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Application for Searching for Livestock Distributor Locations at the North Sumatra Plantation and Livestock Service Using the Euclidean Distance Method

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Abstract

The Plantation and Livestock Agency of North Sumatra Province plays an important role in supporting the availability and distribution of livestock for farmers and livestock business actors. However, information about the locations of livestock distributors, which are scattered across various regions, is often difficult to access quickly and accurately. This situation makes the process of finding distributor locations inefficient and time-consuming. Therefore, a system is needed to help users find the nearest livestock distributor locations automatically and accurately. This study aims to design and develop an Android-based application that provides information on livestock distributor locations in North Sumatra Province and determines the nearest distance between the user and the distributors using the Euclidean Distance method. This method is used to calculate the distance between two points based on their geographic coordinates (latitude and longitude), allowing users to get recommendations for the nearest distributor from their current position. The result of this study is an Android application that can display a list of livestock distributors, show their locations on a map using GPS services, and provide real-time information about the closest distance. This application is expected to make the process of finding livestock distributor locations more effective and efficient, as well as help the Plantation and Livestock Agency of North Sumatra Province provide digital information services to the public.

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1. Introduction

Information and Communication Technology (ICT) has significantly developed Geographic Information Systems (GIS). GIS has become increasingly easy to use due to increasingly accessible and

faster internet connections. Previously accessible only through web-based applications, it is now accessible via mobile devices. One of the most important aspects of many applications, particularly GIS, is the ability to determine the position or location of an address (Harahap, 2023).

Location search has numerous functions and uses, and in this day and age, location search is crucial. This is evident in the problems that arise without using a location search system, including a company lacking extensive distributor connections and not knowing the locations of nearby distributors.

The livestock sector is a crucial component in supporting food security and economic growth in Indonesia, particularly in North Sumatra. The North Sumatra Provincial Plantation and Livestock Service plays a strategic role in supporting livestock development through various programs and services, one of which is providing information related to livestock distribution. However, in practice, locating livestock distributors is still done manually and not digitally integrated, making it difficult for farmers and the public to obtain fast, accurate, and efficient information.

In an era of rapidly developing information technology, particularly with the increasing use of Android-based devices, the need for responsive and mobile-friendly information systems is urgent. The use of Android-based applications allows users to access information anytime and anywhere. By utilizing this technology, the process of locating livestock distributors can be automated, accelerated, and expanded.

To date, the process of finding livestock distributors has generally been done manually, either by directly contacting the agency or through informal communication between farmers. This method is relatively time-consuming and ineffective, especially when users are located far from information centers. The lack of a digital-based information system also means that the data received is often out of date, hampering the distribution process and decision-making by farmers. This situation impacts the efficiency of the livestock supply chain and has the potential to reduce livestock productivity in the region.

Current developments in information and communication technology offer significant opportunities to address these issues. The use of Android-based mobile devices holds significant potential, as almost everyone uses smartphones in their daily activities. With the support of location-based services and GPS, livestock distributor locations can be automatically located based on the user's location. One method that can be used to calculate the distance between the user and the distributor is Euclidean Distance. This method can calculate the straight-line distance between two coordinate points (latitude and longitude), allowing for quick and accurate identification of the nearest distributor.

One method that can be applied to the process of finding the nearest location is the Euclidean Distance method. This method calculates the straight-line distance between two geographic coordinates (latitude and longitude), making it highly suitable for determining the location of livestock distributors closest to the user. This method can improve distribution efficiency and facilitate livestock farmers' access to needed resources.

However, to date, there is no official Android-based system or application that utilizes the Euclidean Distance method to facilitate the search for livestock distributor locations in North Sumatra. This presents both an opportunity and a challenge in creating an application that is not only informative but also interactive and practical for use by a wide range of groups, including traditional and modern livestock farmers.

