

Geographical Information System Mapping of Temporary Landfills Using the Haversine Formula Method Based on Android

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ABSTRACT: The potential for waste generation at Merauke district with population at 223,389 people reaches 111.69 tons per day. Moreover at the city of Merauke itself with population at 98,986 people, the potential for waste generation is 49.99 tons per day. However, the number of customers recorded up to 2019 is 6,428 customers, with the potential for waste generated to be only 2.88 tonnes per day. This figure is of course still very less than the total potential for existing waste generation, therefore we need a system that can help and make it easier for people to find, find out the information on the nearest dump and the distance to be traveled.

The Geographical Information System for temporary landfill mapping uses the Android- based Haversine Formula method, the design uses Eclipse with the Java programming language, and the database uses MySQL.

The results that obtained from this application were the system can map the closest dump, provide information on the condition of the dump and can display the distance between the start point and the dump so it can help the public to finding the information.

KEYWORDS: GIS, Dump, Android, Method Haversine

1. INTRODUCTION

1.1 Research Background

Due the number of population that growth increased rappidly and naturally as well transmigration flows in Merauke City, causing the expansion of residential areas

that are difficult to reach by waste processing facilities provided by the government. This certainly creates a potential waste generation point. The potential for waste generation in Merauke district with a population of 223,389 people reaches 111.69 tons per day. Especially at the city of Merauke itself with a population of 98,986 people, the potential for waste generation is 49.99 tons per day. However, the number of customers recorded up to 2019 is 6,428 customers, with the potential for waste generated to be only 2.88 tonnes per day. This figure is, of course still very less than the total potential for existing waste generation[1].

Based on data from the Environment Agency, the Merauke City government has provided a temporary landfills in the form of 33 waste containers with a load capacity of 6 tons. These polling stations are spread across 24 locations including Wamangu Market, SMKN 3 Merauke, SDN Cenderawasih, Mopah Airport, SMAN 1 Merauke, SMAN 2 Merauke, Marine Complex, Kompleks SATRAD 244, Kompleks LANTAMAL XI, SMA JHON 23 Merauke, Merauke Hospital, Jl. Soekarjo, Lapas Complex, Binaloka Complex, TPS KPG / Ndoremkai, SMAN 3 Merauke, Jl. Soldier, Blorep Housing Complex,

Company A Complex, Local Government, Bunda Harapan Hospital, Jl Ahmad Yani, SMP Muhamadiyah and Yobar Localization [2]

Current technological developments have brought new breakthroughs in mobile phones with an operating system, namely Android. Android is a Linux-based operating system that makes it easy for users to interact directly with the system. Android is open source and has various features or facilities that allow a programmer to create various applications to meet user needs, one of them which is digital mapping.

Currently, a digital map that is quite good and quite accurate and supports the development of a geographic information system were Googel Maps. This digital map has been supported by many browsers both on computer and mobile devices. Google Maps has a feature that can determine the shortest route between locations. Meanwhile, distance determination can be done by applying the Haversine Formula method. This method can provide information about the distance between two location points. The haversine formula itself is an important equation in navigation that can provide the distance between two points based on longitude and latitude [3].

Based on the description above, the writer takes the title " Geographical Information System Mapping Of Temporary landfills Using The Haversine Formula Method Based On Android". So that it can help residents in identifying the

closest dump position to their residential area. This system will later be managed by an admin. The admin here is a staff at the Environmental Agency who has the authority to regulate access rights to the system and also matters relating to operational arrangements on this system.

1.2 Identification of problems

The identification of problems in this study are as follows:

1. Most of the population still littering, because they do not know the location of the temporary landfills closest to their settlement.
2. The position of the temporary landfills is not permanent or still moving.

