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Mobile-Based Spatial Map Application of Horticulture Produce in Wonosalam Sub District, Jombang District, East Java

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Abstract

The purpose of this study is to build information on spatial maps (Geographic Information System-GIS) on horticulture commodities. Users of the Mobile GIS (MoGIS) application are observers of agricultural issues, agricultural services, industrial institutions, professionals related to agricultural problems from upstream to downstream. This moGIS is expected to help every region that has superior products of horticultural crops, where its data will be integrated with moGIS with the compass traveler technique that becomes the system of a region on the map. The specific target in this study is to present horticulture information in the sub-district of Wonosalam, Jombang, East Java by using moGIS. If each horticultural data of each region can be integrated with moGIS, users will know the potential of superior crops in the area which is expected to improve production and better quality, thus making the region and its produce are growing and better known by the community. The activity plan in developing this model are: (1) Analysis of the need for research equipment and survey data on locations, while data collection includes horticultural data and land photo data so that plants that have grown and developed in the area can be identified, (2) Mobile spatial-based system designs which includes the user interface and performance of the data system and interface, (3) coding and system data, (4) trial and (5) Maintenance or improvement to expand the data system. The result is a working app in beta version available for download in the Android marketplace.

Keywords: android application, horticulture produce, moGIS, mobile GIS

INTRODUCTION

Horticulture is a plant consisting of fruits, vegetables, ornamental plants and biopharmaceutical plants. Today, horticulture also includes nurseries, culture tissues, plants production, pests and diseases, and other areas involving plants with garden cultivation. Horticulture has high economic value because it is needed for the drug and food industry, tourism, herbal medicine, community consumption needs, and the need for exports to generate foreign exchange. Horticulture plants have some characteristics, such as: (1) are seasonal plants, (2) some are only suitable grown in certain areas, (3) can meet community needs, and (4) are easily rotten (Ucihadiyanto, 2018).

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Jombang District is one of the areas in East Java Province which contributed around 5% to the total horticulture produce in the province in the year 2017 (East Java Central Bureau of Statistics, 2018), while Wonosalam Sub District is a superior area of Durian fruit which has a pilot fruit garden specialized for Durian. In 2012, the total production was 65,905 quintal (East Java Office of Agriculture and Food Security, 2013). One specific garden is the University's land in Wonosalam which produces not only durian, but also other kinds of fruit and plant such as longan, sapodilla, banana, mango, lime, and cloves. Currently, the form of marketing is still through intermediaries who buy products in large quantities and sell them to local markets or fruit shops as well as markets in the province's capital of Surabaya. From the land owner's side, there are some difficulties in finding buyers who are willing to buy in large quantities and even if there are some buyers, the price offered is not suitable. From the potential buyer's side, there are still some difficulties to find information on which gardens are ready for harvest and sell their produce.

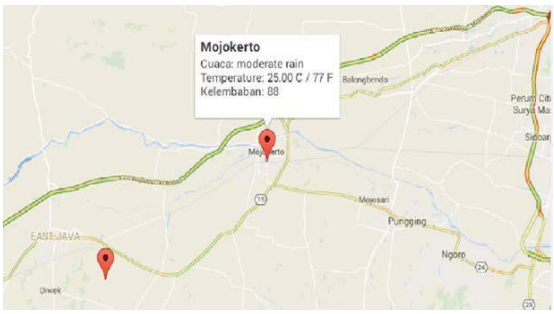

Figure 1. A map with weather information

Geographic Information System (GIS) is an Information System based on the work of computers to input, manage, manipulate, and analyze data as well as to provide descriptions (Aronof, 1989). According to (Rice, 2000), GIS is a computer system used to input, store, examine, integrating, manipulating, analyzing, and displaying data connected with positions on the earth surface. Burrought (1986) defines GIS as a system device that can collect, store, retrieve, modify, transform, and visualize spatial data for specific needs. This research is a development of a previous one, where maps were integrated with Android mobile devices to identify the weather, temperature, and humidity of each region chosen by the user. The research, published in 2016, has developed a model to determine horticulture commodities based on area suitability to grow crops using Self Organizing Maps and Genetic Algorithm (A.D. Irfianti *et al.*, 2016). The weather, temperature, and humidity information change dynamically, according to the geographical conditions of the parameters obtained through the Google Map version 2 component. For example, in Figure 1, the red symbol shows the location coordinates and the application provides information that Mojokerto city has moderate rainy weather, temperatures of 25°C, and air humidity 88.

