Design and development of information system for tractors distribution based on android in Maros Regency of South Sulawesi

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Abstract. One of the major issues in agricultural machinery and equipment grant programs is the difficulty to access the information of their distribution. So far, the data collection process is still done manually. This system needs to be replaced with a more reliable and more efficient system to map the distribution of the agricultural machinery and can be accessed through android mobile. This study aimed to design and develop information system based on android that can be used to locate tractors distribution, a case study in Maros Regency. The application was designed using Android Studio and Google Maps API, supported by Firebase google and stored at Firebase cloud. Java was used as the language program, and PHP MySQL was employed as a data basis. An android-based application, namely "GIS Tractor" is designed and released for mapping the distribution of tractors in Maros. The developed system can be easily maintained, and data can be updated in real-time by an administrator and accessed by anyone through a login procedure to access the information of machinery distribution. GIS Tractor application has been successfully tested on Android Operating System 4.0-10.0, enable everyone to find information about tractor distribution.

1. Introduction

Agricultural machinery and equipment have been provided and distributed for the farmers to facilitate agricultural development in Indonesia. However, agricultural machinery and equipment aids program often face some distribution constraints. Among the constraints are uneven distributions and unsuitability of the supply to requirements. The result of such problem will lead to excess of machineries availability in one area but on the other hand the lack of machinery is found in other area [1].

The mentioned problems can be minimized with the reliable and representative of data information. Unfortunately, the data collection process is still done manually and not well managed. Big data is the latest agricultural issue and trend that includes the use of information technology in the digital era. This makes the need for geographic information system (GIS) software to be designed for research in the field to support precision agriculture program [2]. Indonesian research products to support
precision agriculture, for example are Nutrient Manager for Rice, e-petani, GIS mapping C and N status on rice, and Katam System Information [3]. Some of the mentioned research products are available on android operating system.

As an open-source operating system for smartphones based on Linux, android enables the freedom for smartphone users and android phone operators to develop an operating system and develop applications [4]. Moreover, android operating system is familiar to most Indonesian, so the development of an Android-based system was chosen to make it easier to operate [5]. There are GIS-based applications on android have been designed for mapping, including FinDoctor to assist patients reach out the doctors [6], hospital and pharmacy mapping [7], Kulineran Solo for culinary place mapping in Solo City [8] and AgriMach: an android application for agricultural machinery service [1]. However, to date, there is no android application for any agricultural machinery mapping in Indonesia, including for tractors. Such information of distributed tractors is held by restricted stake holders, which cause the lack of information disclosure. Indonesian Ministry of Agriculture concerns about information services and public disclosure systems. In 2020 its quality of information services and public disclosure systems significantly increased up to 10% [9]. Thus, bridging the information gap in tractors distribution is important as part of information disclosure.

An android application for mapping the population and distribution of agricultural machinery is expected to address the difficulty of information access regarding the distribution of the machines, particularly tractors. Tractors are one of the most needed agricultural machineries. These include two- and four-wheeled tractors. Two-wheeled tractor (TR2) is needed to overcome the shortage of human resources and catch up on planting time simultaneously, while the use of TR4 for soil cultivation and seed planting tools can accelerate and ensure simultaneous planting time especially for rice [10].

As one of the rice producers in South Sulawesi, Maros has received machinery aids program including tractors. Most farmers in Maros have applied mechanization, and the local extension officers are familiar with some mobile application in agriculture.

The purpose of this research is to design an android application based on geographic information system for mapping the distribution of tractors. The previous manual process data collection is replaced by a system that makes it easier and more efficient for mapping the distribution of hand tractors and four-wheel tractors. The expected output of this research is to assist related agencies and stakeholders to locate, record the lacks and excesses of particular machinery distribution, that make the management of agricultural machinery assistance for farmers efficient.

2. Materials and methods

2.1. Materials

- Computer Hardware (Hardware) with specifications:
  - Processor: Intel Pentium core 15, Clock Speed 1.4 GHz
  - RAM: 8 GB DDR3 SODIMM PC-10600
  - VGA: NVidia 8, 1 Gb.
  - Screen: 14” WXGA LED with a screen resolution of 1366 x 768
  - 1 TB hard drive
- Software (Software) used:
  - Windows 10 64 Bit
  - Android Studio
  - Flutter
  - XAMPP Control Panel
- Books references about web and android
2.2. Methods

2.2.1. Data collection. This study used observation and study of literature to design the application. The collected data, as many as 30 farmer groups includes farmer group names, tractor owner’s names, tractor types, and tractor distribution locations including spatial data collection by open camera, minutes of handover documentation from the local extension officers.

![Flow chart of the application design](image)

**Figure 1.** Flow chart of the application design.

2.2.2 Application design. The system design began with the design of the Use Case Diagram, Application Navigation Structure design, and Application Storyboard design. Designing the application started with the detailed design of the pages that will be displayed in the application. The application was designed using Android Studio, supported by Firebase Google and stored at Firebase Cloud. Java was used as the language program, and PHP MySQL was employed as a database, and Google Maps is used for data location indicator. Flowchart diagram of the study is presented in figure 1.

2.2.3 Requirement analysis. Requirement analysis was used to identify the requirement of new system. System requirement including user requirement and admin requirement. System will display the
information to users by processing the recorded database. User requirements include the preview of tractor distribution location map in Maros, notification information preview from the system, route preview from user location to tractor location, detailed information about location and condition of tractor. Admin requirements in this system are administering the data of tractor location in Maros and notification information data by the system.

