

RESEARCH ARTICLE

Mobile Application on Malay Medicinal Plants based on Information Crowdsourcing

Wan Abdul Rahim Wan Mohd Isa¹ • Indah Mohd Amin^{2*} • Norhidayah Saubiran³

¹Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Malaysia. E-mail: wrahim2@uitm.edu.my

²Faculty of Dentistry, Universiti Teknologi MARA, Malaysia. E-mail: indahmohdamin@gmail.com

³Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Malaysia. E-mail: hidayahsaubiran@gmail.com

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ABSTRACT

Mobile Application on Malay Medicinal Plants Based on Information Crowdsourcing is an application that provides information on Malay medicinal plants. The information in this application is obtained from a crowd of people including researchers, Malay villagers, traditional medical practitioners, and the public who are willing to share their knowledge and information on Malay medicinal plants. This project focuses on the use of Malay medicinal plants that contain nutrients which is good for human health. There are a lot of Malay medicinal plants founded by the researcher that can help to treat human illnesses. This project involves crowdsourcing. Crowdsourcing is the best way for people to get information from the researchers and crowd people. This project is related to crowdsourcing information systems. Crowdsourcing information systems are information systems that produce informational products or services for internal or external customers by utilizing the potential of crowd people. This project promotes knowledge sharing and awareness among researchers, Malay villagers, traditional medical practitioners, and local herbs entrepreneurs, and the public towards Malay medicinal plants. This project applies the concept of Wikipedia whereby the information is obtained from a crowd of people. It allows the researchers, Malay villagers, traditional medical practitioners, local herbs entrepreneurs, and the public to share their knowledge and findings on Malay medicinal plants on the internet easily. This project also focuses on motivating the public that there are a lot of Malay medicinal plants that can be used for health care. This project is developed in the Malay language as it provides information on Malay medicinal plants and the target user is Malaysia's citizens. For future enhancement, this project plan to be developed in English and wider target users from other countries.

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Introduction

This project focuses on information sharing between the crowd of people on the information and knowledge for Malay medicinal plants. The medicinal plant is defined as a group of plants that are used for medicinal purposes and contains special features that qualify them as articles of drugs and therapeutic agents (Ahmed & Kabilul Azam, 2014). There is a lot of benefit of the Malay medicinal plants. The medicinal plant is important for health care, and it can be used as a treatment.

Malaysia's plants are broadly valuable for their unique aromas and tastes; moreover, most of these plants are categorized as traditional medicine and can be used to treat human disease (Alsarhan, Sultana, Al-Khatib, & Abdul Kadir, 2014). In the area of modernization, the recording of traditional knowledge of medicinal plants is very important because traditional knowledge might cause changes or even loss (Chooi Ong, Mat Zuki, & Milow, 2011). Currently, a lot of people do not practice the use of traditional medicine. Malaysian citizens, especially those living in cities, have less knowledge of Malay medicinal plants that can help to treat human diseases. Their perception of how to treat human diseases is more on the modern medicinal. The young generation also has low knowledge about Malay medicinal

* Corresponding author: indahmohdamin@gmail.com

plants. Caused by a lack of knowledge and interest among the young generation, some of the information related to traditional medicine will be buried along with the previous generation.

Many Malays medicinal plants can be used to treat human diseases in our country. According to the folk botanical survey conducted in Kampung Tanjung Sabtu, Terengganu, Malaysia, this survey recorded 52 species of medicinal plants used in one village (Ong, Ruzalila, & Milow, 2011). The findings and knowledge regarding the Malay medicinal plant need to be shared with other people through the internet about the knowledge on the importance and the use of Malay medicinal plants. Most of the villagers are willing to share their traditional knowledge of herbal medicine with other people (Chooi Ong, Mat Zuki, & Milow, 2011). Unfortunately, it is not an easy way for them to share their knowledge on the internet. This is because they need to take a lot of steps to share their information on the internet. This will cause a lack of knowledge sharing among people towards the medicinal plants. The findings and knowledge regarding the Malay medicinal plant need to be shared with other people through the internet because nowadays the internet use is growing.

As everyone knows, there is a lot of information and knowledge regarding Malaysia's natural herbs on the internet. This knowledge is disorganized on the internet and merely own by local people that cause difficulty in forming a knowledge-based system (Sahri, Nordin, & Harun, 2012). Even though the information is easily accessible however it is disorganized on the internet. The data can be kept in the database. However, there are a lot of challenges in the process of developing a database of medicinal plants for ethnopharmacological knowledge sharing (Ningthoujam, Talukdar, Potsangbam, & Choudhury, 2012). Ethnopharmacology is related to the use of plants. There are many types of medicinal plants that need to be shared and if the data is kept in the database, it can cause a problem like overlapping of data and data redundancy. Issues that are related to data standards, data linking, and unique identification should be handle in addition to general issues for example lack of updates and sustainability (Ningthoujam, Talukdar, Potsangbam, & Choudhury, 2012).

This project is developed based on the concept of a crowdsourcing information system. A system is a set of interrelated components or elements that work together to achieve an overall objective (Geiger, Rosemann, Felt, & Schader, 2012). Crowdsourcing information systems are information systems that produce informational products or services for internal or external customers by utilizing the potential of crowd people (Geiger, Rosemann, Felt, & Schader, 2012). A crowd in this context refers to a group of people that is addressed via an open call for participation in a particular task. The essential work in crowdsourcing information systems is conducted by the crowd whereby the activities and processes in such systems rely mainly on contributions from the crowd to produce new information or modify existing information (Geiger, Rosemann, Felt, & Schader, 2012).

1. Mobile Application on Malay Medicinal Plants Based on Information Crowdsourcing

This project will develop a mobile application on Malay Medicinal Plants based on information crowdsourcing. This project can allow the researchers, Malay villagers, traditional medical practitioners, and public to share their knowledge and finding on Malay medicinal plants with other people. The important source of raw material for traditional medicines is medicinal plants and many people earned from the collection of these plants. The design of the user interface of this project is based on the concept of a user interface of social media.

The strength of this project is it used the concept of a crowdsourcing information system, whereby the information of medicinal plants in the application is provided by a crowd of people. This project promotes knowledge sharing and awareness among researchers, Malay villagers, traditional medical practitioners, and local herbs entrepreneur, and public towards Malay medicinal plants. This project focus on motivates the public that there are a lot of Malay medicinal plants that can be used for health care. This application will help the researchers, Malay villagers, traditional medical practitioners, and the general public whereby they can share their findings and post them, and other people can view, read and get information. Registered users are allowed to edit descriptions and the images of the medicinal plants whether to add or update. Unregistered users can view the content of this application and get valuable information. Both users can bookmark any information. Furthermore, this application also provides a forum for the registered user so that they can write their comment or question at the comment text box provided. This will lead to a conversation between users. An internet forum is an online discussion site where people can create conversations in the form of messages. This project is developed in the Malay language as it provides information on Malay medicinal plants and the target user is Malaysia's citizens.

An example of an existing mobile application on medicinal plants is "Medicinal Plants". This application published the information for general and educational purposes only. It provides information for medicinal plants by listing the names and users can view and read it. It provides the description, usage, and other names of the medicinal plants. The information provided is limited that is only for certain medicinal plants.

2. Problem Statement

In Malaysia, there are various kinds of Malay medicinal plants that were found. According to the folk botanical survey conducted in Kampung Tanjung Sabtu, Terengganu, Malaysia, this survey recorded 52 species of medicinal plants used in one village (Ong, Ruzalila, & Milow, 2011). Most of the villagers are willing to share their traditional knowledge of herbal medicine with other people (Chooi Ong, Mat Zuki, & Milow, 2011). Unfortunately, it is not an easy way for them to share their knowledge on the internet. This is because they need to take a lot of steps to share their information on the internet. For example, if they want to share information on the blog, it is not an easy way to

create a blog. In the area of modernization, the recording of traditional knowledge of medicinal plants is very important because traditional knowledge might cause changes or even loss (Chooi Ong, Mat Zuki, & Milow, 2011). Malaysian citizens, especially those living in cities, have less knowledge of Malay medicinal plants that can help to treat human diseases. The young generation also has lacked knowledge about the Malay medicinal plants. Caused by a lack of knowledge and interest among the young generation, some of the information related to traditional medicine will be buried along with the previous generation.

Moreover, the existing application provides information only for certain types of medicinal plants. The information provided is limited. Besides that, the user only can view the content and cannot add or edit the content of the application. According to the interview conducted with one of the patients (public) and said that,

“The existing application that provides information on medicinal plant, however, provides the limited information which is only for certain medicinal plants. The user only can view the content and cannot add or edit the content of the application”

Mobile applications on medicinal plants based on information crowdsourcing used the concept of crowdsourcing information systems. It allows the researchers, Malay villagers, traditional medical practitioners, local herbs entrepreneurs, and the public to share their knowledge and findings on Malay medicinal plants on the internet easily. They can just upload the picture of the plants and provide a description and the scientific name of the plants. They are also able to add and edit the content of the application. Other people can view the content of the application. This project promotes knowledge sharing and awareness among researchers, Malay villagers, traditional medical practitioners, and the public towards Malay medicinal plants. As people can easily get the information and knowledge of medicinal plants, their interest in the use of medicinal plants will grow. This will motivate them to practice the use of medicinal plants in their daily life. This application also provides a forum for the registered user so that they can write their comment or question at the comment text box provided. This will lead to a conversation between users. The data and information of this application are from the users themselves not from the database. This is because there are a lot of challenges in creating the database for the medicinal plants because of too much data on medicinal plants on the internet. People also will be able to get a lot of knowledge and information on medicinal plants from a crowd of people.