1.3. Research purposes

This research aims as follows:

1. Produce a system that can help provide information on the nearest temporary landfills for each residential area using the Heversine Formula method based on Android
2. Produce a system that can provide the latest temporary landfills positions to the public using the haversine formula method based on android

2. THEORY BASIS AND LITERATURE REVIEW

2.1 Geographical Information Systems

Geographic Information System is a special information system that manages data that has spatial information (spatial reference). Or in a more narrow sense, is a computer system that has the ability to build, store, manage and display geographically efficient information, for example data identified by location, in a database. [4]

2.2 GIS Subsystem

The subsystems owned by GIS are input data, output data, data management, data manipulation and analysis [5]. The GIS subsystem is described below:

1. **Data Input**
This subsystem is responsible for collecting and preparing spatial data and attribute data from various sources. This subsystem is also responsible for converting or transforming the original data format into the formatted used by GIS.
2. **Data Output**
This subsystem displays or produces the output of all or part of the database in softcopy or hardcopy, such as: tables, graphics, maps and others.
3. **Data Management**
This subsystem organizes both spatial and attribute data into a database in such a way that it is easy to call and edit.
4. **Data manipulation and analysis**
This subsystem determines the information that can be generated by GIS. In addition, this subsystem also performs data manipulation and modeling to produce the expected information.

2.3 Haversine Formula Method

The haversine formula method is a method used to calculate the distance between two points on a map. This method is widely applied in Android applications to find the shortest or closest route to a certain place, such as the nearest house of worship, hospital, and so on. The haversine formula is an important equation in navigation, giving the distance of a large circle between two points on the surface of the sphere (earth) based on longitude and latitude. The use of this formula is accurate enough for most calculations, it also ignores the elevation of hills and the depths of valleys on the earth's surface [3]. Here's the form of the Haversine Formula:

$$\Delta lat = lat2 - lat1$$

$$\Delta long = long2 - long1$$

$$a = \sin^2(\Delta lat / 2) + \cos(lat1) \cdot \cos(lat2) \cdot \sin^2(\Delta long / 2)$$

$$c = 2 \cdot \text{atan2}(\sqrt{a}, \sqrt{1-a})$$

$$d = R \cdot c$$

Information :

R = the radius of the earth is 6371 (km) Δlat = the amount of change in latitude $\Delta long$ = the amount of change in longitude c = calculation of the intersections of the axes

d = distance (km)

2.4 Android

Android is a subset of software for mobile devices which includes the operating system, middleware and core applications released by Google. The Android SDK (Software Development Kit) provides the tools and APIs needed to develop applications on the Android platform using the Java programming language. The history of Android begins in 2005, Google later that year also started building the Android platform intensively. November 12, 2007 Google together with OHA (Open Handset Alliance), a consortium of open mobile devices, released the Google Android SDK, after announcing a week earlier [6].

3 RESEARCH OBJECT SYSTEM DESIGN

3.1 Analysis of the device used

Non-Functional Requirements describe what requirements are needed in the system design process which includes hardware, software and design requirements which are shown in the following table.

Table 3.1 Analysis of the Devices Used

No	Needs	Features
1	Hardware	1.67 GHz processor
		1.6 7.88 GB hard drive
		4 GB RAM
		Monitor screen resolution of 1024x600 pixels

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		Keyboard and Mouse
2	Software	Windows 10 operating system
		Android Studio
		XAMPP
		Code Igneter (CI) Framework
		Google Maps
		Microsoft visio 2013
		Pencil

