

Development of an Android Application for Smart Farming in Crop Management

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Abstract. Agriculture technologies have shown potential to improve agriculture management. This awareness has attracted researchers to develop technologies for farmers to ease their daily routine and also to reduce cost of labor and increase the yield production. Smartphone is one of the gadgets that can be useful in agriculture because of its useful functions, portability and affordable. It helps users to find locations, access information and capture images and sound. Smartphone functions can be combined to build versatile mobile agriculture applications. These helps to deliver information about crops and management needs. This paper develops an Android application for smart farming in crop management known as Padi2U. Padi2U is a mobile application developed to help farmers in their paddy field management. The application is developed using Master App Builder, a software that is used to create mobile applications. This application contains information about PadiU Putra paddy variety, agriculture agency, sites information, planting schedule, drone images, paddy disease, pest, weed, weather forecast, yield information and farmer report. All information is described in the native language of the farmers that is the Malay language. Final results of this project is the mobile application which will be useful to manage crops and improve the management. The same method can be applied to different crops in the future.

Keywords: smart agriculture, agriculture technology, mobile application, paddy management

1. Introduction

In Malaysia, rice is the staple food and it is the second most important agriculture products. However, the rice industry has problems in the production management, one of them is low yield [1]. It is important to monitor the rice production in order to support the demand from the consumer and to prevent any food shortage problem. One of the reasons of low yield is no proper management in pest and disease. The control activity started late as the disease and infection at rice crop is already severe and impossible to control. The control activity for pest and disease should be done before the symptoms become serious and frequent monitoring of the crop is compulsory. The application must follow the safety requirement



for the human and environment. On the other hand, rice check that is provided by the Department of Agriculture must be followed by the farmers to prevent any pest, disease outbreak and weed infestation. Nowadays, Unmanned Aerial Vehicle (UAV) or drone has been widely used in agriculture application [2]. There is RGB camera and multispectral camera attached to the drone and captures aerial images for crop health monitoring [3]. The drone flies above the paddy field and captures images followed by the image processing step at the computer to derive important information about the crop condition and crop status [4]. The benefits of information technology become a potential solution to increase the rice yield by a proper crop management and improvement in rice cultivation. As technology moves forward, an online platform is used to obtain important information about rice cultivation starting from planting to harvesting [5]. A mobile application provides all the information about the crop and it can be accessed through their smartphone [6]. User will use the application by downloading the application in their smartphone and most functions of the application is free.

1.1 Mobile technology

The development of mobile technologies was introduced to the world as a new generation (G) such as 2G and 3G of a smartphone. Before smartphone, a mobile device can only function to call, record voice messages and send text messages. With advanced technologies in smartphone, more than all the basic functions can be done. Smartphone can capture images and record video in high resolution, with addition of hardware sensor [7]. Wireless data access is the highlight of any smartphone features with mobile data plans via 2 generation (2G), 3 generation (3G) and 4 generation (4G). Smartphone has become a part of our lifestyle and changed our life and made it easier. With high demand in smartphone, mobile applications is widely used for the daily routine like as alarm clock to set time, fitness tracker, motivation reminder, steps counting and many more.





1.2 Mobile application

Mobile application is developed to run in the operating system and machine firmware of mobile devices. An example of mobile application on paddy cultivation that is developed and available at Google Playstore are MARDI MyPerosakPadi, Rice Check, Rice Check Padi and Agrimaths. MyPerosakPadi and Rice Check Padi which focus on disease and pest management such as early symptoms identification and methods to control the infection. All the applications will help user especially farmers for their decision making and improve their current practices. According to [8] most smartphone user spend 86% more time in mobile application compared to website (14%). It is because the application is more user-friendly and can be accessed from their smart phone immediately. Most of the mobile applications do not need Internet connection but all mobile website must have Internet connection and this is hard if users do not have connectivity to the Internet. This is one of the reasons why people prefer to use mobile application. Many useful applications are available at play store and easy to be found in the smart phone. Users need to download the application and uninstall if not really useful.