This research proposed a mobile application which integrates the potential local horticulture produce with geographic information on the location of local fruit shops and land mapping of the University's garden. The geographic information on the site of local fruit shops is hoped to help visitors or tourists to find nearest shops which sell local fruits and plants. It is also hoped that by mapping lands of the fruit and plant garden, information on land contour and the specific plants in several zones can be identified. This information would help the management to arrange more professional treatments to maximize the garden's potential. Harvest readiness of each product can be informed in the application and notify potential buyers (intermediaries or others) to buy it first hand from the producer.

METHODS

The previous research was further developed to display information on horticultural commodities from each region. The information displayed boils down to survey data at the location and source of literature. Markers of each area are used as coordinates, while the components needed to build the technology are described in Figure 2.

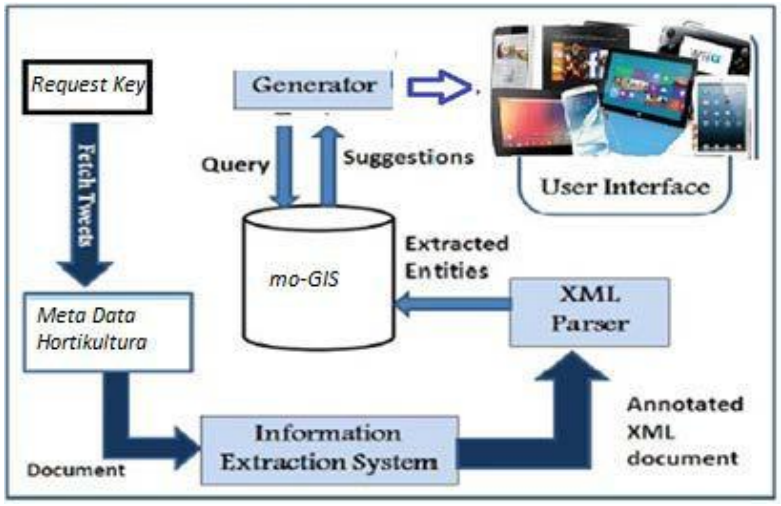

Figure 2. *MoGIS* Components and Architecture

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From Fig. 2, the *moGIS* application extracts entities from horticulture data documents supplied to the Information System. Users make requests as queries on specific information to the application, and it returns the result to users using user interface in the respective device.

The steps performed in the research were:

1. System requirement identification on software and hardware requirement. For designing applications, StarUML system design software is needed. For the design of the interface and the making of applications, it is necessary to edit the editor of Android Studio version 2.1, and above and for the needs of the implementation of the application, an operating system based on Android version 3 and above is required. For data retrieval required hardware drones and related applications to be operated through an Android app, while the implementation needs a set of smartphones with an Android-based operating system that can download apps from Google's Play Store
2. Data collection which included users interview and field surveys.
3. MoGIS interface design to determine input variables and output variables
4. MoGIS system development which incorporated Compass Traverse method (Skvortzow, 2007) to fill in detail on a topographic map.
5. MoGIS testing, and
6. MoGIS implementation

RESULT AND DISCUSSION

Interviews with users have been conducted in 2 visits. The land used as the object of research was the garden owned by UPN "Veteran" East Java, located in Jombang. This garden produces various kinds of horticultural commodities such as cloves, sapodilla, lime, durian, longan, mango, and banana which are potential to be marketed. The problem faced by the plantation manager is regarding marketing garden produce, which is expected to be fruit collectors (intermediaries) who are willing to buy large quantities for resale. Garden products ready for harvest need some buyers who can buy directly in large numbers. Otherwise, the produces will be rotten. However, from the side of fruit collectors, it is also difficult to obtain information on which fruit orchards are ready for harvest so that collectors can directly visit the location of the garden and make a purchase transaction. So far, only a few people

know the information, so the marketing is limited, and the price offered by collectors is not necessarily by the wishes of the plantation manager.

Field surveys have been carried out to map garden lands in the lowlands and also the highlands. This land mapping is done in 3 dimensions and shooting is done by air using uncrewed aircraft, or drones. The results of the garden land map are digitally redrawn to provide more accurate information about the collection of horticultural commodities contained in the garden. The results of the digital image and video survey can also be used for overall monitoring of the garden area to find out which commodities will enter the harvest period so that the application will inform the fruit collectors.

In designing this application, it is not only intended for garden managers belonging to the UPN "Veteran" East Java but also can accommodate other garden owners in the vicinity to help them inform through an Android-based application developed. Therefore, in addition to collecting data on UPN-owned gardens, data collection is also conducted on the locations of the surrounding gardens and fruit shops.