3. Research Question

- How to design the user interface elements for this application based on information crowdsourcing?

4. Project Objective

The objective of this project is:

- To identify the design principle for mobile applications on Malay Medicinal Plants based on information crowdsourcing.
- To apply the design principle for designing the mobile application on Malay Medicinal Plants based on information crowdsourcing.
- To develop the mobile application based on the design principle of information crowdsourcing.

5. Project Scope

- The main user of this application, which is the researchers, Malay villagers, traditional medical practitioners, and public to share their findings or knowledge on medicinal plants and to read, view and get the valuable information from this application.
- The android platform is used to develop this application.
- The Malay language is the main language of this application.
- Develop an application that used the concept of information crowdsourcing.
- Develop an application that used the concept of Wikipedia.

6. Project Significance

This project promotes knowledge sharing and awareness among researchers, Malay villagers, traditional medical practitioners, and the public towards Malay medicinal plants. It provides the opportunity to the researchers, Malay villagers, traditional medical practitioners, and the public to share their knowledge and findings on Malay medicinal plants. The citizen can get a lot of knowledge on the uses of Malay medicinal plants from the crowd of people who know Malay medicinal plants.

Researcher

Malay Villagers and traditional medical practitioners. This project provides knowledge regarding the Malay medicinal plants and findings from the researcher, Malay Villagers, and traditional medical practitioners. If they had created their account and are assigned as the registered user, they can share their findings and knowledge on medicinal plants in this application. They can upload the image of medicinal plants, provides the scientific names and some descriptions. They also can add and edit the content in the application. Furthermore, they are allowed to bookmark the content and write comments or questions on the comment text box. This application can be a reference source for the researcher to get the information.

General Public

Furthermore, the public is also allowed to share their knowledge of medicinal plants. If they had created their account and are assigned as the registered user, they can share their knowledge on medicinal plants in this application. They can upload the image of medicinal plants

and provide some description. They are also can add and edit the content in the application. However, if they are not assigned as the registered user, they only can view the valuable content of the application and bookmark the content. They are not allowed to add and edit the content.

Literature Review

Nowadays, there are a lot of research done regarding medicinal plants. The findings from the research need to be shared with other people. There are many kinds of medicinal plants in Malaysia that can be used to treat various human diseases. Malaysia's plants are broadly valued for their unique aromas and tastes and most of these plants are categorized as medicinal plants and can be used to treat many kinds of human disease (Alsarhan, Sultana, Al-Khatib, & Abdul Kadir, 2014). Researchers, Malay villagers, traditional medical practitioners, local herbal entrepreneurs, and the public are willing to share their knowledge and findings on medicinal plants. The knowledge of medicinal plants is very important because medicinal plants are not only able to treat human disease but also can prevent people from being affected by any disease.

1. Mobile Application on Medicinal Plants

Mobile application on medicinal plants is a mobile application that provides information and knowledge regarding medicinal plants. Various mobile applications provide information about medicinal plants, for example, Medicinal plants application. This application published the information for general and educational purposes only. It provides information for medicinal plants by listing the names and users can view and read it. It provides the description, usage, and other names of the medicinal plants. The information provided is limited that is only for certain medicinal plants.

Besides that, Prasvita and Herdiyeni (2013) conduct research that proposes a new mobile application called Medleaf that is for the identification of medicinal plants based on the leaf image. The two main functionalities of Medleaf are document searching of medicinal plants and medicinal plants identification (Prasvita, & Herdiyeni, 2013).

2. Medicinal Plants

A medicinal plant is also defined as a group of plants that are used for medicinal purposes and contains special features that qualify them as articles of drugs and therapeutic agents (Ahmed & Kabilul Azam, 2014). There are various kinds of medicinal plants around the world that can be used to treat human diseases. According to Tyler, there are about 13,000 species of plants that are used by various cultures around the world for traditional medicine (as cited in Samet, & Cikili, 2015).

3. Traditional Malay Medicine

Traditional Malay medicine use plants and herbs which contain a variety of nutrients and can be used to treat various human diseases. Malay medicinal plants are not only

used to heal human disease but also can be used to avoid being affected by any diseases. There are many kinds of medicinal plants found in Malaysia. According to the folk botanical survey conducted in Kampung Tanjung Sabtu, Terengganu, Malaysia, this survey recorded 52 species of medicinal plants used in one village (Chooi Ong, Mat Zuki, & Milow, 2011). Furthermore, based on the folk botanical survey conducted in Kampung Mak Kemas, Terengganu, Malaysia, it recorded 56 species of plant used by the Malay villagers in traditional medicine.

4. Information Sharing of Medicinal Plants Issue

The information regarding medicinal plants is very important because nowadays people are focusing more on modern medicine. Knowledge of medicinal plants is rarely recorded in a written form by the villagers because the traditional knowledge is orally passed on through generations (Chooi Ong, Mat Zuki, & Milow, 2011). In the area of modernization, the recording and publishing of traditional knowledge of medicinal plants are very important because traditional knowledge might cause changes or even loss (Chooi Ong, Mat Zuki, & Milow, 2011). The findings and knowledge regarding the Malay medicinal plant need to be shared with other people through the internet so that everyone will know the importance and the use of Malay medicinal plants. Most of the villagers are willing to share their traditional knowledge of herbal and traditional medicine with other people (Chooi Ong, Mat Zuki, & Milow, 2011). However, it is not an easy way for the villagers to share their knowledge.

Besides that, there is a lot of information and knowledge regarding medicinal plants and herbs on the internet. However, this knowledge is disorganized on the internet and merely own by local people that cause difficulty in forming a knowledge-based system (Sahri, Nordin, & Harun, 2012). Even though the information is easily accessible unfortunately it is disorganized on the internet.

5. Mobile Application

Mobile apps make sense because it has an interactive interaction with users and provides an application which has the features like a computer program than a website (Inukollu, Keshamoni, Kang, & Inukollu, 2014). The apps are either free apps or paid apps (Inukollu, Keshamoni, Kang, & Inukollu, 2014). Mobile apps can extract information and content from the internet like the website, moreover it also able to download the content so that it can be used later on without the connection of the internet (Inukollu, Keshamoni, Kang, & Inukollu, 2014). Mobile apps have similar features to the website however, mobile apps can be downloaded on mobile devices.

6. Mobile Application Development Life Cycle (MADLC)

MADLC has been used for over a year in developing Android mobile applications (Vithani, & Kumar, 2014). The

MADLC consists of 4 phases of the processes. The MADLC life cycle is as follows:

1. Discovery phase
2. Design phase
3. Development and testing phase
4. Maintenance and update phases

The MADLC phases are as follow:

1.1. Discovery Phase

The task involves in this phase is to define the system. The problem, objectives, and scope of the project are identified. Besides that, this phase also analyzes the requirements based on the user or customer requirement. Identifying the project method is very important to allow for controlling the overall management process through effective problem-solving. The discovery of the problem statement is to make the application function effectively based on user requirements and able to solve the arising issues. The objective of this phase is to gather the information or improves the existing application.

1.2. Design Phase

The most important task in the design phase is to design the interface of the application. The design phase is based on the user requirements and must be systematic and specific. In this phase, the deployment platform, application interface, user interface, the framework-driven design process will be identified. The important part of this design phase is to design the storyboard of the project for the user interface interaction. Design should consider the user requirements, issues, and problems that had been identified, and also be based on the study of the existing similar applications.

1.3. Development and Testing Phase

In this phase, the system is developed. There are two stages in the developments phase. The first stage is coding for Functional requirements that focus on core functionalities. The second stage is the UI requirement that is supported on many mobile operating systems (OS) platforms. User acceptance testing and system and performance testing are done in this phase. The testing on mobile applications plays an important role in identifying the performance and quality of the application (Inukollu, Keshamoni, Kang, & Inukollu, 2014). Testing of the mobile application can be carried out whether by real mobile device or by emulator tools (Inukollu, Keshamoni, Kang, & Inukollu, 2014).

1.4. Maintenance and Update Phases

The maintenance and update phases are the final phases of the MADLC model. This maintenance is a continuous process. There is a high probability that users might face a few problems that were not identified during the testing phase of the mobile applications after the

development and testing of the mobile applications (Inukollu, Keshamoni, Kang, & Inukollu, 2014). The maintenance phase deals with fixing the problems that were fronted by the mobile users. Issues that occur are from the many reasons, include the device software and hardware constraints, compatibility, and also network problem. Feedback is collected from the users and updates, or changes are made whenever required for the improvements of the system.

Crowdsourcing

The term crowdsourcing was created by Jeff Howe in 2006 which is a compilation of the words crowd and outsourcing (Karnfelt, 2014). According to Karnfelt (2014), crowdsourcing is defined as “a set of distributed production models that make an open call for contributions from a large, undefined network of people”. The process of getting funding or work, usually with the presence of an internet connection, from a crowd of people, is known as crowdsourcing. Information crowdsourcing is the information getting from a crowd of people. Obtaining information, knowledge, and ideas from a large group of people can help people to get a lot of information and solve a problem quickly. The word crowdsourcing splices together two words which are crowd and outsourcing. This means that the crowd of people gets and outsourcing the information. Crowdsourcing helps people to get information or funding from a crowd of people and usually online. Crowdsourcing also helps to distribute the information, work, or funding.