3. Results and discussion
The implementation system was built to address the requirement system. It can be divided into 2 categories: system implementation on android for users and system implementation on website for admin. The GIS Tractor android application has been successfully tested for installation and has worked well on android operating system 4.0 to 10.0. Application on android operating system can be further developed for any changes and improvement.

3.1. System implementation on android
The following is the display result of the GIS Tractor Maros application on android.

![GIS Tractor Maros](image)

**Figure 2.** (a) Welcome page preview, (b) Login page preview, (c) Register page preview, (d) Dashboard page preview.

3.1.1. Welcome page preview. The welcome page is the initial display for application security with two options before entry. Each user has a user account to log in; if the user does not have an account, they can sign up on this page (figure 2a).

3.1.2. Login page preview. Login page is an entry process for users to access computer systems for the registered users (figure 2b). Login intended to manage the identification process. The minimum login process consists of a user name/user account and a password to obtain access rights.

3.1.3. Sign up page preview. For those who does not have an account, is able to sign up in this page (figure 2c). Register is the process of recording the registrant's identity, which will be stored in a storage area which will be used to enter the GIS Tractor application. On this menu, the user will register using e-mail and enter the password that will be used when entering the application.

3.1.4. Dashboard. The dashboard is the first page that user will see after successfully logging in (figure 2d). The GIS Tractor Maros application dashboard contains various menus in the form of shortcuts that have different functions. Recent location is a display of tractor positions based on the
names of farmer groups in Maros Regency. Tractor maps are used to view the overall tractor distribution using the map of Indonesia.

3.1.5. **History page preview.** The history page is a page that displays the user's travel history to the tractor location (figure 3a). On this page, the user can see which areas that the tractor has visited.

![History page preview](image)

**Figure 3.** (a) History page preview, (b) Inbox page preview, (c) Profile page preview.

3.1.6. **Inbox page preview.** The inbox page is the page used by users and admins to communicate through notifications (figure 3b). Admin can display software updates and update the tractor location that has been entered in the data. On this page, an application notification will automatically appear when the application is used.

3.1.7. **Profile page preview.** The profile view is a page that displays the user's full name, email used and mobile phone number (figure 3c). On this page the user can change the account data that has been registered via the settings menu. This page also contains the agreed application rules. The logout menu is available if the user account wants to exit the application.

![Profile page preview](image)

**Figure 4.** (a) Location page preview, (b) Map page preview for details, (c) Route page preview.
3.1.8. **Detail location page preview.** The location detail page shows the location of the tractor by the name of the farmer group. The farmer group menu will display the location on the map provided by Google map. See figure 4a.

3.1.9. **Map page preview.** The map view is a display of the position of the tractor on the map. The map has an enlarge feature that the user can see the location details and zoom out feature that the user can see the position by looking at the map as a whole. The picture of tractor is displayed as well (figure 4b).

3.1.10. **Route page preview.** The route view is a route page to the location of tractors based on the location of the user's position. This route view makes it easy for users to visit locations and find the nearest road (figure 4c).

Figure 2b – 4c are the interface of developed information system for tractor distribution application on android, namely GIS Tractor Maros. The newly developed system is proposed to replace the old manual system which often lead to confusion due to data inconsistency. The result of this study is upgradable because it is developed on android operating system. An operator or admin team is required to input and manage the related data for the information system. For future and advance development of the system, chips can be attached to the tractors for real-time GIS tracking. However, it will be costly in implementation. Thus, as initial design of information system, an admin is responsible for data entry.

3.2 System implementation on website for admin

3.2.1. **Tractor list preview.** The tractor list website view is a feature to view data on two- and four-wheeled tractors that have been entered. The page preview will show a photo of the tractor condition, the name of the farmer group, the owner of the tractor, the complete address of the tractor position and the coordinates (figure 5).

![Figure 5. Tractor list preview.](image)

3.2.2. **Add tractor data preview.** The page enables the admin to add data which include tractor type, brand, volume, machine number, frame number, condition, name of farmer group, tractor owner, full address, upload photos of tractor conditions and coordinates on the map of the tractor location (figure 6).

![Figure 6. Add tractor data preview.](image)

3.2.3. **Tractor data change preview.** Tractor data change display is a page to change the data that has been entered, if there is any wrong or incomplete data (figure 7).
3.2.4. Notification list preview. The notification list display is an information page if there is an application improvement or an application change includes changes in appearance, feature additions or changes to the work system (figure 8).

3.2.5. Add notification preview. The page of add notification is used by the admin to enter application information (figure 9). Admin is able to make notification which will appear on the interface of GIS tractor application. It contains the title and the content of notification. Once the submitted the notification, but need to make amendment, this shall be done from notification data change.

3.2.6. Notification data change preview. It is the page for editing notifications if there is any change in information or incorrect information that has been entered (figure 10).
System implementation for admin is based on firecloud. Involvement of extension officer in each subdistrict is required for tracking the validity of collected data. Data entry must be matched with the minutes of handover as the legal document. Hence, the data disclosure for tractor distribution information system is acquired.

4. Conclusions

An android application has been successfully designed and launched on play store, namely GIS Tractor Maros. It performed well on Android 4.0-Android 10.0 for several brand of smartphones. The application can replace the previous manually record system and support the information disclosure for public. Further study is required to assess the usability testing of the software and also user perception towards the newly developed system information of GIS Tractor Maros.

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