The Hortimart application as a moGIS software product from this study has been designed and developed, and has been published on Google's Play Store that can be downloaded by users (Web link: https://play.google.com/store/apps/details?id = com.ade.hendi.mogis, whereas if via a smartphone it can be accessed by directly type Hortimart keywords in the search list). This application is made with a simple and informative concept so that ordinary users can use this application easily. It is also a location-based application which can show users of horticulture gardens and even the nearest fruit shops from the user's current position. Besides being able to be used by fruit collectors, this application can also be accessed by the general public who want to find out the location of the nearest fruit and vegetable shop from the position of users who are around Jombang District. The Hortimart application can be used by both general users and landowners or fruit and vegetable shop owners who want to register their commodities for the public to know.

There are two users of the application: General Users (no registration required) and Shop/Land Owners (requires registration). Figure 3 shows flowcharts for General Users and figure 7 for Shop/Land Owners.

Figure 3 explains the flow for general users. After opening the Hortimart application, users have the option to choose from three further submenus:

1. To search for UPN land (in this case, it means finding land that is ready for harvest to buy in large quantities). In this menu, users can view the UPN land map which consists of 3 zones (Figure 4a and 4b) and has information on fruit trees in each zone. In Figure 4b, there is a series of additional menus that can be accessed, namely (from left to right):
    a. Like: to like pictures
    b. Add a comment: to add a comment in the image
    c. Location map: to open the Google Map menu and display the route to the area contained in the image
    d. Share link: to share image links through other applications.
    e. Telephone: to make a phone call to the number written on the telephone data in the picture.
    f. Render detail: to display rendering of 3-dimensional information from the land image.
    g. Mail: to send e-mail messages to landowners (login required first).
    h. Info: to display address info and land/shop rating.

From the three land zones, it can be seen that each zone has several types of horticulture plants. Zone 1 has durian, sapodilla and clove plants. Zone 2 has sapodilla, durian and banana plants, while Zone 3 has sapodilla, durian, banana, and longan plants. There is no specific grouping for horticulture plants on UPN land and is still allowed to grow naturally. To find out the detailed conditions of each horticultural plant, such as the condition of the tree whether it is ready for harvest or not, it still needs direct monitoring (manually). It can also be done automatically by using the help of a type of drone that can be operated at low altitude and can flexibly move between trees that are close enough without crashing. The kind of drone used in this study still cannot do this because it will automatically stop flying if it encounters an obstacle (tree branch). Therefore, this monitoring can only be carried out from the land at an altitude of 50 m.

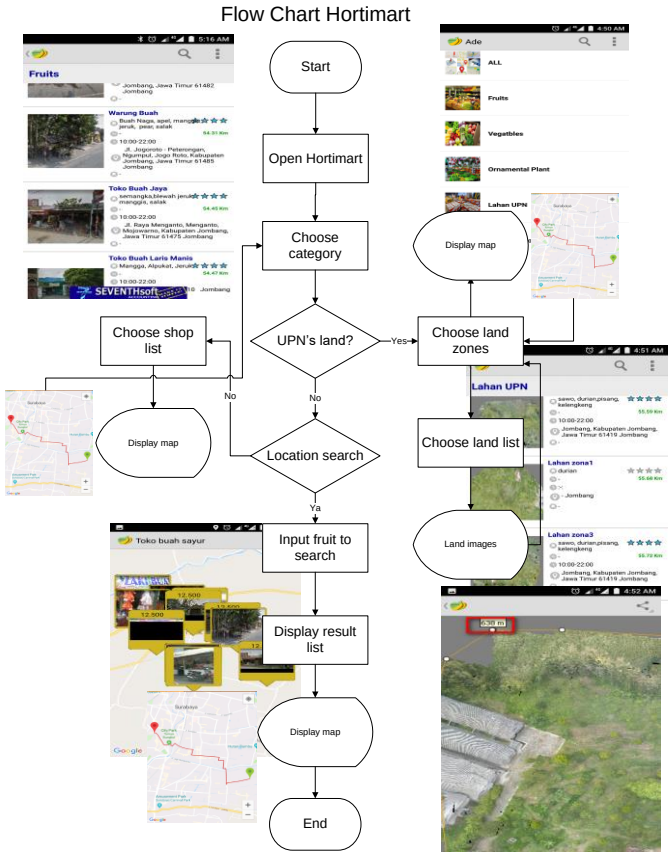
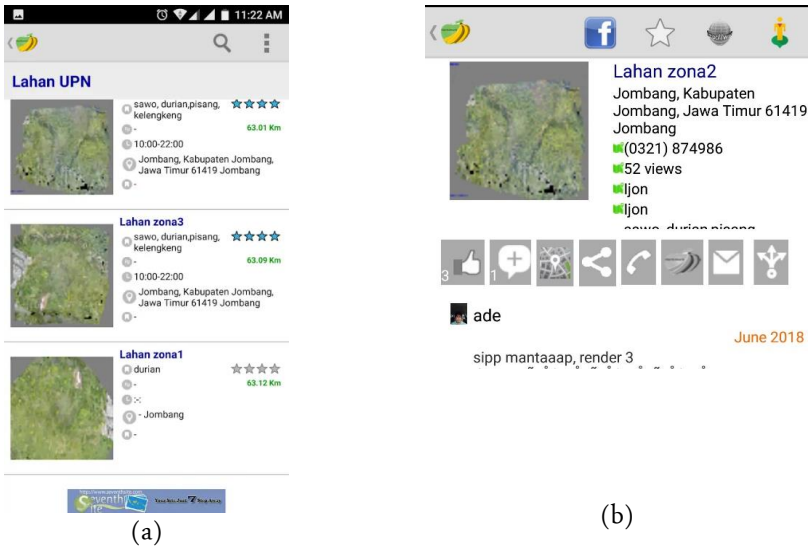


