

# Implementation of a Geographic Information System for Mapping and Promoting Tourist Attractions in Kupang City

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## Abstract

Tourism is one of the key sectors with significant potential to support regional economic development. Kupang City, located in East Nusa Tenggara, offers various attractive tourist destinations. However, the lack of integrated information and effective promotion remains a major obstacle in maximizing this potential. This study aims to implement a Geographic Information System (GIS) to map and promote tourist attractions in Kupang City. The K-Nearest Neighbor (K-NN) method is applied to classify and recommend destinations based on specific criteria such as location. The resulting system provides accurate, interactive, and easily accessible information for both the public and tourists. Moreover, the system is expected to assist local governments in managing and promoting tourism more effectively. The implementation of this GIS-based system is projected to increase tourist visits to Kupang City, support local economic development, and showcase the natural and cultural beauty of East Nusa Tenggara to a broader audience.

**Keywords:** K-NN, Kupang City, Promotion, GIS, Tourist Attractions.

## 1. Introduction

The tourism sector has become one of the main pillars in Indonesia's economic development [1]. As a continuously growing industry, tourism contributes to job creation, increases community income, and drives the growth of other related sectors [2]. The advancement of information technology has also had a significant impact across various fields, including the provision of map-based geographic information. One of the rapidly developing technologies in spatial information management is the Geographic Information System (GIS) [3]. GIS functions in managing spatial data—data that refers to positions on the Earth's surface. This technology enables efficient and accurate presentation of spatial information and the attributes of tourist attractions [4].

Kupang City, as the capital of East Nusa Tenggara Province (NTT), holds great tourism potential in terms of natural beauty, culture, and historical heritage. However, the management and promotion of tourist destinations in Kupang City remain suboptimal, and thus the existing attractions have yet to draw a significant number of visitors [5]. One of the main obstacles is the lack of integrated and easily accessible tourism information for travelers. Although location search and web-based mapping technologies exist, many tourists still face difficulties accessing information about destinations, supporting facilities, and distances between tourist sites [6]. According to data from the Central Statistics Agency (BPS) of Kupang City, the number of international tourist visits to Kupang City reached 1.28 million in September 2024. In today's digital era, the availability of accurate and easily accessible tourism information is a critical factor in attracting tourists. A 2023 survey by the Indonesian Internet Service Providers Association (APJII) shows that internet penetration in Indonesia has reached 78%, with the internet being the primary source of information for the public. Therefore, innovation in delivering more interactive, technology-based tourism information is essential.

The application of GIS for mapping tourist destinations has proven effective in the management and promotion of tourism in various regions. For example, the implementation of a web-based GIS in Karanganyar Regency has positively impacted the distribution and promotion of tourism information [7]. However, in Kupang City, the availability of digital platforms capable of delivering complete and integrated tourism information remains limited. This limitation hinders tourists from accessing relevant information and results in under-recognition of local tourist attractions. This study aims to implement GIS to map tourist locations in Kupang City and support digital tourism promotion. Additionally, the k-Nearest Neighbor (KNN) method will be used as a supporting algorithm for mapping, particularly in locating the nearest tourist sites based on available data. The KNN algorithm classifies objects based on proximity to a reference point defined within the dataset [8]. This technology is expected to enhance the efficiency of tourism information management and assist tourists in finding destinations more easily. The implementation of GIS and the KNN method aligns with the vision of the Kupang City Government in realizing "Kupang City as an Environmentally Conscious Tourism City" (RPJMD Kupang City 2022–2026). Furthermore, the

development of this system is expected to contribute to post-pandemic economic recovery by supporting tourism sector growth and improving the welfare of Kupang City residents.

Based on the above explanation, this research aims to develop a GIS-based tourism mapping system supported by the KNN method to provide more accurate and accessible tourism information. The implementation of this technology is expected to enhance the attractiveness of Kupang City's tourism, strengthen the promotion of local destinations, and bring benefits to tourists, tourism managers, and local government.

