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IMPLEMENTATION OF SEQUENTIAL SEARCH ALGORITHM FOR STREET NAME SEARCH IN MEDAN CITY

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ABSTRACT

In the era of increasingly rapid development of information technology, the need for fast and accurate access to information is also increasing, especially in searching for location information and street names in urban areas. One of the problems often faced is the difficulty in obtaining street name information along with administrative data, such as sub-districts, villages, and postal codes, in a structured and easily accessible manner. This study develops a website-based street name search system in Medan City by implementing a sequential search algorithm for the data search process and a Geographic Information System (GIS) for presenting street location information visually. The sequential search algorithm is used to match street names based on keywords entered by users by examining data sequentially, so it can be used on unsorted data. GIS is used to display search results in the form of a digital map so that street locations can be understood more clearly. This system is designed to make it easier for users to search for street name information quickly, simply, and accurately without requiring a complicated manual search process.

INTRODUCTION

The development of information technology has significantly influenced daily life, particularly in the field of information retrieval. Today, people increasingly rely on digital applications to obtain information quickly and accurately for various purposes, including education, business, and mobility. Despite technological advancements, many people still face difficulties in obtaining complete information about a particular street, such as district, village, and postal code data. In many cases, users only know the street name without understanding the administrative area to which it belongs. This condition often causes inefficiencies and errors in address identification, package delivery, and population administration processes. According to Aprinia and Sutanta (2025), one of the major challenges in road data management is the lack of complete address metadata, including administrative boundaries and postal codes, which reduces the effectiveness of information retrieval.

To address this issue, a street name search system capable of providing complete and accurate information is required. The Sequential Search algorithm is considered suitable for this purpose because it can perform searches on unsorted datasets and is relatively simple to implement. The algorithm works by comparing each data element sequentially until a matching record is found. Rahmanto et al. (2021) stated that Sequential Search is highly effective for text-based information retrieval because it can identify matching data accurately even in relatively simple data structures.

Previous studies in Indonesia have mainly focused on route optimization and shortest-path determination using algorithms such as Dijkstra and A*. For instance, Manik et al. (2024) implemented the Dijkstra algorithm in a Geographic Information System (GIS) to determine the fastest route between locations. However, limited research has explored the use of Sequential Search for road name retrieval and administrative information searching. This indicates a research gap regarding the application of simple search algorithms for road information systems.

Therefore, this study proposes the development of a web-based street name search system for Medan City using the Sequential Search algorithm and Geographic Information System (GIS) technology. The system is designed to provide complete information regarding street names, districts, villages, postal codes, and geographic locations. By integrating Sequential Search and GIS, the proposed system is expected to provide accurate, efficient, and user-friendly access to road information for residents and visitors in Medan City.

RESEARCH METHODS

This study employed a software development research approach to design and implement a web-based road name search system for Medan City. The system integrates the Sequential Search algorithm for data retrieval and Geographic Information System (GIS) technology for location visualization. The objective of the study was to facilitate users in searching for road information, including road names, districts, villages, postal codes, and geographic locations.

Data Collection

This study used road data from Medan Kota District, including road names, administrative information, and geographic coordinates, collected from the Medan Kota District Office and online sources.

Three data collection techniques were applied:

1. **Observation :** The author conducts a direct field visit to analyze and evaluate data related to the topic addressed in this research.
2. **Interviews** : The author conducts interviews with relevant parties to obtain valid data, thus facilitating research on the topic.
3. **Literature Review** : The author collects scientific articles related to the author's title.

System Development

The development of the application followed the Waterfall software development model. The Waterfall method was selected because it provides a systematic and structured approach to software development. The stages of the Waterfall model implemented in this research are described as follows:

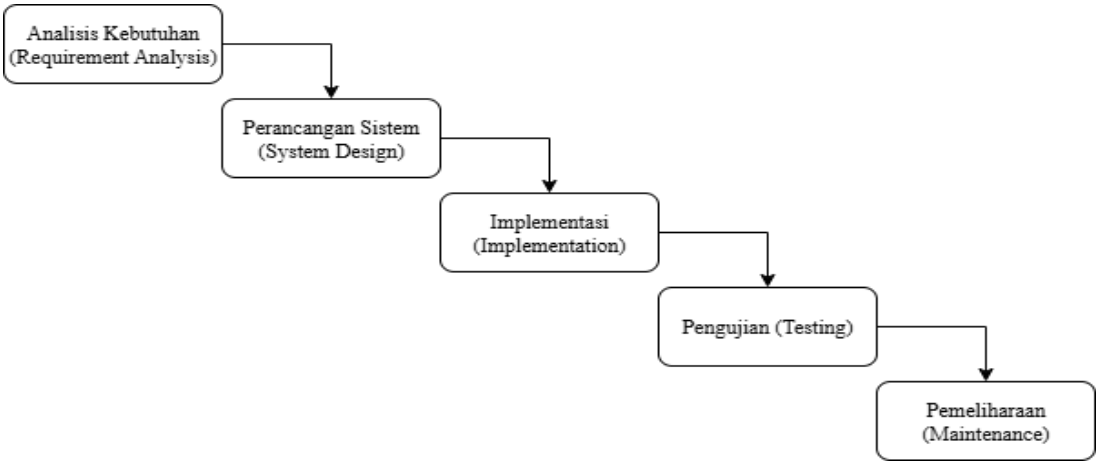

Figure 3.1 Waterfall Model

This research adopts the Waterfall development model, which consists of five sequential stages: requirements analysis, system design, implementation, testing, and maintenance. The model provides a structured approach to system development, ensuring that each stage is completed before proceeding to the next stage.

System Requirements Analysis

The system requirements were analyzed to identify the functionalities needed for the web-based road search application. The system provides two user roles, namely administrator and user. Administrators are responsible for managing road data, including adding, updating, and deleting road information stored in the database. Users can search for road names and view detailed information such as district, village, postal code, and geographic location.

System Design

The system was modeled using Unified Modeling Language (UML) to describe system functionality and structure. The UML diagrams used in this study include Use Case Diagrams, Activity Diagrams, and Class Diagrams. These diagrams illustrate user interactions, system workflows, and relationships between system components, providing a clear representation of the overall system design

1. Use Case Diagram
   The Use Case Diagram illustrates the interaction between users and the system. Administrators can manage road data, while users can search road information and view search results.

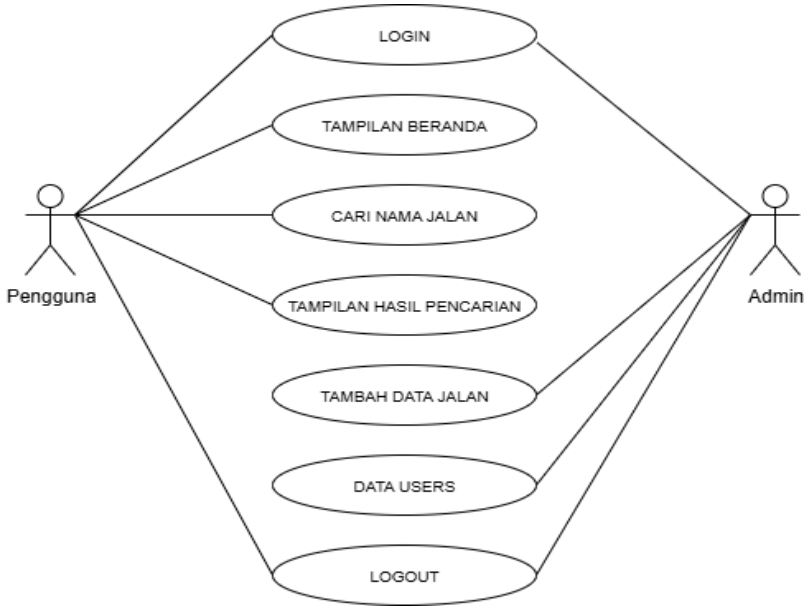

Figure 3.2 Use Case Diagram

2. Activity Diagram

   The Activity Diagram describes the workflow of the road search process, starting from user input, data processing using the Sequential Search algorithm, and displaying search results.