Figure 3. System flowchart for General Users



(a) (b)

Figure 4. Land Map Menu

In Search for UPN land menu, there is a Render Detail submenu to see the 3-dimensional rendering image of the land as shown in Figure 5. From the results of air monitoring, it can be seen that the UPN land area is 889 m^2.

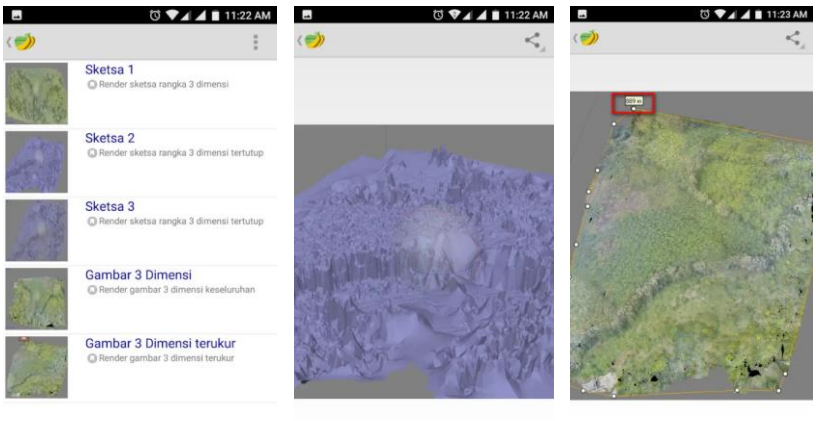


Figure 5. Three-dimensional rendering of UPN Land. (a) Detail Render Submenu, (b) 3-dimensional sketches before rendered into real 3-dimensional objects, (c) 3-dimensional drawings after made into real 3-dimensional objects with information on area size

(1) To search for sales locations for certain fruits

In this menu, users can access the Fruit Location menu and directly type in the name of the fruit to find in the area around Jombang Regency. The system will display a list of search results in the form of a location pointer on the map along with the image thumbnail info which, if tapped, will present the address information of the store location along with its latitude and longitude coordinates.

(2) To look for a list of horticulture stores based on the categories of fruits, vegetables, or ornamental plants

In this menu, users can search for horticultural stored data by types of fruit, vegetables, or ornamental plants. Search results can be displayed in a sequence based on distance, the number of likes, rating, lowest price, or highest price. If the Map menu is tapped, the system will immediately open the Google Map application and display the distance and route that can be taken to go to the store location as shown in Figure 6.

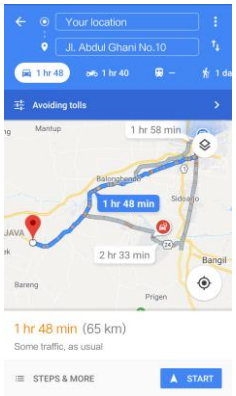


Figure 6. Map s and Routes generated by Google Map to get to the location

Flowcharts for landowners/horticulture stores are depicted in Figure 7. There are two main menus, namely registration of new members and login of registered members. To access the landowner/horticulture shop menu, users can tap the menu at the top right of the application (marked with three vertical dots).