Crowdsourcing Information System

There are various fields of research on crowdsourcing such as management, psychology, computer science, and many other fields that have discovered crowdsourcing as a useful approach (Geiger, Rosemann, Fielt, & Schader, 2012). A system is a set of interrelated components or elements that work together to achieve an overall objective (Geiger, Rosemann, Fielt, & Schader, 2012). Crowdsourcing information systems are information systems that produce informational products or services for internal or external customers by utilizing the potential of crowd people (Geiger, Rosemann, Fielt, & Schader, 2012). The essential work in crowdsourcing information systems is conducted by the crowd whereby the activities and processes in such systems rely mainly on contributions from the crowd to produce new information or modify existing information (Geiger, Rosemann, Fielt, & Schader, 2012).

Research Methodology

1. Mobile Application Development Life Cycle (MADLC)

In this modernization area, mobile application usage is growing day by day. It is a great need for process-oriented approaches to design and develop mobile applications to handle the complexity and quality of apps. The apps are developed because of a meticulous mobile development life cycle. Mobile Application Development Life Cycle (MADLC) is

implemented in this project. In the developing Android mobile application, MADLC had been used for over a year (Vithani, & Kumar, 2014).

MADLC consists of 4 phases of the process. The MADLC life cycle is as follows:

1. Discovery phase
2. Design phase
3. Development and testing phase
4. Maintenance Phases

a) Discovery Phase

The task involved in the discovery phase is research, preliminary study, reviewing the existing application and their design features.

Research

The task involves is research on crowdsourcing. Research is done by the review and study on related online journals, articles, and online materials. Study the concept of crowdsourcing and crowdsourcing information systems. Research on information crowdsourcing systems is done by analyzing the content and observed the example of an information crowdsourcing system which is Wikipedia. To get the crucial features for designing the user interface of the application, research on social media is done by the review and study on related online journals, articles, and online materials. Research on social media is also done by the observation on the example of social media such as Twitter, Facebook, and YouTube.

Preliminary Study

The task in the preliminary study involves identifying the objectives, significance, scope, and method of the project. Identifying the project method is very important to enabling for the controlling of overall management process through the decision making and also through effective problem-solving. The discovery of the problem statement is also the most important part to make this application fully function based on user requirements and able to solve the arising issues. The project significance describes the advantages of this mobile application and defines why this project is developed. A full understanding of the area of Mobile Application On Medicinal Plants Based On Information Crowdsourcing. The area includes a mobile application, medicinal plants, Malay traditional medicine, and crowdsourcing. Identifying the scope of the project is a very important part to identify the target people that would use this mobile application.

Activities in the preliminary study involve information gathering that is related to the project. The information gathering can be done during the initial study so that the requirements will be identified. The interview was conducted to identify the problem, analyze the requirement and manage user or customer expectations. In the detailed study, the sources and information gathered are to be used

and solve the problem that had been identified in the early study. Thus, the information was gathered and analyzed from many different sources and related work such as online articles, journals, research, and online materials.

Reviewing the Existing Application

The identifying and study of the existing related mobile application will be able to make this application as the improvements of the existing mobile application. Review similar applications also to understand the functional and non-functional features to develop new applications. In this study, five similar applications had been reviewed:

1. *Medicinal Plants and Herbs*
2. *Medicinal Plants*
3. *Plants Pedia*
4. *10 Herba Kesehatan*

The development of mobile applications on Malay Medicinal Plants Based on Information Crowdsourcing must be planned wisely so that it will meet the project duration. This is to make sure that the project will be complete according to the project schedule. The selection of an appropriate methodology needs to be taken.

b) Design Phase

The task involves in the design phase is designing the user interface design and storyboard of the application.

Storyboard

The most important part of the design phase is to design the storyboard of the project for the user interface interaction. The storyboard is a panel or series of panels that is a set of sketches is arranged to depict consecutively the important changes of action in a series of shots. Design should consider the user requirements, issues, and problems that had been identified. The design phase is also based on the study of the existing similar application and provides some changes and improvements based on the existing application. Mobile Application on Malay Medicinal Plants Based on Information Crowdsourcing is a dynamic application. It needs to access the server to make it function, which means it needs an internet connection.

User Interface Design

Developing a mobile application on Malay medicinal plants based on information crowdsourcing must have a proper user interface design. The design of the user interface is based on the concept of crowdsourcing information system which is Wikipedia. The design is also based on the concept of the social media user interface for example Facebook, Twitter, and YouTube. When designing interfaces, identifying the target audience, their behaviors, project objectives, and the barriers to success are important. In this project, the target user Malay villagers, traditional medical practitioners, researchers, and the

public. In this case, the interface must be designed appropriately with the user. The language used for the interface also must be considered. This application used the Malay language because the user involves Malaysia's citizens.

Use Case Diagram

The use case diagram describes the functionality of the new system and the interaction between the user and the system. Use case diagram is typically involved 'actors' which is the user that interacts with the system to perform meaningful work.

Activity Diagram

The activity diagram describes how activities are aligned to provide service. The activity diagram shows the flow of activities, beginning from the starting point of the activity until the finishing point, by describing in detailed the decisions along with the progress of the events in the activities and the overall flow of control.

C) Development and Testing Phase

The task involves in the development phase is to develop the application according to the design phase. This is to make sure that the project is complete according to what had been the plan. The first stage is coding for Functional requirements that focus on core functionalities. Functional requirements are any requirement that specifies **what** the system should do. It needs to translate and convert the design to the coding using some related programming tools. The second stage is the UI requirement that is supported on many mobile operating systems (OS) platforms. Tools that are used in Mobile Applications on Malay Medicinal Plants Based on Information Crowdsourcing are Android Studio.

In this phase, the hardware and software need to choose wisely to make the system will function properly and efficiently according to the design. Computer hardware refers to the physical parts of the computer. Internal computer hardware includes the motherboard, random access memory (RAM), and hard drives. Besides that, external hardware includes keyboards, monitors, and a mouse. During the development of this project, 8GB SDRAM DDR3 RAM is installed for efficient device performance.

Table 1. Hardware use in developing the system

No	Hardware	Specification	
1	Laptop	Model	DELL
2	Smartphone	Model	Samsung J7
3	Wi-Fi	Any Internet connection	

There are two types of software that are application software and system software. The application software is for example Microsoft Word, Microsoft PowerPoint, and

others. System software is an operating system for example windows, Ubuntu and Mac OS. In this project, the operating system that will be used is Windows 7.

Table 2. Software used in developing the system

No	Software	Type
1	Android Studio	Coding Workshop
2	Android SDK	Mobile Software Development Kit
3	Microsoft	Microsoft Word 2010, Microsoft Project 2007
4	Firebase	Database Design

There are two stages in the testing phase. User acceptance testing and system and performance testing are done in this phase. Testing of mobile applications plays an important role in identifying the performance and quality of the application (Inukollu, Keshamoni, Kang, & Inukollu, 2014). Testing of mobile applications can be done either by using a mobile device or by using emulator tools (Inukollu, Keshamoni, Kang, & Inukollu, 2014). Android Emulator simulates a device and displays it on the development computer.

d) Maintenance Phases

There is a high probability that users might face a few problems that were not identified during the testing phase of the mobile applications after the development and testing of the mobile applications (Inukollu, Keshamoni, Kang, & Inukollu, 2014). The maintenance phase deals with fixing the problems that were fronted by the mobile users. Problems that occur are from many kinds of reasons, including software and hardware constraints, device compatibility, and network problem. The issue log is the deliverable of the system maintenance. The issue log is the documentation of the software project management and contains the list of ongoing and close issues of the project. Issue log can be view as a method to detect errors in the project.

Results and Findings

1. Requirement Analysis

This segment explains the requirement analysis. The analysis is very important in this project to ensure that it addresses end-user needs. To gather the requirement of this project, the interview method is conducted. The purpose of the interview is:

- To identify user requirements for Mobile Applications on Malay Medicinal Plants based on Information Crowdsourcing.
- To design Mobile Application on Malay Medicinal Plants based on Information Crowdsourcing.
- To develop a Mobile Application on Malay Medicinal Plants based on Information Crowdsourcing.

2. Interview

Interview Question and Answer

General Public

1. How do you think about the existing application?

"The existing application that provides information on medicinal plant, however, provides the limited information which is only for certain medicinal plants. Users are not allowed to edit the content of the application. However, the interface is quite good as it provides the description and full images of the medicinal plants."

2. Does the existing application help you to get a lot of information on medicinal plants?

"In my opinion, the existing application provides limited information on medicinal plants, thus, it does not give a lot of information on medicinal plants. The information is limited which is only for certain medicinal plants that are being provided."

3. Do you think you need a mobile application on medicinal plants based on information crowdsourcing?

"Yes, because I will be able to get the information of medicinal from a crowd of people. The information also is not limited. Besides that, the researcher, Malay villagers, and public also will have the opportunity to share their knowledge and findings on medicinal plants."