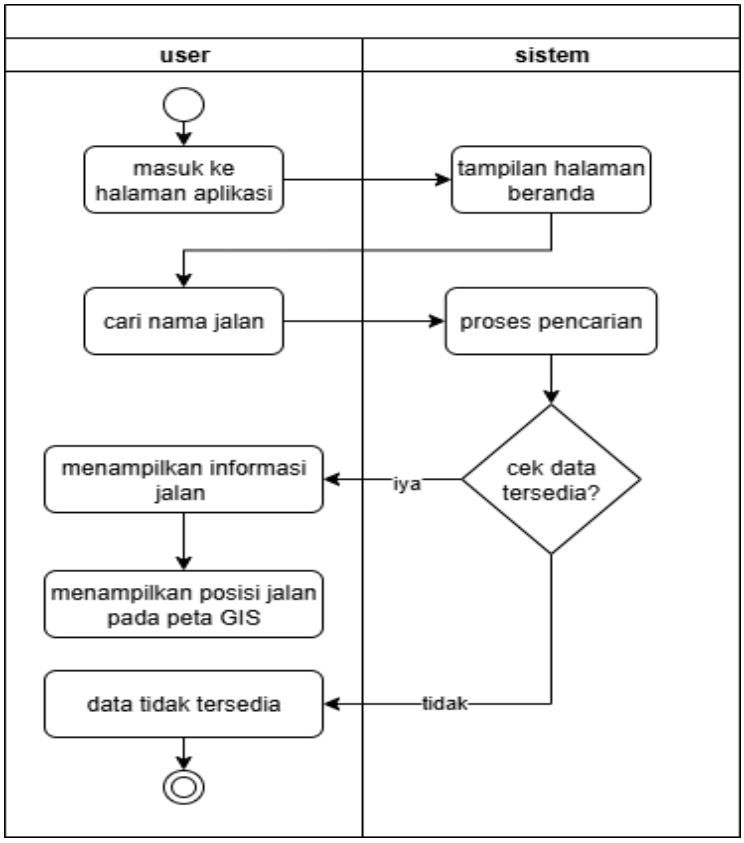

Figure 3.3 Activity Diagram

3. Class diagram

   The Class Diagram shows the structure of classes, attributes, methods, and relationships used in the road search system.