Therefore, this study will design an Android-based livestock distributor location search application using the Euclidean Distance method. This application can assist the North Sumatra Provincial Plantation and Livestock Service in digitizing livestock distribution information services. This application is expected to improve the quality of public services, support spatial data-based decision-making, and accelerate the growth of the livestock sector in the region.

This application utilizes a geolocation map, employing the Euclidean Distance method. Each livestock distributor point is displayed based on the user's route and displays the closest destination. Euclidean Distance is a method for calculating the distance between two points in Euclidean space,

introduced by the Greek mathematician Euclid. This method is often used as a heuristic function in various applications. Its relationship with the Pythagorean Theorem is significant, as it relates this distance calculation to the length of a straight line (Shafira et al., 2023). It is hoped that users can search for routes to their desired livestock distributor locations by utilizing the shortest distance to reach the livestock distributor they visit.

2. Research Methodolgy

In completing this research, the author used two research methods:

1. Field Study

This method involved conducting direct fieldwork to collect data on livestock distributor locations in Medan City. The data collection techniques used by the author were:

a. Observation

This is a fairly effective data collection method for studying a system. This involves searching for livestock distributor locations.

b. Sampling

This involves collecting necessary data samples, such as photographs of livestock distributor locations in Medan City.

2. Library Research

The author conducted a literature study to obtain data related to the writing of this thesis from various sources, such as guidebooks on creating Firebase database processing applications using Java, and books or journals discussing concepts related to the research title.

This is a method of data collection by examining literature, module packages and guides, manuals, library books, and any other sources deemed necessary and supportive. Researchers used a fishbone diagram to illustrate the workflow they followed to complete this research.

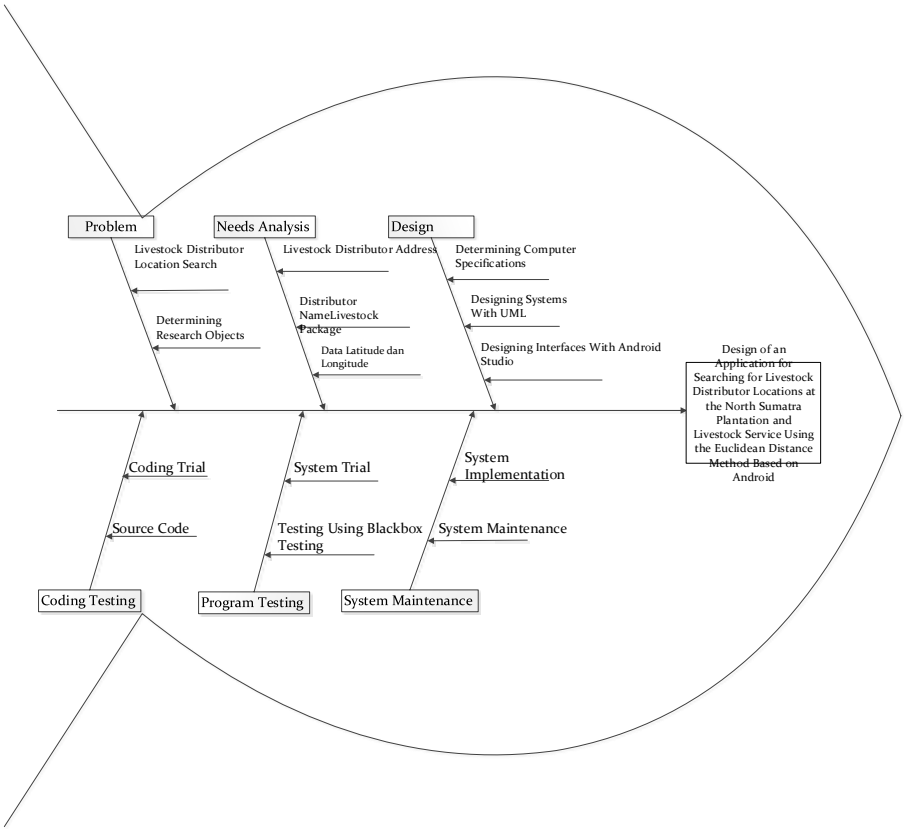

Figure 1. *Diagram Fishbone*

The development of the fishbone framework method involves several stages: requirements analysis, system design, coding, program testing, and system maintenance.