4. Do you think mobile application on medicinal plants based on information crowdsourcing is important for everyone?

"In my opinion, mobile application on medicinal plants based on information crowdsourcing is important for everyone because everybody should know medicinal plants because it is very useful for health care and healing various human diseases."

Researcher

1. Do you think you need a mobile application on medicinal plants based on information crowdsourcing?

"Yes, and I think it is important because as a researcher, I need to share my knowledge on medicinal plants with other people so that everyone can get that valuable information. Besides that, I can use this application as a reference in doing my research."

2. Do you think the registered user can upload the image of the medicinal plant?

"I think it is very important to upload the image of medicinal plants because sometimes people only know the name of the plants."

3. Do you think it is important for the registered user to write a description of the medicinal plants?

"Yes, it is very important because that is where they need to share their knowledge and information. They can

share about the nutrients of the plants, what kind of disease can be treated by the plants."

4. Do you prefer to add and edit the existing content (Wikipedia concept) that is related to the concept of an information crowdsourcing system?

"I prefer to add and edit if the content of the medicinal plant already exists because the information of the medicinal plants can be properly organized and up to date."

5. Do you prefer the public who only wish to view and read the content of this application to have their account, or they can access this application without having their account?

"I think it is better if the general public who only wishes to view and read the content of this application to access to this application without creating their account."

6. Is it important to get the information from the public?

"Yes, because there is a lot of people who had information and knowledge on medicinal plants. For example, traditional medical practitioners, who practice the use of medicinal plants, might have a lot of knowledge that they are willing to share with other people."

7. Do you have any other requirements for this application?

"Yes, I think you can provide a forum whereby the registered user can write their comment or question so that there will be a conversation between user and public can be viewed by the public."

Interview Analysis

In this project, the interview was conducted twice. The first interview was conducted to identify the problem and issue faced by the Malay villagers and traditional medical practitioners, and the public in information sharing off medicinal plants. The venue of the interview was conducted at Kampung Jalan Kebun, Klang, Selangor, Malaysia with one of the Malay villagers, and traditional medical practitioners. The second interview was conducted to identify the problem and issue faced by the researcher and to identify the requirement of the features for this application.

Based on the first interview conducted, the interviewee said that the existing application gives limited information which is only for certain medicinal plants. The existing application only provides information for certain medicinal plants only. In addition, they also said the existing application does not help much in finding the information on medicinal plants because sometimes the information needed is unavailable. They said that they need the mobile application on Malay medicinal plants based on information crowdsourcing because they will be able to get the information of medicinal plants from a crowd of people. Besides that, they are also willing to use this application because this application can help them to find information on Malay medicinal plants and the knowledge or information on medicinal plants should be shared with other people.

The public and traditional medical practitioner:

1. General Public
2. Traditional Medical Practitioner

Based on the interview conducted with the researcher to collect the requirement for this application, they said that they need the mobile application on Malay medicinal plants based on information crowdsourcing because as a researcher, they need to share their finding on medicinal plants to other people so that everyone can get that valuable information. They also said that this app can be their reference in doing her research. Based on the question regarding the requirement for the feature of this application; they said that it is very important to upload the image of medicinal plants because people can know how the plants look like. It is very important for the users to write the description of the medicinal plants because that is where the user can share their knowledge and information for example about the nutrients of the plants and what kind of disease can be treated by the plants. Besides that, they prefer to add and edit if the content of the medicinal plant already exists because the information of the medicinal plants can be properly organized and up to date. Regarding the opinion whether the public who only wishes to view and read the content of this application needs to have their account or not, they prefer that the people do not need to have their account. Furthermore, they also added a feature that should be in this application which is a forum whereby the registered user can write their comment or question so that there will be a conversation between user and public can be viewed by the public.

Researcher

1. Researcher 1
2. Researcher 2

3. Functional Requirement

The functional requirement describes the function of the system. It describes the function of a software system or its components. It also supports the user requirements by explaining the processing of the information as inputs or outputs. The function includes inputs, processes, and output.

The scenarios below show the functional requirement for Mobile Applications on Malay Medicinal Plants Based on Information Crowdsourcing:

Scenario 1 - Register and Sign in Account

The user such as researchers, Malay villagers, traditional medical practitioners, local herbal entrepreneurs, and the public need to register to create their account and log in if the account is already created to be able to upload, post, add and edit the content on the application. The system will save their information.

Scenario 2 - Add Content

The registered user can upload the image of the medicinal plants and describe the plants. After they complete upload the image and write the description, they can post it so that other people can view it. The registered users also can edit the content of the application whether to add or update the content.

Scenario 3 - Edit Content

The registered users also can edit the content of the application whether to add or update the content.

Scenario 4 - View Content

Everyone can view what had been posted by the researchers, Malay villagers, traditional medical practitioners, and the public. They can view and read the content without creating their account.

Scenario 5 - Search Content

In this scenario, the user should be able to search the intended information user need to enter the keyword into the search text box and the application matches the keywords entered by the user and show the result based on the keywords entered by the user.

Scenario 6 - Write Comments or Questions

In this scenario, registered users can leave their comments or question at the text box provided.

Scenario 7 - Bookmark Content

Both registered and unregistered users are allowed to bookmark any medicinal plant that they want. Users need to click on the favorite button, and they can view their bookmark list on the bookmark page.

4. Use Case Diagram

Use case diagram is the representation of a user's interaction with the system that indicates the relationship among the user and the different use cases where the user is involved. Use case diagram is utilized to portray the desired features and functionality of mobile applications on Malay medicinal plants based on information crowdsourcing. Figure 1 below shows the use diagram for this project.

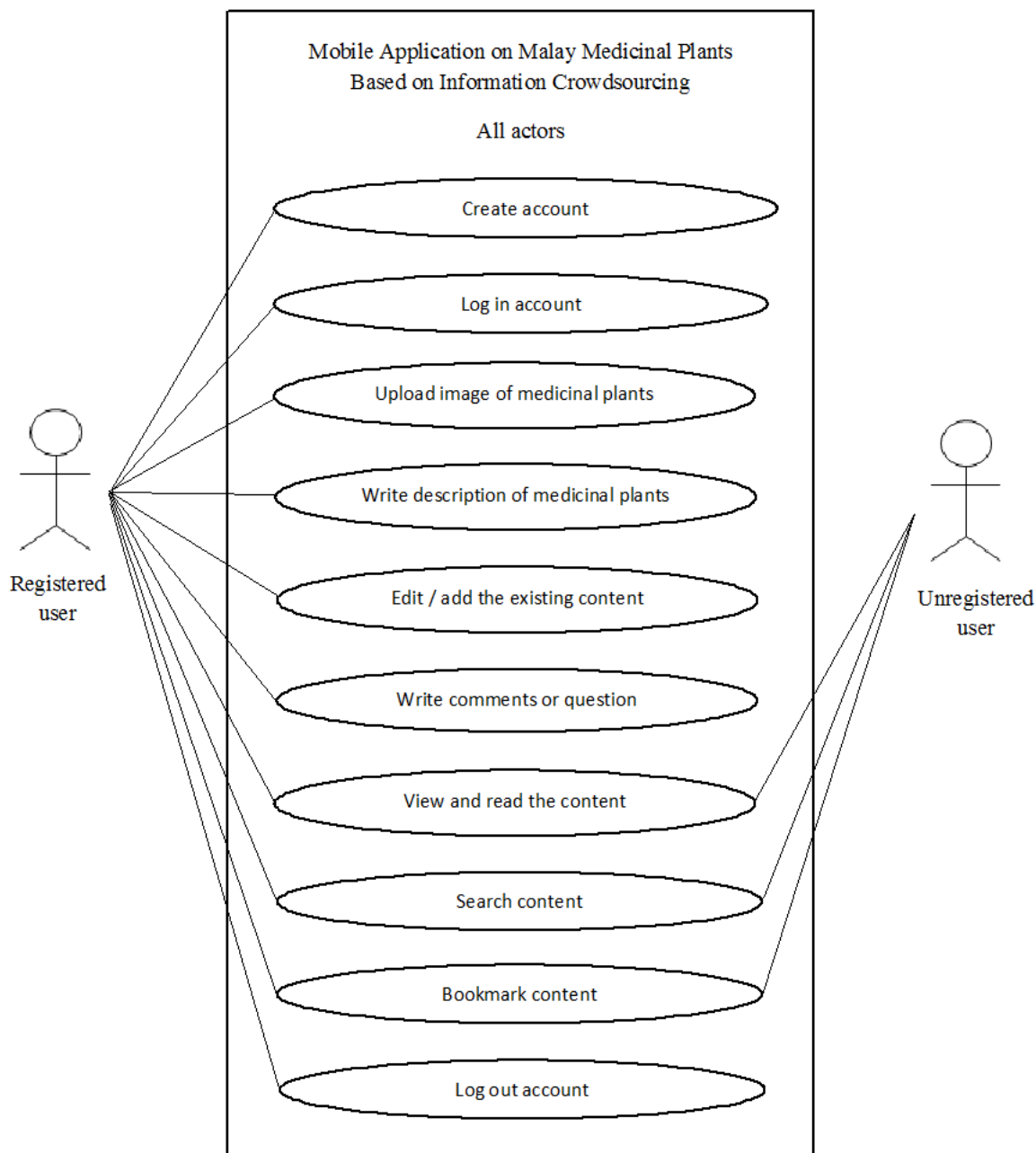


Figure 1. Use Case Diagram

Table 3. Description of Use Case Diagram

Actor	Use Case	Description	
Registered User	Create account	The user can create or register their account to be able to add or edit content.	
	Log in account	Registered users will log in to their account	
	Upload image of medicinal plants	Registered user can upload the image of medicinal plant.	
	Write a description of medicinal plant	Registered users can write a description of medicinal plants.	
	Add/Edit existing content	Registered user can edit / add on existing content (change image / edit description).	
	Write a question or comment	Registered user can write their comment or question in the comment text box.	
	Log out account	Registered users can log out of their accounts.	
	Registered and Unregistered user	View and read the content	Registered and unregistered users can view and read the information about medicinal plants.
		Search content	The user will be able to search the intended information. The user needs to enter the keyword into the search text box.
Bookmark content		Registered and unregistered users can bookmark any medicinal plants by clicking on the favorite icon.	