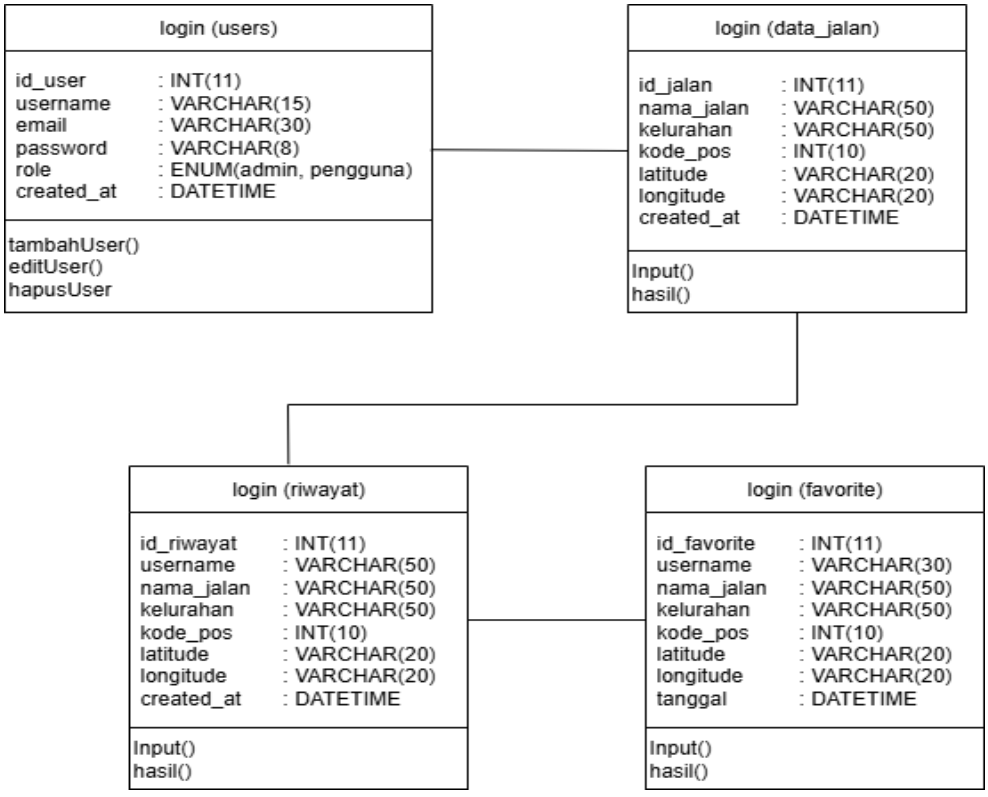

Figure 3.4 Class Diagram

Database Design

The system uses a MySQL database to store and manage road information and user data. The database consists of four main tables: **Users**, **Data_Jalan**, **Riwayat**, and **Favorite**. The *Users* table stores account information, the *Data_Jalan* table stores road names along with administrative information such as district, village, postal code, and geographic coordinates, the *Riwayat* table records user search history, and the *Favorite* table stores roads marked as favorites by users. This database structure supports efficient data retrieval and management for the road search application.

Implementation of the Sequential Search Algorithm and GIS

Data Representation

In this study, road data from Medan City are collected and stored in a Geographic Information System (GIS) database. The dataset contains information such as road names, postal codes, villages, and geographic coordinates (latitude and longitude). GIS is used to store and manage all road information.

Example of Road Data

No	Road Name	Postal Code	Village	Latitude	Longitude
1	Jl. SM Raja	20218	Sudirejo I	-3.589	98.674
2	Jl. Turi	20218	Sudirejo I	-3.594	98.682
3	Jl. Bahagia	20218	Sudirejo II	-3.602	98.686
4	Jl. Pelangi	20217	Teladan Barat	-3.503	98.678

Retrieving Road Names from GIS

The application retrieves the **Road Name** field from the GIS database and stores it in an array:

$$A = [a_1, a_2, a_3, \dots, a_n]$$

- A = collection of street names
- a_1= nama jalan ke-1
- n = total number of street names
- k = the data you want to search for

Example:

$$A = [\, Jl.SM.Raja, Jl.Turi, Jl.Bahagia, Jl.Pelangi \,]$$

Search Input

The user enters the road name to be searched:

$$k = Jl.Pelangi$$

Sequential Search Process

The Sequential Search algorithm checks each element one by one until a match is found.

- Compare Jl. SM Raja with Jl. Pelangi → Not Match
- Compare Jl. Turi with Jl. Pelangi → Not Match
- Compare Jl. Bahagia with Jl. Pelangi → Not Match

- Compare Jl. Pelangi with Jl. Pelangi → Match

The road name is found at position:

$$k = 4$$

GIS Data Extraction and Map Display

After the road name is found, the system retrieves its geographic coordinates:

- Latitude = -3.503
- Longitude = 98.678

The GIS module then displays a marker at the location **(-3.503, 98.678)** on the digital map, allowing users to view the exact position of the selected road.

Time Complexity

The performance of the Sequential Search algorithm depends on the position of the searched data within the dataset.

Table 2. Time Complexity of Sequential Search

Search Condition	Description	Time Complexity
Beginning	The road name is located in the first record	O(1)
Middle	The road name is located in the middle of the dataset	O(n)
End	The road name is located in the last record or not found	O(n)

The table shows that the search time increases as more records need to be examined.

$$T = t_{akhir} - t_{awal} \qquad (1)$$

$$c = \frac{T_b - T_a}{n_b - n_a} \qquad (2)$$

$$T(n) = T(1) + (n-1) \times C \qquad (3)$$

The search execution time is calculated using Equation (1), which measures the difference between the start time and end time of the search process. This equation is used to determine the actual time required by the system to find a road name. To analyze the performance of the Sequential Search algorithm, Equation (2) is used to calculate the average time per comparison. Furthermore, Equation (3) is applied to estimate the search time at a particular data position. The results show that the execution time increases proportionally to the number of examined records, indicating that the Sequential Search algorithm has a linear time complexity of (O(n)).