1. Research Target/Objective

The target of this research is to design and build an Android-based application for finding the nearest route to livestock distributors in Medan City using the Euclidean distance method.

2. Needs Analysis

Analyze the existing system requirements and add new ones to the design if needed. The data required for the analysis are the addresses, names, and latitude and longitude data of the livestock distributors.

3. System Design

According to the proposed solution, the system design requirements for this application include designing the system using UML and designing the interface using Android Studio.

4. Program Coding

Program coding is the translation of a design into a computer-recognizable language. It is performed by a programmer who translates the transactions requested by the user. This stage is the actual stage in developing a system. Computer utilization is maximized during this stage. After coding is complete, the system will be tested. The goal of testing is to identify errors in the system and then correct them.

5. Program Testing

This stage involves comprehensive application testing, including functional testing and system robustness testing. The testing performed involves software testing that tests the application's functionality against its internal structure or operation. Specialized knowledge of the application's code or internal structure, and general programming knowledge, is not required; this testing is conducted for each individual piece of equipment designed.

6. System Maintenance

Software that is difficult to deliver to customers will undergo changes. These changes can occur due to errors, the software having to adapt to a new environment (a new peripheral or operating system), or because the customer requires functional developments.

3. Results and Discussion

The rapid development of technology today has created numerous business opportunities, one of which is in the livestock sector. Livestock is closely linked to mobile phones, a basic human need today, making livestock-related businesses a promising business. Given this need, many people want to become livestock agents, leading them to search for livestock distributor locations.

Based on this, the author designed an application to find the nearest route to livestock distributor locations. This allows people who want to become livestock agents to easily reach distributor locations, thus reducing transportation costs. This application utilizes a geolocation map, employing the Euclidean Distance method. Each livestock distributor point is displayed based on the user's route and displays the closest destination.

A. Penerapan Metode Euclidean Distance

Euclidean distance is the calculation of the distance between two points in Euclidean space. Euclidean space was introduced by Euclid, a Greek mathematician around 300 B.C.E. to study the relationship between angles and distance. This Euclidean distance is related to the Pythagorean Theorem and is usually applied in 1, 2, and 3 dimensions. However, it is also simple when applied to higher dimensions, in 1 dimension. For example, if you want to calculate the 1-dimensional Euclidean distance, the first point is 4, point.

Formula Euclidean Distance

$$d = \sqrt{(x1 - x2)2 + (y1 - y2)2} \quad (1)$$

So from the formula above we can implement it as:

$$\text{Distance} = \sqrt{(\text{Lat } 1 - \text{lat } 2)2 + (\text{Long } 1 - \text{Long } 2)2} \quad (2)$$

Studi Kasus

In the case of determining the closest distance between the User Location with Latitude 3.608151 and Longitude 98.6646595 to livestock location 1 with Latitude 3.610345 and Longitude 98.661556, User Location with Latitude 3.608151 and Longitude 98.6646595 to livestock location 2 with Latitude 3.582089 and Longitude 98.626336 using the Euclidean Distance method with the specified route, is as follows:

Formula

$$\text{Distance} = \sqrt{\left(\text{Lat}_1 - \text{lat}_2\right)^2 + \left(\text{Long}_1 - \text{Long}_2\right)^2} \quad (3)$$

The distance calculation above is still in decimal degrees (according to the longitude format used), so to adjust it, it needs to be multiplied by 111,319 km (1 degree Earth = 111,319 km). This can be implemented as follows:

$$\text{Distance} = \sqrt{\left(\text{Lat}_1 - \text{lat}_2\right)^2 + \left(\text{Long}_1 - \text{Long}_2\right)^2 .S} \quad (3)$$

Solution:

User's location leads to the livestock location at Livestock Distributor 1.