Table 4. Use Case Description (View Homepage)

Use Case Name	View homepage
Scenario	The user wants to view the homepage and content
Description	Registered and unregistered users can view and read the information about medicinal plants.
Actors	Registered and Unregistered user
Flow of activities	1. Users view the homepage

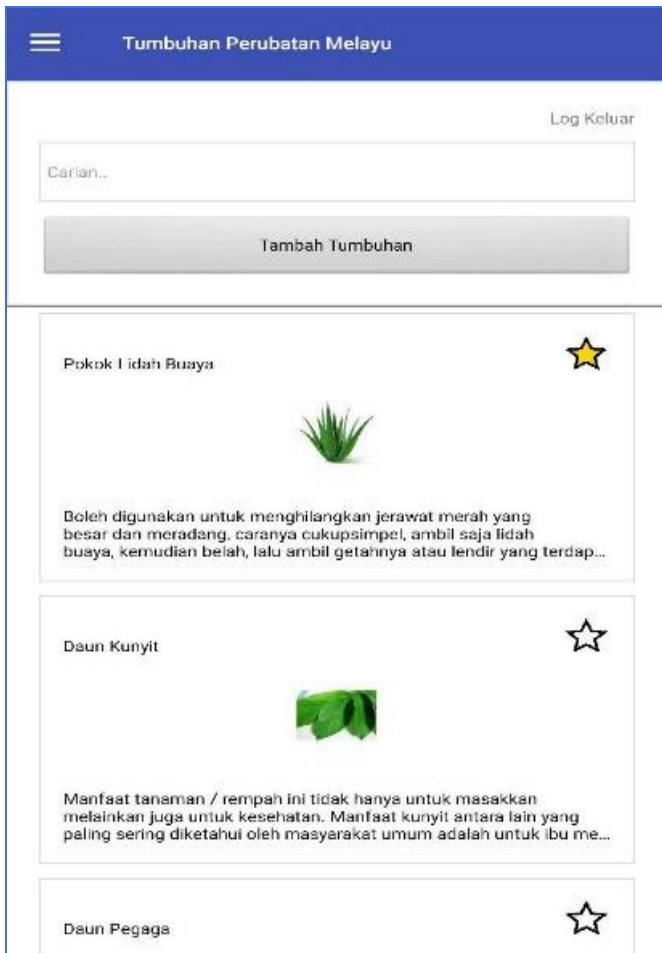


Figure 2. View Homepage

Table 5. Use Case Description (Create Account)

Use Case Name	Create account
Scenario	The users want to create their account
Description	User can create their account and will be able to log in.
Actors	Unregistered user
Flow of activities	1. Users click at the login button at the homepage 2. If they do not have an account, click on the register button. 3. Register account



Figure 3. Create Account

Table 6. Use Case Description (Login Account)

Use Case Name	Login account
Scenario	The users want to log in to their account
Description	The user can log in to their account and be able to add and edit content.
Actors	The Registered user
Flow of activities	1. The user clicks on the login button at the homepage. 2. Log in account

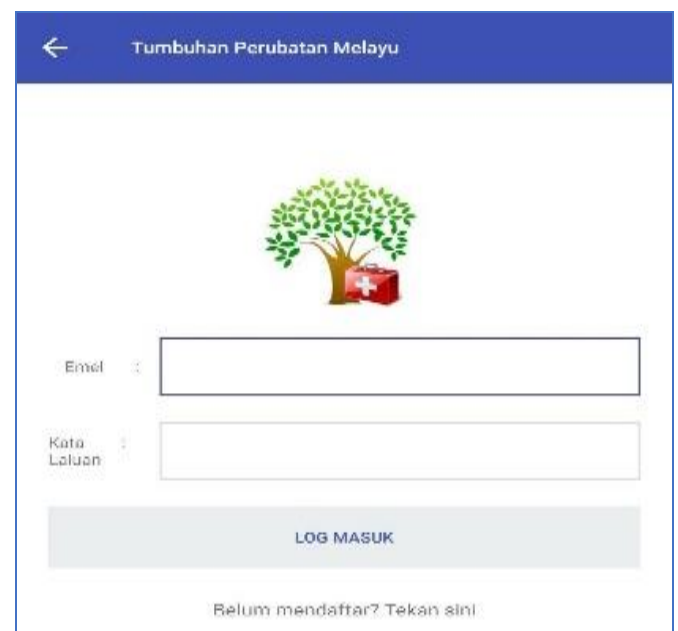


Figure 4. Login Account

Table 7. Use Case Description (Search)

Use Case Name	Search content
Scenario	The user wants to search for medicinal plants information.
Description	The user will be able to search the intended information User need to enter the keyword into the search text box and the application match the keywords entered by the user and show the result based on the keywords entered by the user.
Actors	Registered and unregistered user
Flow of activities	<ol style="list-style-type: none"> 1. Users write the name of the plant. 2. The information of plants that match with the keyword entered by the user will appear.

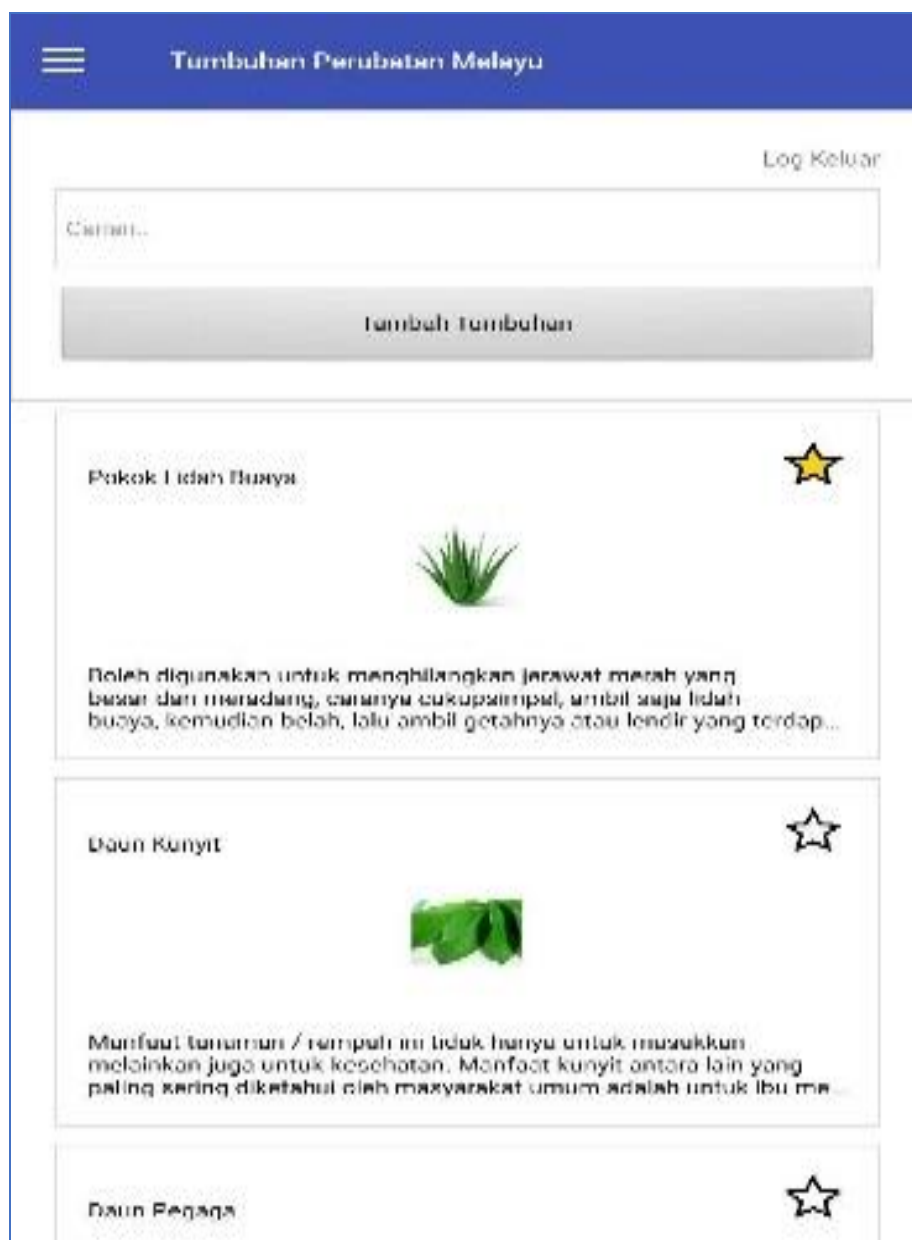


Figure 5. Search

Table 8. Use Case Description (Bookmark content)

Use Case Name	Bookmark content
Scenario	The user wants to bookmark any of the medicinal plants' information.
Description	Users are allowed to bookmark any medicinal plant that they want. Users need to click on the favorite button, and they can view their bookmark list on the bookmark page.
Actors	Registered and unregistered user
Flow of activities	<ol style="list-style-type: none"> 1. Users click on the favorite button 2. Users view their bookmark list at the bookmark page.