Case Study

Case 1: Single Search

Assume that the GIS-based road search system contains 100 road records. The user searches for **"Jl. Banteng"**, and the road is found at index 51.

The recorded execution times are:

t_awal = 1777798332.3526

t_akhir = 1777798332.3796

The search time is calculated using:

$$T = t_{akhir} - t_{awal} \quad (1)$$

$$T = 1777798332.3796 - 1777798332.3526$$

$$T = 0.027 \text{ detik}$$

Therefore, the search process requires **0.027 seconds**.

Case 2: Multiple Searches

Several searches were performed and the results are presented in Table 3.

Table 3. Search Results

Road Name	Index	Time
Jl. Mawar	1	0.002 s
Jl. Melati	25	0.010 s
Jl. Banteng	51	0.018 s

The average time per comparison is calculated as:

The search time model is:

$$c = \frac{T_b - T_a}{n_b - n_a} \qquad (2)$$

$$c = \frac{0{,}018 - 0{,}002}{51 - 1}$$

$$c = \frac{0{,}016}{50}$$

$$c = 0.00032$$

For index 25:

$$\mathrm{T(n)} = \mathrm{T(1)} + (\mathrm{n} - 1) \times \mathrm{C} \ldots\ldots (3)$$
$$\mathrm{T}(25) = 0.002 + (24 \times 0.00032)$$
$$= 0.002 + 0.00768$$
$$= 0.00968 \approx 0.010 \text{ second}$$

The results indicate that Sequential Search has a linear time growth pattern, where the search time increases proportionally to the number of records examined. If only one search result is available, the execution time can be calculated directly using Equation (1) without computing the average time per comparison.

RESULTS AND DISCUSSION

The street search application was successfully developed as a web-based system using PHP, MySQL, HTML, CSS, and JavaScript. The system integrates the Sequential Search algorithm for road name searching and Geographic Information System (GIS) technology for location visualization. The application provides several main features, including user authentication, road listing, road searching, search history management, and GIS-based location display.

Login Page

The login page is the first gateway for users to access the system. This page functions to perform authentication based on usernameand passwordstored in the database. After successfully logging in, the system will detect the user's role:

• User → directed to User Dashboard Page
• Admin → directed to Admin Dashboard Page

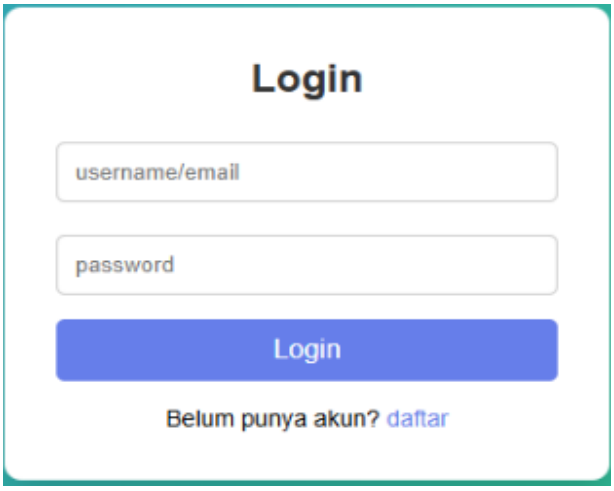

Figure 4.1 Login

Dahsboard Page

The dashboard is divided into two user roles: Administrator and User. The Administrator Dashboard provides access to system management features, including road data management, user management, and search history monitoring. Meanwhile, the User Dashboard provides access to road search functionality, road information, favorite roads, and GIS-based location visualization, enabling users to obtain road information quickly and efficiently.