1.3 Advantages and disadvantages of mobile application

The advantage of mobile application is that it is a problem solver. For example, users can use Google Maps to plan a trip to a new area and safely arrive at their destination. The application gives better performance and experience compared to website because website takes longer to load a page, while it can load faster using mobile apps [9]. Mobile applications have notification function to give news or information regarding the status of the apps or the latest update of the application. The negative impact is to the human health such as eye problems and depression [10] and wasting time on applications such as game application.

Table 1: Example of Mobile Application for Paddy in Malaysia.

Application Name	Function	Developer Name
 <p>MARDI My Perosak Padi</p>	<ul style="list-style-type: none"> • This application is focusing on pest and disease at paddy field. • It helps farmer to identify the pest, disease and weed. • It explains to farmer how to control pest and disease for better management. 	<p>MARDI</p> <p>Last access: 6 Feb 2020</p> <p>[11]</p>
 <p>Rice Check</p>	<ul style="list-style-type: none"> • This application provides guidelines and notification to farmer for every season followed with the good agriculture practices. 	<p>Department of Agriculture</p> <p>Last access: 6 Feb 2020</p> <p>[12]</p>
 <p>Rice Check Padi</p>	<ul style="list-style-type: none"> • This application contents guidelines for paddy management at every growth stages, irrigation system, fertilizer management, pest and disease management and harvesting stage. • From this guideline user or farmer will be able to identify problems and take action to overcome the problem occurred. 	<p>Department of Agriculture</p> <p>Last access: 6 Feb 2020</p> <p>[13]</p>
 <p>Agrimaths</p>	<ul style="list-style-type: none"> • This application is calculating crops values such as vegetables, fruits, paddy, coconut, mushroom, honey bee, fertilizer, pesticides, agriculture engineering, fertigation and financial flow. • It is adaptation from “Asas Matematik Pertanian” book. • This application suitable for agriculture extension officer and farmers to manage their crop. 	<p>Department of Agriculture</p> <p>Last access: 6 Feb 2020</p> <p>[14]</p>

2. Methodology

The development of mobile application used Master App Builder software [15]. Since farmers are semi-literate community, hence the application developed using these farmers native language, the Malay

language. In mobile application, there are 3 layers known as presentation layer, application layer and database layer. The presentation layer is utilized by user from their mobile devices such as smartphone and mobile tablet. This layer is made up of User Interface (UI) and its process components. Its focus on the way this application presented to the user. The application layer or business layer is focused on management of the application. The management includes the workflow of the application (Figure 1). The application layer is known as an application program interface (API) passes the information into the presentation layer. The database layer contains all the information entered into the application and it helps to secure it. This layer acts as heart of mobile application. There are 14 main menus in the mobile application and each of the menu has its own focus (Figure 2).

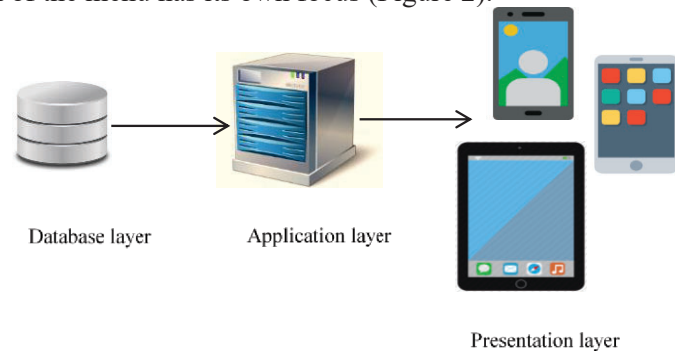


Figure 1. The architecture of Padi2U.