Figure 6. Bookmark content

Table 9. Use Case Description (Add new plant)

Use Case Name	Add new plant (Write name, scientific name, and description, and upload the image of the medicinal plant)
Scenario	The user wants to add new information about medicinal plants by writing the name, scientific name, and description, and upload an image of the medicinal plants.
Description	The user can add information about medicinal plants.
Actors	Registered user
Flow of activities	<ol style="list-style-type: none"> 1. The user clicks on the add new plants button on the homepage. 2. The user writes the name, scientific name, and description, and uploads an image of the medicinal plant. 3. The name of users who provides the information appears as “Edited by”

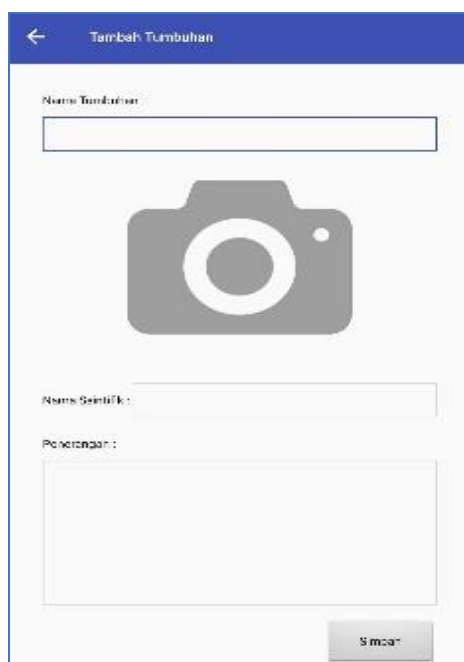


Figure 7. Add New Plant

Table 10. Use Case Description (Edit / Add Existing Content)

Use Case Name	Edit / add the existing content
Scenario	The user wants to edit or add information about medicinal plants by edit the descriptions or change the image of the medicinal plant.
Description	The user can edit or add information on medicinal plants
Actors	Registered user
Flow of activities	<ol style="list-style-type: none"> 1. The user clicks on the information on medicinal plants on the homepage. 2. Users click on the edit icon. 3. Users edit the information. 4. Users click the save button to save editable information. 5. The name of the user who edits the information appears as "Edited by"

Table 11. Write comments or questions

Use Case Name	Write comments or questions
Scenario	Users want to write comments or questions.
Description	The users can write comments or questions at the comment text box provided.
Actors	Registered user
Flow of activities	<ol style="list-style-type: none"> 1. Users click on the information on medicinal plants at the homepage. 2. Users write comments or questions at the comment text box provided. 3. Users click the button send.

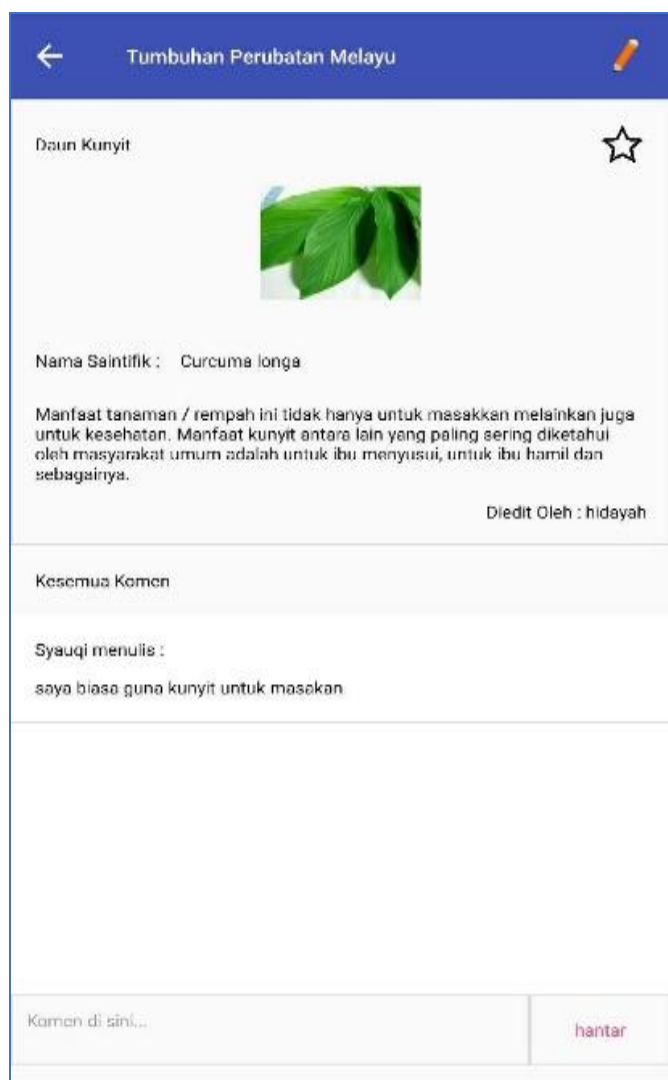


Figure 8. Edit / Add Existing Content

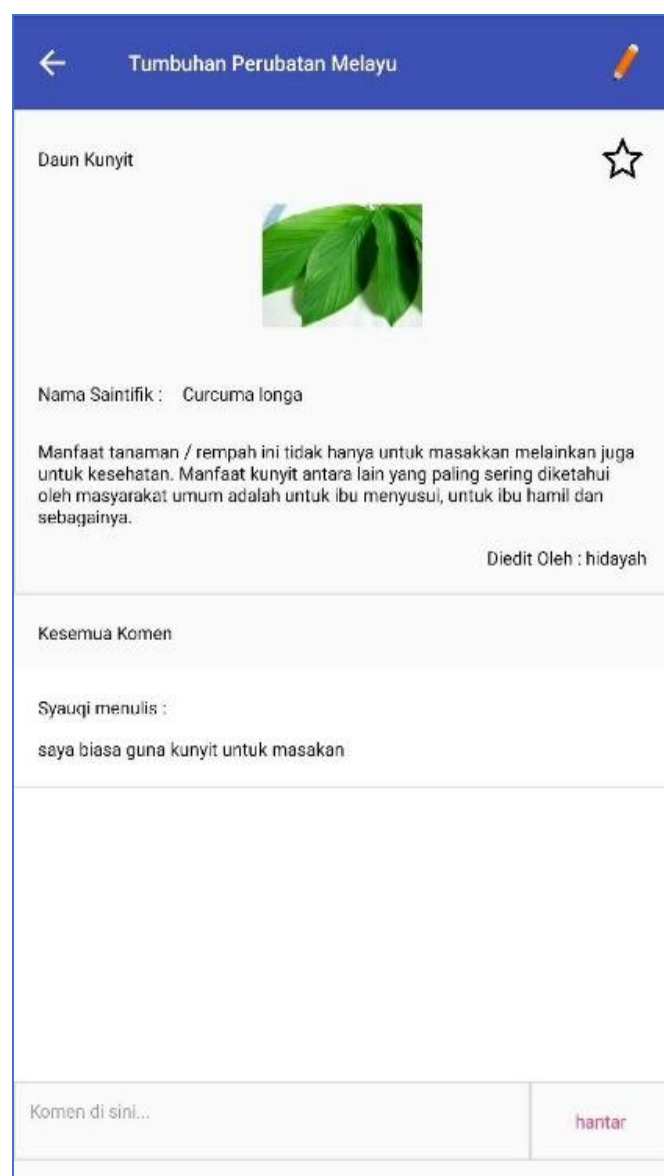


Figure 9. Write Comments or Questions

5. Non-Functional Requirement

According to Wiegiers (2011), a non-functional requirement is defined as the requirement that specifies the criteria that can be used to judge the operation or performance of a system rather than the specific behavior. This project focused on user interface design.

a) Accessibility

Registered users can view and post the content whereas the unregistered user can only view the content.

b) Portability

Users can access Mobile Applications on Medicinal Plants Based on Information Crowdsourcing anytime and anywhere.

c) Performance

This application allows registered users to edit the content of the application.

6. Work System

In general, Work System Diagram is an overview of the system in which human participants or machines perform a business process by using technology, information, and other resources to produce products or services for internal or external customers.