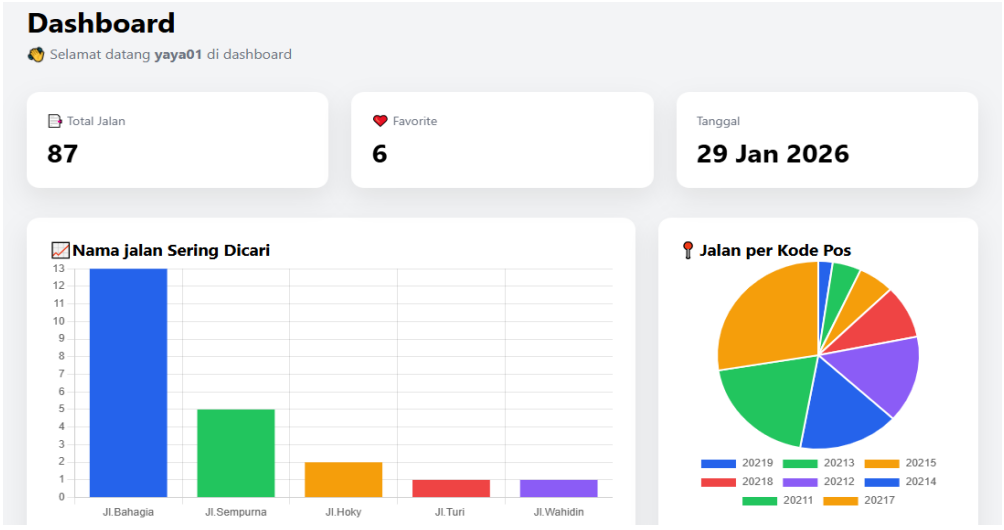

Figure 4.2 Dashboard Page

Search Page

The search result page displays detailed information about the selected road, including the road name, district, village, postal code, and geographic location. The information is presented to help users identify the desired road accurately.

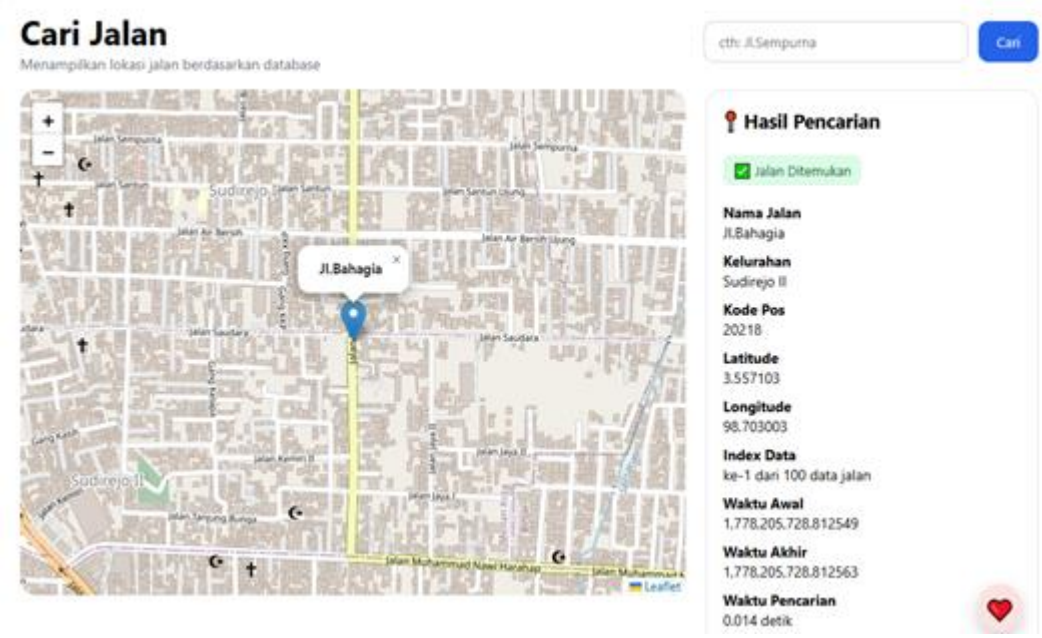

Figure 4.3 Search Page & result

Algorithm Testing

This study utilized Black Box Testing to evaluate the functionality of the developed system and the performance of the Sequential Search algorithm. Testing was conducted using 100 road name records to measure search accuracy and execution time. Several search scenarios with different data positions were performed to analyze the relationship between data position and search performance, while ensuring that the system produced the expected results.

