activities such as preliminary studies, literature reviews and semi- structured interviews with management officers of LT Sdn Bhd were conducted. During Phase 2, the study tends to have cross- referenced results from literature reviews and interviews with management representatives of LT Sdn Bhd to provide functional and non- functional requirements for mobile application. A comparative study of the four mobile apps specifically for property management has been done. As represented in Table 2, four main classes were known from the options comparison of existing mobile application particularly Information, Communication, Society and Monetary. Next, the research process proceeds with a comparative study of mobile application reviewed by the services offered, as shown in Table 3.

Table 2. A Classification of Mobile Apps Service Offered

App Name	Features	Category
Landlords	<ul style="list-style-type: none"> • Delegate internal team to perform daily work • Perform daily works such as record payment, booking, complaint etc. • Recording defect on building and solving defect & complaint 	<ul style="list-style-type: none"> • Information • Communication
Graaab JagaApp	<ul style="list-style-type: none"> • Advise those whom matter that the majority, neighborhood guards, relations and friends • Necessitate help, or re-port a scenario with the Call Guard function immediately • Receive expedited notifications on community issues • Visitor pre- registration for a speedier entry whiles maintaining privacy and security • Communicate on numerous problems directly with the committee or management • Book communal facilities 	<ul style="list-style-type: none"> • Communication • Information

App Name	Features	Category
	<ul style="list-style-type: none"> Permits all community forms like access card requests and renovation forms to be stuffed up in-app Shop for the best qualified experts and services online 	
ADDA	<ul style="list-style-type: none"> Real time notifications so that residents do not miss an important information Connect with neighbors with similar interests Participate in polls created by other owners, residents or association View society maintenance dues and make payment Maintain all maintenance due payment history Lodge any complaint related to the apartment and track the progress to closure. 	<ul style="list-style-type: none"> Communication Information Society Financial
ApnaComplex	<ul style="list-style-type: none"> Collaboration tools such as notice boards, discussion forums and photo galleries Facility management tools such as asset tracker, inventory tracker, vehicle and parking lot management A complaint box, enabled with service level agreements and auto-escalations Broadcast SMS Notifications to all Owners / Residents of the Apartment Complex 	<ul style="list-style-type: none"> Communication Information

Table 3. A Comparative Study Matrix

App Name	Categories			
	Communication	Information	Society	Financial
Landlords	✓	✓	✓	✓
Graaab JagaApp	✓	✓	✓	✓
ADDA	✓	✓	✓	✓
ApnaComplex	✓	✓	✓	✓

Based on the gap analysis in literature review and comparative study, the research tends to propose an adopted conceptual framework by mapping the common mobile application options to the property Indicator Frameworks from [11] as in Table 4. Aside from that, Figure 4 illustrates the adopted framework for property management.

Table 4. Mapping Sustainable Indicator to the Mobile Apps Features

Sustainable Indicator	Dimensions	Mobile App Features
Financial	Financial Resources	<ul style="list-style-type: none"> Online Billing Financial Reporting Financial Tracker
	Financial Expenses	
	Financial Allocation	

Sustainable Indicator	Dimensions	Mobile App Features
Maintenance	Service Quality	<ul style="list-style-type: none"> • Online Chat • Notice Boards • Online Complaints Form • Info Zone • Emergency Contacts • Broadcast SMS
	Health and Safety Quality	
	Maintenance Quality	
People	Resident Involvement	<ul style="list-style-type: none"> • Polls Participation • Discussion Forum • Make a payment on fees and charges • Real-time Notification
	Resident Responsibility	
	Resident Alertness	

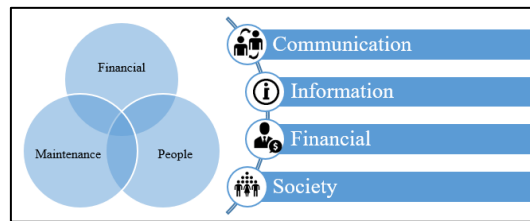


Figure 4. Adopted Conceptual Framework of Property Management

Based on the comparative study matrix in Table 3, it will be all over that each of four reviewed applications are comparable to a minimum of one class of the planned framework. To beat the gap mentioned within the comparative study, and to supplement the present method flow of LT Sdn. Bhd., MyLT has been proposed which consists all four classes of our adopted framework. The options of the mobile application are classified in step with the comparative study matrix. Functional demands for the selected options are achieved through the cross- reference of the comparative study with the meeting notes. Table 5 shows the practical needs for the planned mobile application