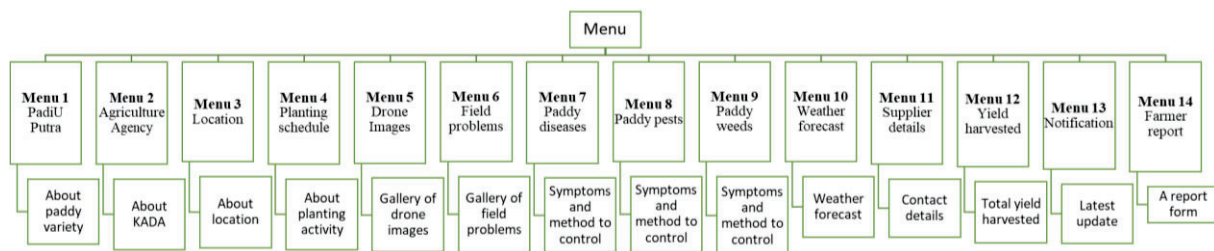


Figure 2. Flow chart of mobile application Padi2U menu.

3. Result and Discussion

Padi2U is a mobile application developed for farmers and agriculture officers. This project is located at Kampung Lundang Paku, Ketereh Kelantan, Malaysia with a total area of about 87067 meter² (Figure 3). The type of paddy variety used in this project is PadiU Putra. This variety is created a new technology made by UPM to help farmers increase their rice production and income. PadiU Putra is a variety that increases the yield and is disease resistance [2]. This mobile application is developed to monitor the paddy fields using UAV images as input data. These UAV images are analysed and a Normalized Difference Vegetation Index (NDVI) map is created to monitor the crop status. Users will be able to get information about rice cultivation, agriculture agency, weather, planting schedule, drone images, field problems and supplier information (Figure 5). The application is user-friendly and all the information is easy to understand by user. The data in this application is only for one season. This application requires an Internet connection. User can download this application into mobile devices. Padi2U was developed for Android operating system.



Figure 3. Study location at Kampung Lundang Paku.

3.1 Information of the application

Figure 4 shows the GUI for Padi2U mobile application. Padi2U mobile application contains 14 menus known as PadiU Putra, agriculture agency, location, planting schedule, drone image, field problem, paddy disease, paddy pest, paddy weed, weather, supplier details, yield, notification and farmer report. Padi2U provides information of paddy management that includes the aerial image analysis, Normalized Difference Vegetation Index (NDVI) map and the management of the disease, pest and weed. The NDVI map shows the crop health status using index number to indicate crop health from -1 unhealthy crop to 1 healthy crop. In Padi2U, the index number labelled as -1 “Unhealthy” and 1 “Healthy” in different range of color. Therefore, users will get the idea and understand their crop status. Field problems such as direction of water flow, uneven ground condition and weedy rice can be viewed by the users. Results show that, farmer can manage paddy field efficiently by knowing the specific location of the problem. For instance, the uneven ground condition allows farmers to see the direction of the water flow and improve the uneven surface by the next season. The identification of pest, disease and weed by identifying their symptoms from the pictures provided by Padi2U. Padi2U will give the recommendation methods to control the infection. Users can send a report and photo to the agriculture officer through Padi2U. The agriculture officer will receive it by email and fast action can be taken from the report. Weather forecast is one of the menus in Padi2U. It helps users to see the weather information at the site.

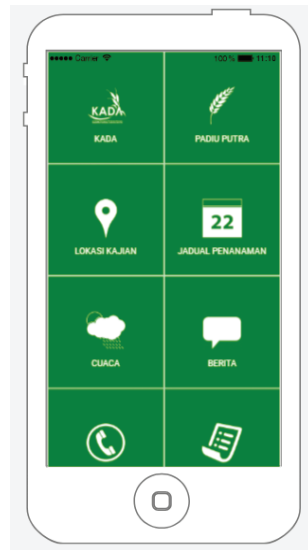


Figure 4. The main page of Padi2U mobile application [15].



Figure 5. Example of images (A) RGB image (B) Multispectral image captured by UAV [15].

4. Conclusion

Padi2U mobile application is an agriculture application that have multiple features in one platform. It is different with other mobile application developed in Malaysia because it accepts aerial images, NDVI map and RGB map as inputs. So far no mobile applications for Malaysians agriculture use offer these imageries and maps as input data. The map will assist users to manage their paddy fields in good practice and management. This will help famers to save their input cost and better manage the area that needs extra care. The information in this application can be used to improve paddy management for the next season and help to increase the rice production. This mobile application development proves that its successful use in paddy can be emulated other crops.

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