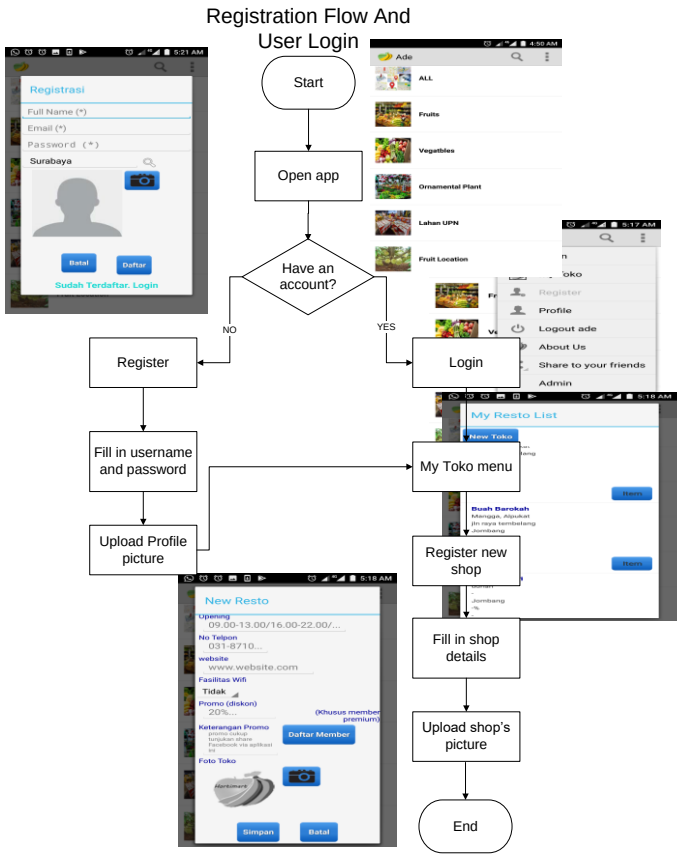


Figure 7. System flowchart for Land/Shop Owners

1. New member registration menu

   Before landowners or horticulture shops can promote their products or stores, they need to register as members first. To register as a new member is free of charge, choose the Register menu after accessing the list at three dots at the top right of the application. Prospective new members fill in the full name, valid e-mail address (Gmail), and password to access the member menu. Locations field can be filled with the name of the city where the land or horticulture shop is located. Then prospective members can also upload photos of landowners or shops

2. Registered member login menu

   After being registered, users can register his land or shop. After a successful login, the user can choose the New Shop menu and fill in some additional information, such as Opening days and hours, Phone Number, Website (if any), Wifi or no facilities, Promos (discounts), and shop photos. After that, the owner can fill in various products or items sold by tapping on the Item menu.

From the results that have been achieved, it can be seen that the prototype moGIS application can be used to provide geographic information about horticultural land and stores in the Wonosalam area, Jombang Regency. On UPN land, 889 m^2 of land was divided into 3 zones. Each zone has a variety of horticulture plants that are still not grouped and managed professionally. From the results of monitoring, it is also known that the conditions of the land vary in the level of plant density which can indicate different levels of soil fertility and land contours that also vary. Further research is needed to investigate land fertility rates and analysis of land suitability for plant species, to maximize horticultural products produced. The results of this study will be better if it can be used for strategic decision making about better land management plans, such as grouping plant species and intensive and periodic monitoring using technology assistance.

For now, existing horticultural plants are still allowed to grow naturally, and there is no specific management to plant uniform plants and provides special professional treatment and monitoring. For future development, this should be done to maximize the potential of fertile and extensive UPN land which currently has a real potential profit.

For features related to mapping the location of fruit shops around the Wonosalam area, this application has been able to provide information that can help fruit and vegetable traders, both retail and party, to market their products to be better known by people who will buy fruit products and certain vegetables, especially those around the area. Traders need further information in the area to get to know and utilize this application to help promote their products and increase sales.

CONCLUSION

From the results of this study, some conclusions can be drawn, that a prototype of a mobile-based application has been made to provide geographic information (moGIS) about horticultural products found in the Wonosalam area, Jombang Regency, East Java Province. The process of land mapping from the air has been carried out by using drone assistance on UPN land in the Wonosalam Sub District and gave information of the area value of 889 $m^{2,}$ and their three dimensions render of the land plains can be drawn. The identification of horticultural products from the UPN land has also been carried out in three land zones, namely sapodilla, durian, banana, and longan. In addition to mapping the UPN land, data collection of various shops in the Wonosalam and surrounding areas which sell fruit and ornamental plant horticulture products has also been conducted and shop owners, and land can register their stores in the application.

Future works from this research include improvement on this moGIS application by integrating the results of detailed mapping of each horticultural plant location that can provide information on harvest readiness of each plant. The mapping data collection should be carried out periodically using a tool. Further research can also be done on the analysis of the level of land fertility and the suitability of land with plant species so that the level of land use can be maximized. Also, the results of this study can be used for strategic decision making on more professional land management.

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