Table 5. Functional Requirements for MyLT

ID	Description	Explanation
FR-01	Users should be able to join up	Users must be able to register with their email and password by filling out a form
FR-02	Users should be able to log into the app	Users should be able to register with their email and password in the app
FR-03	Users should be able to choose kind of users before login	Users must be able to select either committee or resident user type prior to login
FR-04	Users should be able at any time to sign off the app	Users must be able to log out of the app and press the log out button in the app header menu at any time.
FR-05	The app should provide an error- identification message in case of an error during login or registration	The app should display an error message to the user, emphasising the error if any of the login / registration form input details are incorrect.
FR-06	Users should be able to produce multiple account	Users must be able to create multiple account for each profile.
FR-07	Users should be able to read request outline	Users should be able to view summary of billing at the home page screen

FR-08	Users should be able to produce new criticism	Users must be able to create new complaint from the app
FR-09	User should be able to read criticism standing	User should be able to view complaint status from the app
FR-10	Users should be able to browse abreast of notices	Users should be able to read up on notices on the app
FR-11	Users should be able to browse abreast of announcements	Users should be able to read up on announcements on the app
FR-12	Users should be able to receive push notification	Users must be able to receive push notification of new notices and announcement
FR-13	Users should be able to receive request reminder	Users should be able to receive reminder of billing
FR-14	Users should be able to connect to the cluster chat	Users should be able to log into the app's chat function using their selected screen name

Phase 3 results with affinity diagrams, flowchart and wireframes, whereas the result of phase 4 is the operating prototype of the mobile application. These outcomes were derived from the co-creation sessions with social control representatives of LT Sdn. Bhd. Figure 5 illustrates the initial wireframes of MyLT, divided by modules.

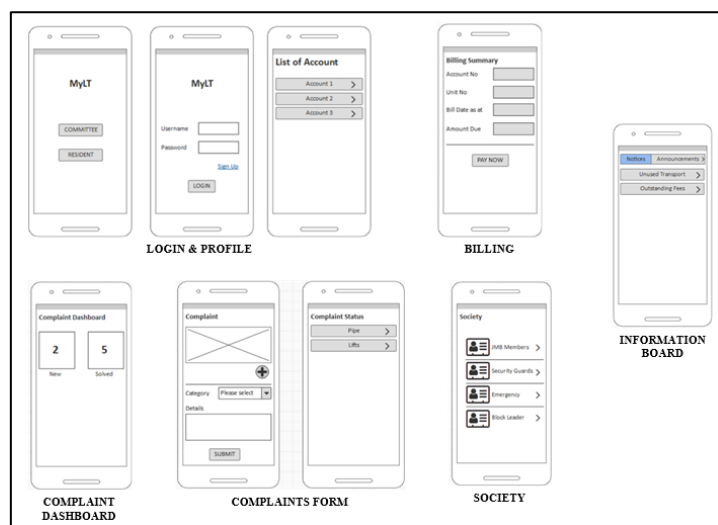


Figure 5. Initial Wireframes of MyLT

After the design phase has been completed, the study proceeds with the development of an MyLT prototype. The platform chosen for developing MyLT is an Android Studio development tool. The subsequent segment mentioned how MyLT was developed using Android Studio. After that, testing was performed to work out on how well the artefact work will. During this section, how well the mobile application as a platform has been ascertained to boost service of quality and expertise for high-rise residential management with ascertained findings. For this phase, the results of the functional testing and non- functional testing are presented before the feedback and proposals of the user are discussed.

5. CONCLUSION AND RECOMMENDATION

The very first objective is achieved with the stakeholder interview in the empathy section. The stakeholder has gone through the present method of management tasks, the communication and data sharing between the community. The need has been mapped with the adopted framework for streamlining communication and data sharing in residential management. The framework encompassed of data, communication, society, and money. These classes complement one another in making a holistic mobile application platform to contour communication and data sharing of high-rise residential management.