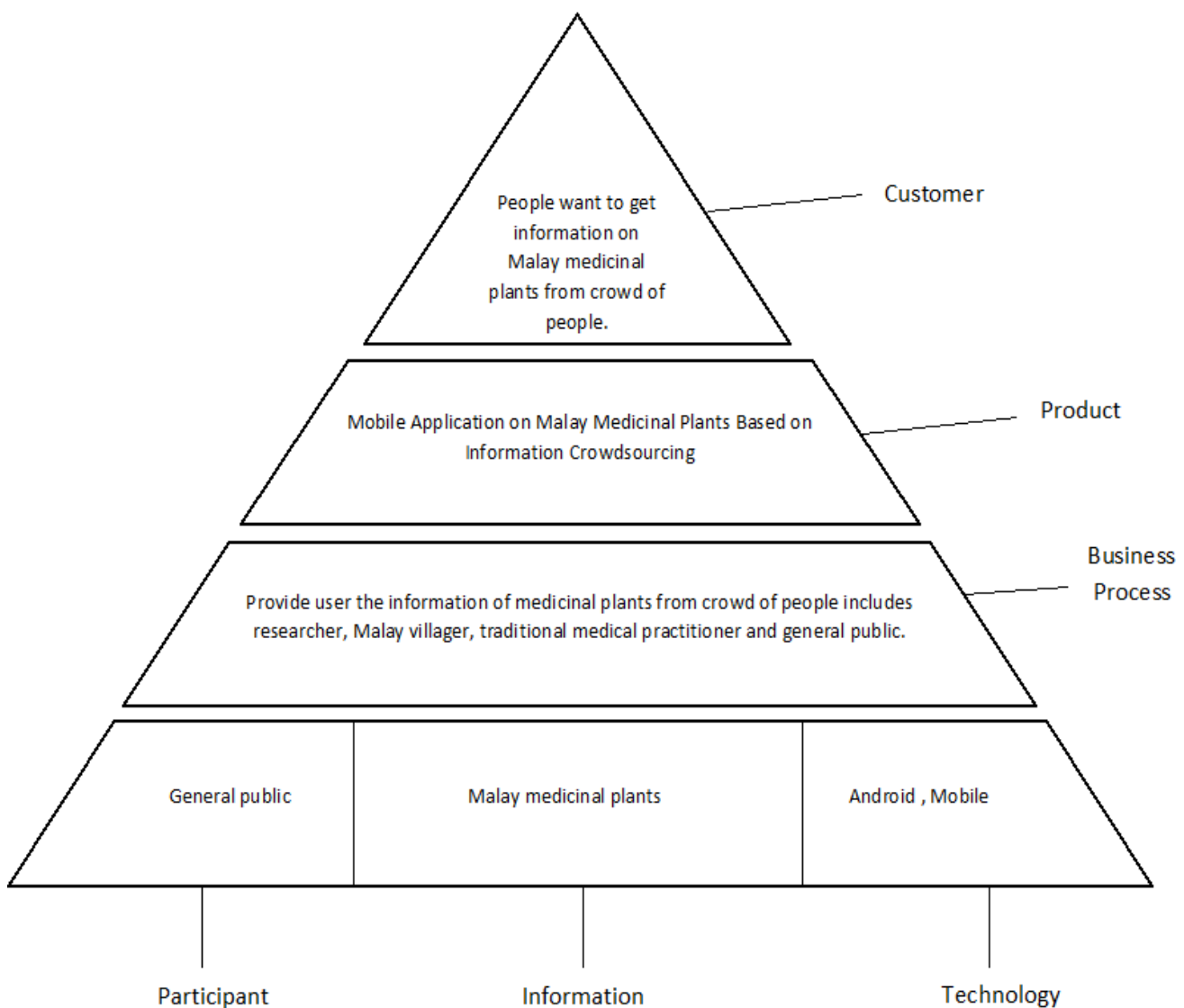


Figure 10. Suggested Work System

7. Activity Diagram

The activity diagram describes how activities are aligned to provide service. Furthermore, the activity diagram shows the activity of the system.

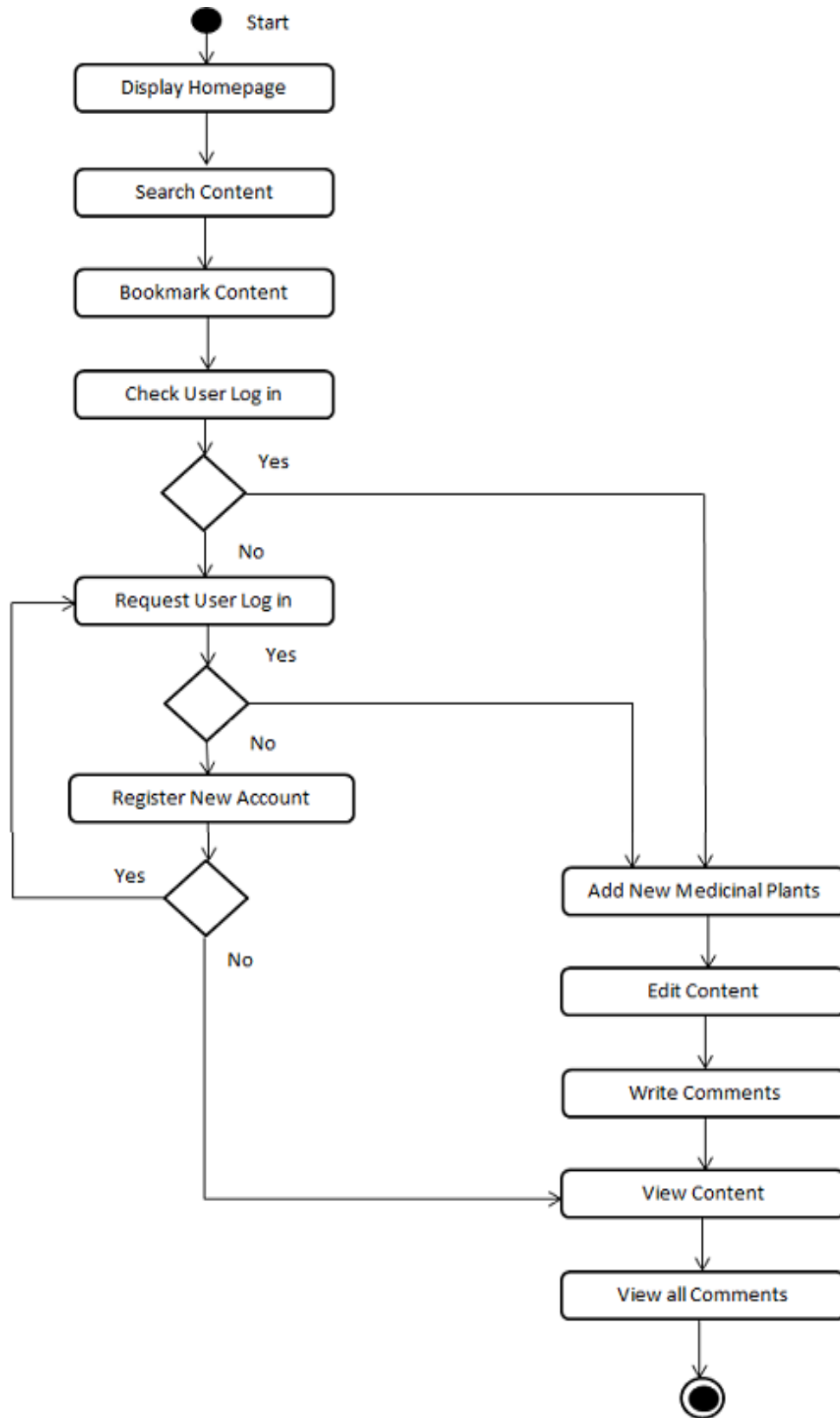


Figure 11. Activity Diagram

8. Storyboard

The most important part of the design phase is to design the storyboard of the project for the user interface interaction that can be reflected in the storyboard. Design

should consider the user requirements, issues, and problems that had been identified.

Figure 12. Homepage

Figure 13. Registration Page

Figure 14. Plant Page

Figure 15. Bookmark Page

Figure 16. Login Page

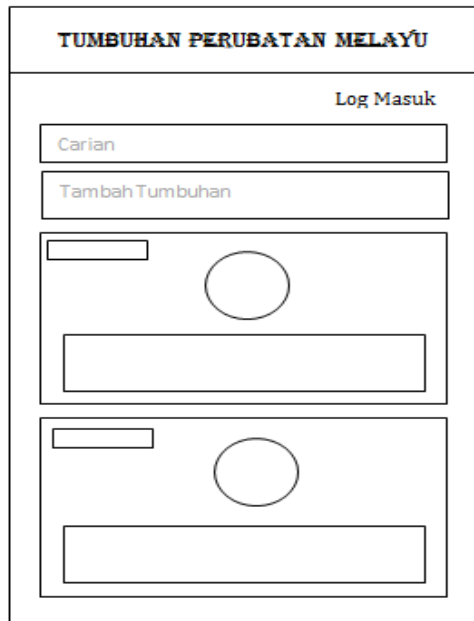


Figure 17. Homepage (registered)

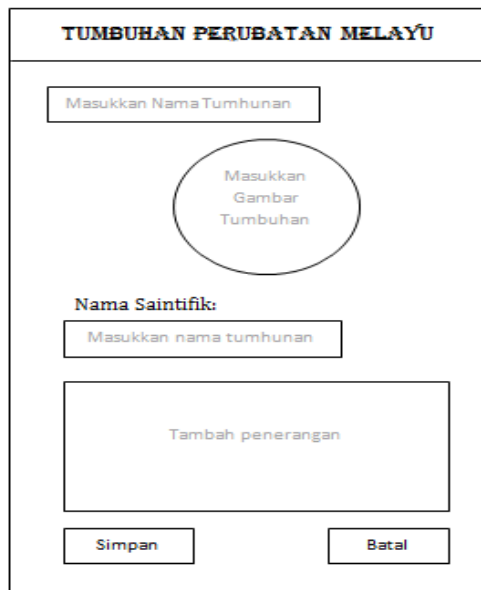


Figure 18. Add Plant Page



Figure 19. Plant Page

9. User Interface Design

Developing a mobile application on Malay medicinal plants based on information crowdsourcing must have a proper game interface design. When designing interfaces, identifying the target audience, their behaviors, project objectives, and the barriers to success are important. In this project, the target user Malay villagers, traditional medical practitioners, researchers, and the public. In this case, the interface must be designed appropriately with the user. The language used for the interface also must be considered. This application used the Malay language because the user involves Malaysia's citizens.