3.4 DFD Level 0

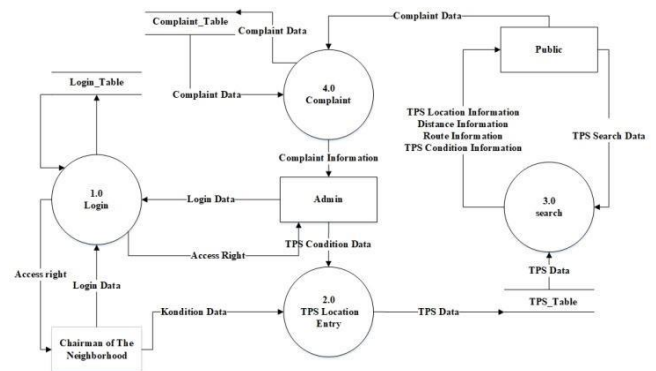


Figure 3.3 DFD Level

3.2 Proposed System Flow

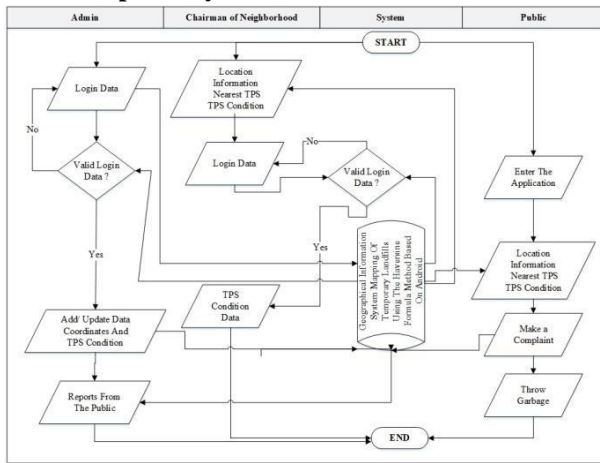


Figure 3.1 Proposed System Flow

3.3 Context Diagram

Context diagrams describe an outline of a system to be built. This diagram has external entities associated with the system and can be seen in the following figure.

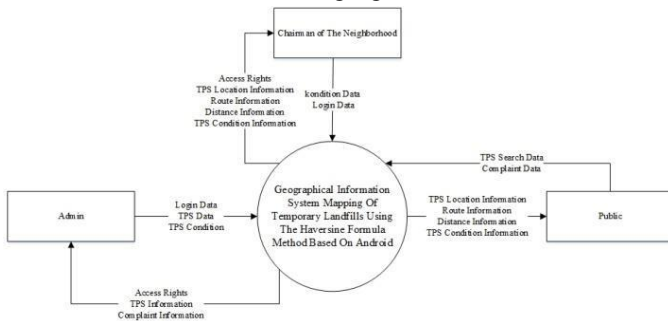


Figure 3.2 Context Diagram

4. RESULTS AND DISCUSSION

4.1 Interface / Application Interface

1. Main Page Menu

Every time the user opens the GIS application, this page will display a map containing the location points and conditions of the temporary landfills. Users can search for the nearest temporary landfills by pressing the existing button, the system will automatically direct to the nearest temporary landfills. By clicking on the temporary landfills icon, the system will provide menu options to find out the distance, conditions and directions to the temporary landfill. The following is a picture of the temporary landfills Map Menu.



Figure 4.1 Main page menu

2. Dump list menu

The Dump List menu will display a list of all Dump complete with their descriptions

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Figure 4.2 Dump List menu

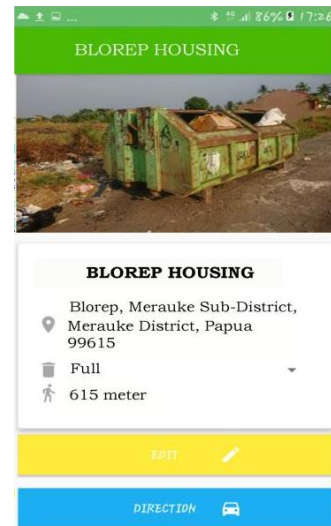


Figure 4.4 dump Conditions

3. Menu Info

The Info menu is a display that displays information about the application maker and also the login menu for neighborhood association.

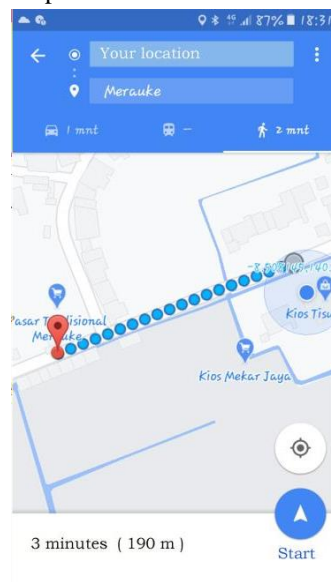


Figure 4.3 Menu Info 4.Dump Condition Picture Menu

The dump condition image menu is a menu that displays the dump condition whether or not dump is full

5. Nearest Route Guide Menu

The closest route pointer menu is a menu to show the closest route to the waste picker



6. Menu to determine the closest dump distance

The menu to determine the closest dump distance is a menu to determine the closest distance to the user's position.