## 2. Methodology

This research is conducted under the title "Implementation of a Geographic Information System for Mapping and Promoting Tourist Attractions in Kupang City", utilizing the K-Nearest Neighbor (K-NN) method. The following are the research procedures undertaken in developing this Geographic Information System:

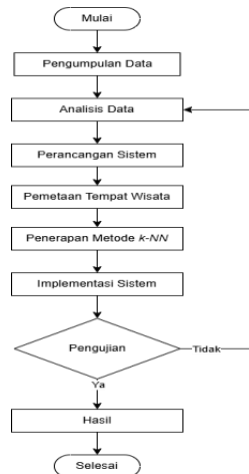


Fig. 1: Flowchart Methodology

The research was carried out through several stages, as described below:

- a. Literature Review  
This stage aims to gather relevant references related to the K-NN method and its application in developing a Geographic Information System (GIS). References include journals, books, or other scientific writings that support the theories and implementation of GIS for mapping tourist attractions in Kupang City.
- b. Data Collection  
The data used in this research were obtained from field surveys, related government agencies (such as the Department of Tourism), and other relevant sources. The data include geographic information, attributes of tourist attractions, and other supporting data for analysis.
- c. Data Preprocessing  
This stage involves data cleaning to remove irrelevant, duplicate, or inconsistent data. The preprocessing process includes data normalization and handling of missing values to prepare the dataset for analysis using the K-NN method.
- d. K-NN Method Processing  
The K-NN method is applied to group tourist attractions based on parameters such as location and travel distance. The results of this process are used to create clusters on the geographic map.
- e. Implementation  
The designed GIS is implemented into a web-based application. The clustering results using the K-NN method are integrated with a digital map (WebGIS), enabling users to view and access information about tourist attractions interactively.
- f. Testing  
The system is tested to ensure data accuracy, ease of navigation, and overall functionality. Testing is conducted using the black-box method to validate the system's functionality.
- g. Results  
The final stage involves producing a comprehensive report that includes the results of mapping tourist attractions using the K-NN method, GIS system evaluation, and conclusions regarding the system implementation.

## 3. Results

### 3.1. System Planning

#### 3.1.1. Use Case

Use Case Diagram is one of the components of the Unified Modeling Language (UML) used to model the interaction between users (actors) and the system within a specific context. This diagram aims to illustrate the main functionalities of the system from the user's perspective, thereby facilitating a better understanding of system requirements.

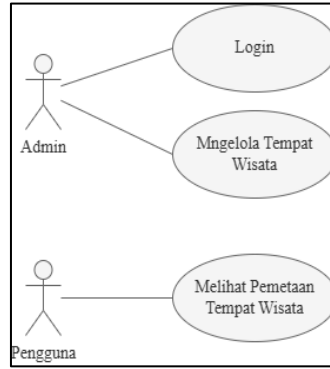


Fig. 2: Use Case Diagram

3.1.2. Class diagram

Class diagram is one of the types of diagrams in the Unified Modeling Language (UML) used to model the static structure of an object-oriented system. This diagram represents the classes within the system, the attributes and methods of each class, as well as the relationships between those classes. Specifically, the class diagram helps illustrate the key elements of a system and how they interact with one another. In this way, software developers can understand the system’s logical flow and structure before implementation begins.

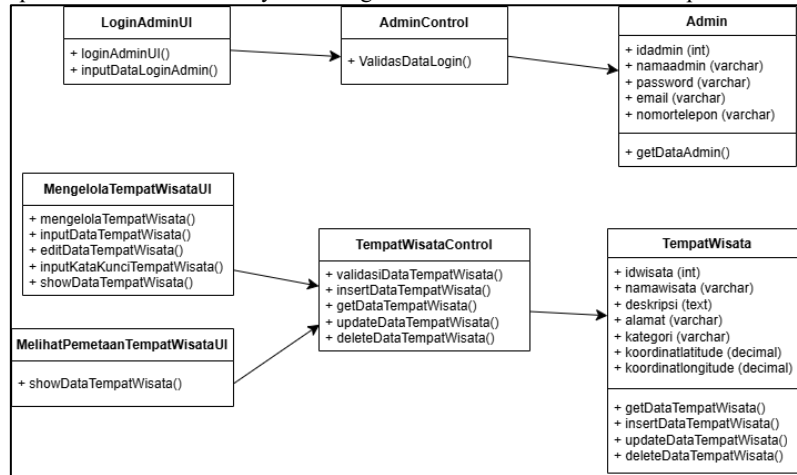


Fig. 3: Class Diagram

3.2. System Implementation

System implementation is the stage of applying the previously designed Geographic Information System (GIS) into a website using the Laravel framework. The implementation includes the development of a database structure to store information about tourist attractions, the design of the user interface, and the integration of the K-NN method to recommend the nearest tourist locations based on the user's coordinates. The website interface can be seen in the following figure:

1. Display of admin login form page

The admin login interface page is a form page that allows the administrator to access the website and manage data. On this login page, the admin can log in using a previously registered email and password. After entering the email and password, the admin can click the “login” button to access the tourist data management page. If the login fails, the admin will not be granted access to the data management page and will be redirected back to the login page.

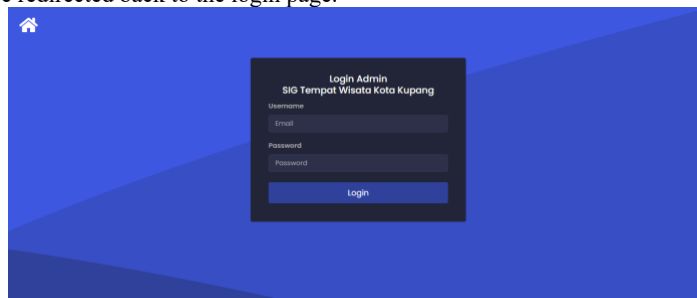


Fig. 4: Admin Login Form Page

2. Visitor Page

The visitor page is the landing page of the website, featuring buttons for Home, Tourism, and Login, which is used by the admin to log in. It also includes a search bar that allows visitors to search for tourist destinations.



Fig. 5: Visitor Page

### 3. Tourist Destination Mapping Page

This page displays the mapping of tourist destinations located in the city of Kupang and includes the implementation of the KNN method, which provides recommendations for the nearest tourist sites based on the user's location.

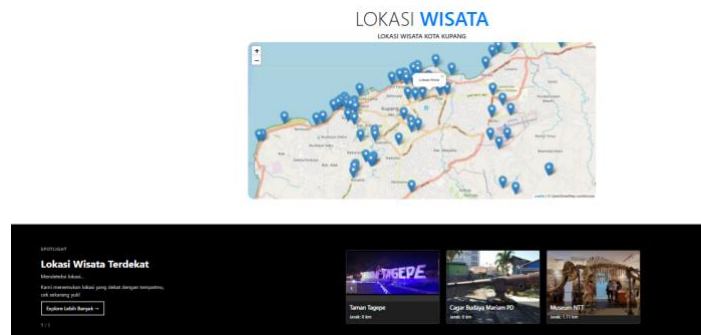


Fig. 6: Tourist Destination Mapping Page

### 4. Tourist Attractions Data Management Page

The tourist destination management page contains a list of existing tourist attractions, which includes the name of the destination, description, address, category, coordinates, image of the tourist site, and actions that allow the admin to view details, edit tourist data, and delete tourist data.

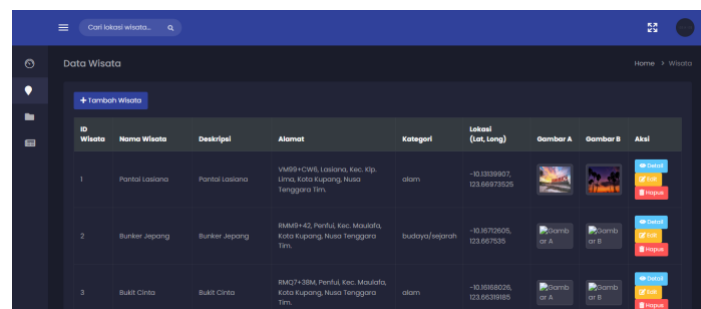


Fig. 7: Tourist Attractions Data Management Page

## 4. Conclusion

Based on the results of the design and implementation of the GIS for mapping and promoting tourist destinations in the city of Kupang, it can be concluded that the system has successfully visualized location data interactively. The use of digital maps allows users to easily view the position and information of each tourist destination. The application of the K-NN method in this system also adds value by providing recommendations for tourist destinations based on the proximity to the user's location.

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