10. User Interface Design

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Figure 20. Menu Page

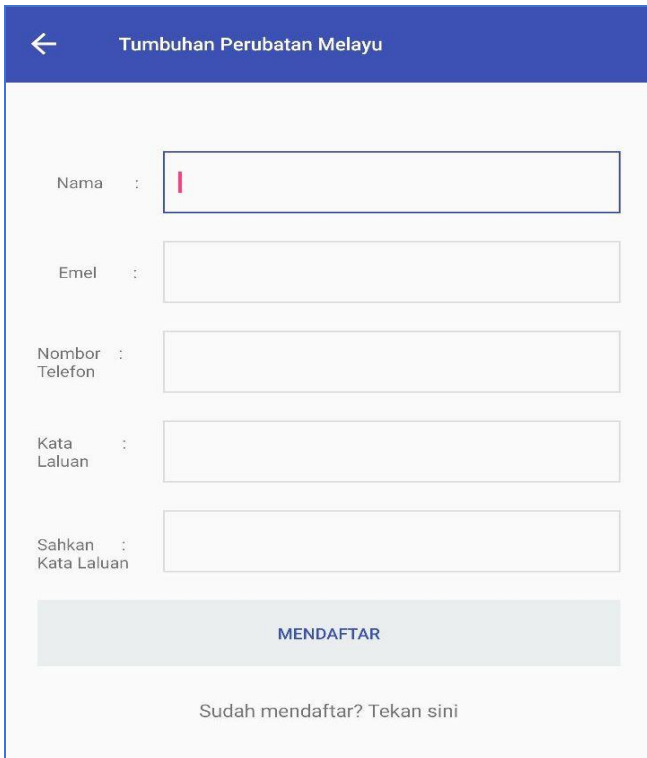


Figure 21. Registration Page



Figure 23. Plant Page

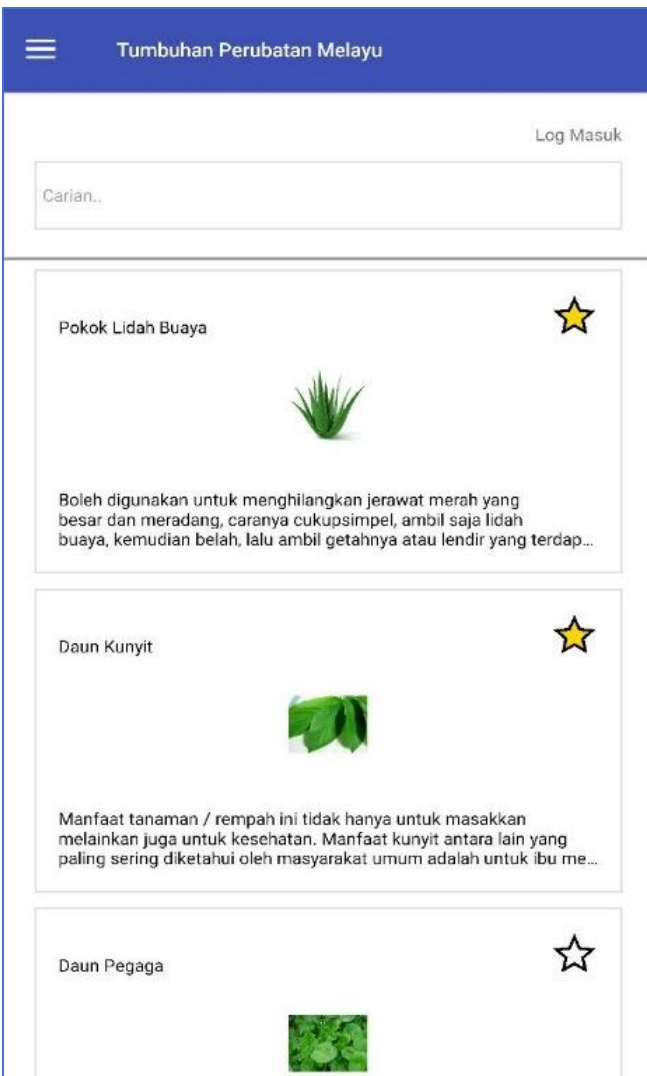


Figure 22. Homepage



Figure 24. Bookmark Page



Figure 25. Login Page



Figure 27. Add New Plant

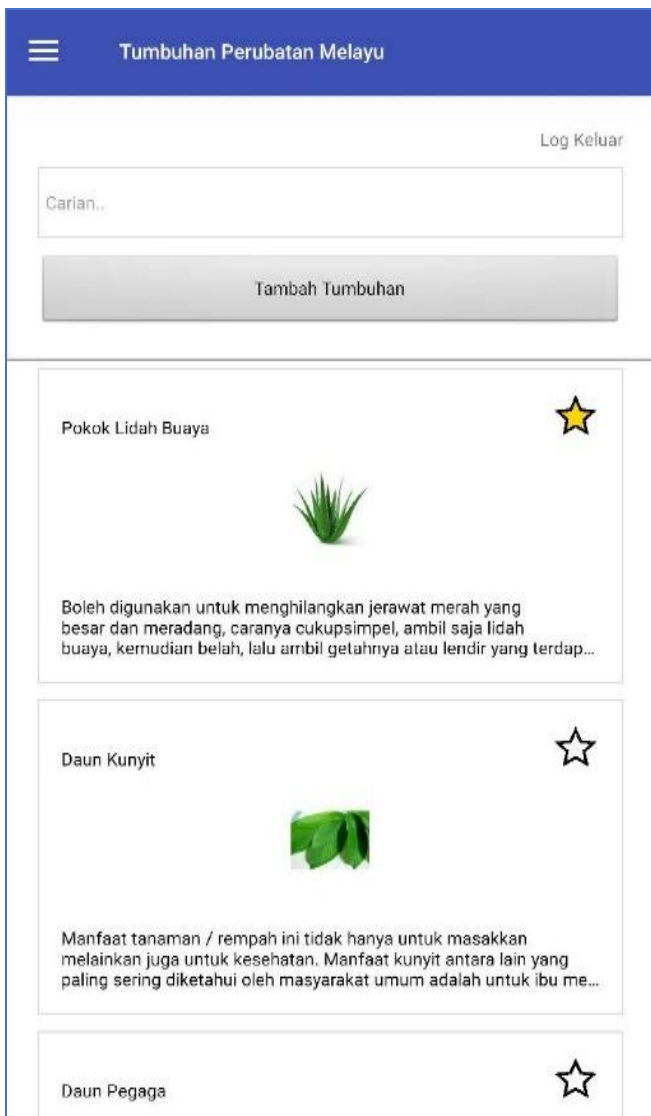


Figure 26. Homepage



Figure 28. Plant Page



Figure 29. Bookmark Page

Development Tools Used

The next step after designing is to carry out the development phase. In the development phase, the tool that is used is Android Studio. Firebase is used for creating the database. In addition, phpMyAdmin was also being used.

Conclusion

This project shows the significance of utilizing the Mobile Application on Malay Medicinal Plants Based on Information Crowdsourcing for the public to gain information and knowledge from the crowd of people. The strength of this project is crowdsourcing whereby the information is provided by the researcher, Malay villagers, traditional medical practitioners, and the public who know Malay medicinal plants and are willing to share their knowledge with other people. This project used the concept of an information crowdsourcing system which is Wikipedia whereby users can add information about new plants or edit the existing information about the plants. The development of this application also provides the opportunity for the researcher, Malay villagers, traditional medical practitioners, and the public who know Malay medicinal plants to share their knowledge and information easily. Furthermore, this project used the concept of social media in designing the user interface. This is to make the application to be user-friendly because nowadays social media are more attractive. The user interface design of this project is based on the crucial features of designing the social media user interface. This will ease the user while interacting with the application. This application also implements a good function whereby a user who is assigned

as a registered user can add the information of plants, edit the content, able to write comments or questions, and bookmark any content. On the other side, the unregistered user can access this application and view the content of this application, thus they will get valuable information without creating an account. Furthermore, unregistered users also can bookmark content. In conclusion, this application promotes knowledge sharing and awareness among researchers, Malay villagers, traditional medical practitioners, and the public towards Malay medicinal plants and will bring a good impact to the public.

Acknowledgment

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