Table 4. Sequential Search Algorithm Testing Results

No	Keyword	Data Position (Index)	Expected Result	Execution Time (Seconds)	Status
1	Jl. Bahagia	1	Road Found	0.014	Success
2	Jl. Turi	2	Road Found	0.017	Success
3	Jl. Sempurna	3	Road Found	0.019	Success
4	Jl. Air Bersih	4	Road Found	0.021	Success
5	Jl. SM Raja	5	Road Found	0.023	Success
6	Jl. Banteng	51	Road Found	0.114	Success
7	Jl. Lembu	52	Road Found	0.117	Success
8	Jl. Kuda	53	Road Found	0.118	Success
9	Jl. Aipda KS	54	Road Found	0.120	Success
10	Jl. Pekanbaru	55	Road Found	0.122	Success
11	Jl. Harimau	96	Road Found	0.200	Success
12	Jl. Angsa	97	Road Found	0.203	Success
13	Jl. Biawak	98	Road Found	0.205	Success
14	Jl. Kemiri	99	Road Found	0.207	Success
15	Jl. Balai Desa	100	Road Found	0.211	Success

Table 4 shows the results of Sequential Search algorithm testing using 100 road name records. The results indicate that all search queries were successfully processed and produced the expected results, with a 100% success rate. The execution time increased as the position of the target data moved further within the dataset. Road names located at the beginning of the dataset required execution times ranging from 0.014 to 0.023 seconds, while road names located in the middle required 0.114 to 0.122 seconds. Meanwhile, road names located at the end of the dataset required the longest execution times, ranging from 0.200 to 0.211 seconds. This demonstrates that the Sequential Search algorithm performs comparisons sequentially from the first record until the target data is found, resulting in increased execution time as the data position becomes larger.

Functional testing

Black Box Testing was performed to evaluate the functionality of the developed system. The testing included login, registration, road searching, road data management, and GIS visualization features. Based on the testing results, all features operated successfully according to the expected requirements, demonstrating that the system functions properly and is ready for use.

Table 5. Functional Testing Results

No	Feature	Input	Expected Result	Actual Result
1	Login	Valid email and password	User is redirected to the dashboard	Success
2	Login	Invalid password	Login failure notification is displayed	Success
3	Registration	Username, email, and password	Account is successfully created	Success
4	Registration	Existing username and email	Username already exists notification is displayed	Success
5	Search	"Jl. Pelangi"	Road information and map are displayed	Success
6	Search	"Jl. TidakAda"	Data not found notification is displayed	Success
7	Add Data	New road information	Data is successfully saved	Success
8	Delete Data	Delete selected data	Data is successfully deleted	Success
9	Search	Empty input	Search process should not be executed	Failed
10	Change Password	Confirmation password different from new password	Password change process should be rejected	Failed
11	Add Road Data	Duplicate road name	Road data should not be added	Failed

Table 5 presents the results of functional testing conducted using the Black Box Testing method. The testing covered major system functionalities, including login, registration, road searching, road data management, and account settings. The results show that most features operated according to the expected requirements. However, several validation functions, such as empty search input handling, password confirmation verification, and duplicate road data prevention, did not perform as expected and require further improvement to enhance system reliability and data integrity.

CONCLUSION

This research successfully developed a web-based road name search system for Medan Kota District by implementing the Sequential Search algorithm and Geographic Information System (GIS) technology. The developed system is capable of displaying road information, including road names, districts, villages, postal codes, and geographic locations through digital map visualization. Based on the functional testing results, most system features operated according to the expected requirements and were able to support road information retrieval effectively.

The testing results showed that the Sequential Search algorithm successfully retrieved road data from a dataset consisting of 100 road name records. The execution time ranged from 0.014 seconds for data located at the first index to 0.211 seconds for data located at the 100th index. These findings indicate that the algorithm performs efficiently for small to medium-sized datasets, although the search time increases as the position of the target data moves further within the dataset. This behavior is consistent with the linear search mechanism and time complexity of O(n).

Overall, the integration of the Sequential Search algorithm and GIS technology provides an effective solution for road information retrieval and location visualization. For future research, more efficient search algorithms, such as Binary Search or index-based searching methods, may be explored to improve search performance when handling larger datasets.

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