The second objective is achieved throughout ideate and prototype phase. The ideate phase concerned a co-creation session with LT Sdn Bhd representatives wherever a prototype affinity diagram is delivered. This can be followed by identifying the relevant MyLT modules. The prototype section is achieved when MyLT is developed using the deliverables from the ideate phase using the Android Studio Development Tool. This prototype can guarantee all Functional and Non-Functional necessities are enforced and dealing properly. Once the task is completed, the mobile application is prepared to be tested by the participants to get the feedback. The third objective is achieved in the Test phase. MyLT has been tested with ten participants encompass residents and member of MC appointed by LT Sdn Bhd. The analysis based on the Think Aloud approach was conducted to seek out the user satisfaction towards the functionalities of the mobile application. After that, the result has been analyzed and came out with recommendations supported which look on the interview question result. There are several upgrades and improvements that can be done for the management of apartments to curb communication and data sharing. The fix can be improved to allow users of several apartments to register on the same platform. This could be helpful because independently of the apartment in Seroja, property managers usually manage multiple residences. The system would be ready to enable property managers to manage several residences in a single platform comprehensively.

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REFERENCES

- [1] Noor, M., & Eves, C. (2010). Malaysia High-Rise Residential Property Management: 2004 2010 Trends & Scenario. 17th Pacific Rim Real Estate Society Conference, 2004–2010.
- [2] Ta, T. L. (2006). Managing High-Rise Residential Building in Malaysia: Where Are We? Naprec Conference, Inспен, 1–25.
- [3] Rashidah, S., Wahab, H. A., Irfan, A., Ani, C., Sairi, A., Tawil, N. M., Razak, A. (2016). Classification of High-Rise Residential Building Facilities: A Descriptive Survey on 170 Housing Scheme in Klang Valley. *Ibcc 2016*, 00103, 1–4.
- [4] Report, P. M. (2017). *Separuh Pertama 2017*. Retrieved from <http://napic.jpjh.gov.my/>
- [5] Nguyen, P. T., Nguyen, T. A., Truong, N., Ha, H., & Nguyen, T. N. (2017). Facilities management in high rise buildings using building information modeling. *International Journal of Advanced and Applied Sciences*, 4(2), 1–9.
- [6] Foth, M., & Sanders, P. (2005). Social Networks in Inner-City Apartment Complexes and the Implications for the Residential Architecture of Public Space. *Proceedings Digital Cities*.
- [7] Building Industry Consulting Service International (BICSI). (2002). *Cabling Installation Expo and Workshop*, October 22-24, Rhode Island Convention Center.
- [8] Quiter JR. (2008). High-rise buildings. In: *Fire Protection Handbook*. 20th ed. Quincy, MA: National Fire Protection Association, pg 20–80.
- [9] Malaysia Government, *Panduan Bersama Dalam Kehidupan Bertingkat (Guideline of Community Living in Multi-Storey Residential)* (2003). Edition 1, Jabatan Ketua Pengarah Tanah & Galian, Kementerian Sumber Asli dan Alam Sekitar.
- [10] Jamila, H. (1994). *Strata Title In Malaysia*. Selangor: Pelanduk Publications (M) Sdn. Bhd.
- [11] Amarilla, B.; Dubowitz, R.; Hasse, R. (2002). *Social Housing Maintenance*. Proceedings of The XXX IAHS World Congress on Housing. 9-13 September 2002. Edited By: Oktay Ural, Vitor Abrantes, Antonio Tadeu. Portugal: Pedro Batista –Artes Graficas, Lda. pp. 1951-1957. Malaysia High-Rise Residential Property Management: 2004-2010 Trends & Scenario. Available from: https://www.researchgate.net/publication/266073395_Malaysia_High-Rise_Residential_Property_Management_2004-2010_Trends_Scenario [accessed Feb 18, 2019].
- [12] Tawil, N. M., Md. Yusoff, Y., CheAm, A. I., Abdullah, N. A. G., & Surat, M. (2012). A study of management corporation financial in high rise residential with correlation of management fund and faculties provided. *International Business Management*.
- [13] Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Thousand Oaks, California: SAGE Publications
- [14] Petersen S., Houston S., Qin H., Tague C., Studley J. (2017). The utilization of robotic pets in dementia care. *J. Alzheimers Dis.* 55, 569-574. 10.3233/JAD-160703