Lat1, long1 (3.608151, 98.6646595) Lat2, ⟶Long2 (3.582089, 98.661556)

= √ (lat1-lat2)² + (long1-long2)² * S

= √ (3.608151 - 3.610345)² + (98.6646595 - 98.661556)² * 111.319

= 0.42309053 km

User location to livestock location at Livestock Distributor 2

Lat1, long1 (3.608151, 98.6646595) Lat2, ⟶Long2 (3.6151332, 98.626336)

= √ (lat1-lat2)² + (long1-long2)² * S

= √ (3.608151 - 3.6151332)² + (98.6646595 - 98.626336)² * 111.319

= 4.33635983 km

The results of the calculations above can be concluded that the closest route from the two livestock distributor locations from the user's location is the livestock location at Livestock Distributor 1 with a distance value of 0.42309053 km, while the user's location to the livestock location at Livestock Distributor 1 with a distance value of 4.33635983 km.

1. Home form display

This Home form display is the initial display for searching for livestock distributor locations at the North Sumatra Provincial Plantation and Livestock Service using the Android-based Euclidean Distance method when opening the application. This display can be seen in Figure 2.

Figure 2. Home form view

2. Maps form view

This page displays a map display for searching livestock distributor locations at the North Sumatra Provincial Plantation and Livestock Service. Users can view and find the nearest location for the livestock distributor search at the North Sumatra Provincial Plantation and Livestock Service. The location form display is shown in Figure 3.

Figure 3. Maps form view

3. Route form view

This page displays a brief route for searching for livestock distributor locations at the North Sumatra Provincial Plantation and Livestock Service. The page view is shown in Figure 4.

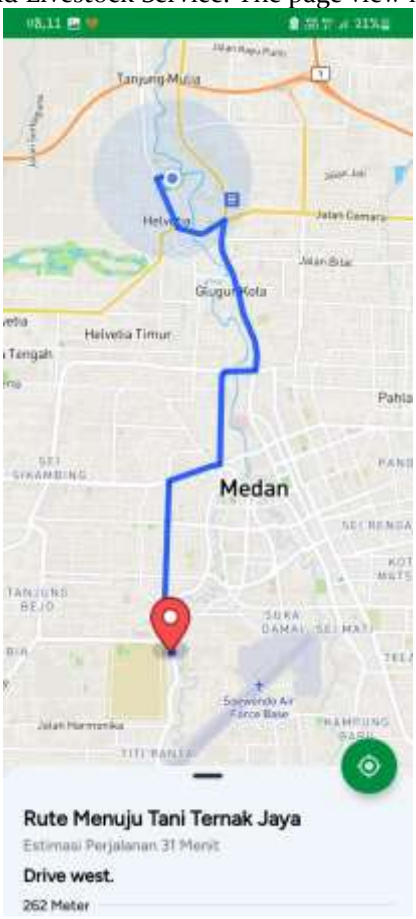

Figure 4. Route form display

4. Conclusion

Based on the research conducted, it can be concluded that the Android-based application for locating livestock feed distributors at the North Sumatra Provincial Plantation and Livestock Service using the Euclidean distance method has been successfully designed and implemented. The system effectively assists users in identifying the nearest livestock feed distributor through real-time location detection using smartphones. The application was developed using Java and Android Studio, providing a practical digital solution to improve accessibility and efficiency in livestock feed distribution services. From a scientific perspective, this study demonstrates the effective use of the Euclidean distance method in geolocation-based decision support systems, particularly in agricultural and livestock management contexts. The integration of geographic information processing with mobile technology offers a scalable model that can be adapted for similar public service applications. Recommendations: Future research is encouraged to enhance the system by incorporating alternative distance algorithms such as Haversine or Manhattan distance for more accurate spatial calculations. Additionally, integrating machine learning for route optimization, cloud-based data synchronization, or user feedback analytics could further improve the system's intelligence, scalability, and responsiveness in real-time operational environments.

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