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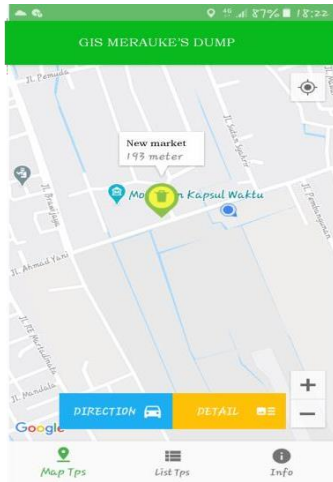


Figure 4.6 Determinants of the Nearest Route

4.2 Google Map testing

Google Map testing is done to compare the distance between the Haversine formula calculation and Google Map calculations. This calculation is done by calculating the distance from the start point to the TPS. Table 4.1 below is the result of calculations between the Haversine Formula method and the Google Map.

Table 4.1 Comparison Results Between the Haversine Method and Google Map

No	TPS addresses	Google Map calculations	Haversine's calculations	Difference
1	Jl.Ahmad Yani	200 m	199 m	1 m
2	Blorep	1,1 km	614 m	486 m
3	Kompi A	1,2 km	836 m	364 m
4	SMA N 1	2,4 km	1,73 km	670 m
5	SMP Muhammadiyah	2,9 km	1,96 km	940 m




From the test results above, the average difference between the Google map test and the Haversine calculation is 492.2 M. The Google map test is calculated by following the road, while the Haversine calculation uses a calculation by drawing a straight line between the start point and temporary landfills.

4.3 Blackbox Testing

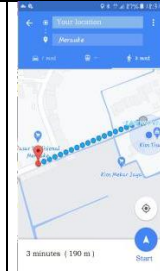

Blackbox testing aims to test each component of the system that has been previously designed and to ensure that it functions as expected.

Blackbox testing focuses on the requirements and functionality or requirements of the software. Testing the system with the blackbox method can be seen in the following table:

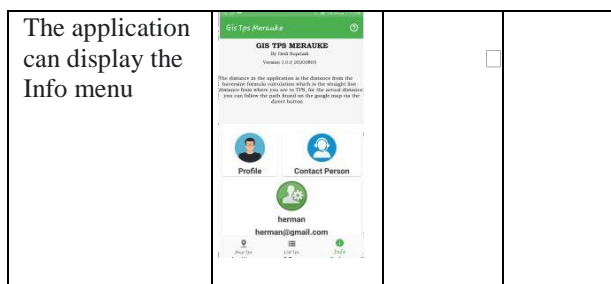
Table 4.2 Blackbox Testing

Terms	Result	Reached	Not achieved
Applications can display maps of Dump at Merauke		<input type="checkbox"/>	
Applications can display a list of polling stations complete with information		<input type="checkbox"/>	
Application Can Find the nearest Dump from the position of the User		<input type="checkbox"/>	

Continued Table 4.2 Blackbox Testing

The application can show the route to the nearest polling station		<input type="checkbox"/>	
Application can display dump conditions		<input type="checkbox"/>	

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6. F. Sifauttjani, T. Listyorini, and R. Meimaharani, “Android-Based Restaurant Search,” ISSN, 2017.

5. FINALE

5.1 Conclusion

Based on the results of the research that has been done, it can be concluded that:

2. The research conducted has resulted in a system that can provide information on temporary landfills by the community as well as by admin or officers.
3. Researchers have produced a system that can provide the position of the closest dump location from each residential area by using the haversine formula method based on android. And based on the questionnaire, respondents obtained a criterion score percentage of 91.4% on time efficiency in selecting temporary landfills and obtained a criterion score percentage of 83.4%, to make it easier for users to throw garbage.

5.2. Suggestion

Based on the research results, there are several suggestions for further system development including the following:

1. It needs to be added on the user application regarding how many dump at that point.
2. It is necessary to add a notification feature to the user or community application if there is a transfer of trash from where to where.

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