A Hybrid User Experience Approach for an Interactive Tourism WebGIS: A Case Study of Bandung City

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***Abstract*— The rapid development of web-based geographic information systems has changed the way tourism information is accessed. However, many tourism platforms in Bandung still present information in static map formats that limit interactivity, route personalization, and data exploration by users. This paper outlines the design and implementation of an interactive WebGIS platform that supports spatial exploration, category-based filtering, and dynamic route creation for tourism destinations in the city of Bandung. The system was developed using a unique hybrid user experience (UX) approach, combining the navigation paradigm of map applications with e-commerce-style destination discovery. The result is a functional prototype that provides a lightweight yet solid foundation for interactive tourism mapping. Although effective as a prototype, its reliance on statically managed data structures limits its long-term scalability, indicating the need for backend integration and automated data flows in the future. Overall, this proposed WebGIS provides a potential model for smart tourism applications in urban environments.**

***Index Terms*— *WebGIS, Tourism, Interactive Maps, Bandung, Route Planning*,**

I. Introduction

The city of Bandung is a major tourist destination in Indonesia, offering a variety of attractions including nature, culinary, shopping, and cultural tourism. Data from the Bandung City Tourism and Culture Office shows a significant increase in the number of tourist visits each year, reflecting its strong appeal to both domestic and foreign tourists. This tourism potential requires the support of an adequate information system to maximize visitor experience and service efficiency.

Tourists face challenges in finding accurate and integrated tourist location information. Tourism information is scattered across various sources such as social media, blogs, and different websites, causing tourists to spend significant time planning their trips [3][4]. This fragmentation of information hinders further development of the tourism sector. Promoting tourism through social media is often ineffective in highlighting the unique characteristics of tourist attractions [5].

Geographic Information System (GIS) offers a solution to this challenge with its ability to integrate spatial and non-spatial data into a single, easily accessible platform [7][10]. WebGIS, as a web-based GIS implementation, allows access to information from various devices via the internet without the need for special software installation. The implementation of tourism WebGIS has been proven to increase tourist accessibility and engagement in various geographical contexts [3][4][6][8][10].

Several regions in Indonesia have implemented WebGIS for the tourism sector with positive results. The implementation in West Jakarta uses Google Maps API and Location Based Service for mapping tourist attractions that provide complete information about various types of tourist attractions [3]. In Langkat Regency, the implementation of Web-GIS with the LBS method has succeeded in presenting clear and complete information about the names, photos, descriptions, and locations of tourist attractions [6]. The design of a geographic information system in West Sumatra using Google Maps API and CodeIgniter technology has resulted in a WebGIS that can be accessed through various devices [4]. Research in Nagari Batuhampar shows that WebGIS has succeeded in managing large data, especially spatial and attribute data from tourist attractions, with a high level of respondent satisfaction [5]. Systematic research shows the continuous evolution in the development of tourism WebGIS with a focus on improving user experience and real-time data integration, including mobile applications, the Internet of Things (IoT), and the use of big data in the context of GIS-based tourism [1].

However, the development of WebGIS for Bandung City that integrates route planning features with a human-centered design approach is still limited. This study developed Bandung Interactive Tourism WebGIS by applying hybrid user experience design that combines the paradigm of established navigation applications (Google Maps) for route planning capabilities and the paradigm of modern e-commerce platforms (Shopee) for the presentation and discovery of tourist destinations.

This paper presents three key contributions: (1) the implementation of a hybrid UX pattern that combines navigation and e-commerce paradigms results in a superior user experience compared to traditional GIS interfaces [9], (2) an integrated tourism information platform that consolidates destination discovery, detailed information access, and route planning in a unified application [2] [3][8], (3) a design-centric approach that demonstrates the importance of user experience considerations in tourism information systems. This development resulted in a prototype that can serve as a model for national tourism portals with proven effective methodologies [1][10].

II. Literature Review

A. Geographic Information System (GIS) and WebGIS in Tourism

A Geographic Information System (GIS) is a computer-based system that collects, stores, manipulates, analyzes, and displays geographic data. GIS integrates spatial data such as maps and coordinates with non-spatial data such as attributes and descriptive information to produce comprehensive information [7][10]. In the context of tourism, GIS enables the visualization of tourist destination locations along with related information such as the type of tourism, facilities, and accessibility, and can be used to predict the number of tourists and analyze tourism infrastructure [7].

WebGIS develops the concept of GIS by making it accessible through a web browser without the need for special software installation. This technology utilizes the internet as a medium for distributing geographic information, offering high accessibility, low implementation costs, ease of maintenance, and cross-platform compatibility [3][4][6][8]. Systematic research shows that WebGIS is very effective for tourism information systems due to its ability to present tourism big data visually and interactively with dynamic maps [1][8][10].

The implementation of WebGIS in various regions of Indonesia has shown positive results in promoting and improving the accessibility of tourism information. A study in West Jakarta used Google Maps API and Location Based Service for mapping tourist attractions with satisfactory usability testing results from 40 respondents, rated “quite effective, simple, and satisfactory” [3]. Implementation in Langkat Regency integrated GIS technology in developing tourist attractions through the LBS method with Google Maps API and CodeIgniter [6]. WebGIS-based tourism mapping in various regions has produced platforms capable of managing large data, particularly spatial and attribute data from tourist attractions, effectively using tools such as QGIS [5][10]. Recent research shows the continuous evolution in the development of tourism WebGIS with a focus on improving user experience, including mobile applications, IoT integration, and the use of big data [1].

B. Route Planning dan Location Based Services dalam Navigasi Wisata

Route planning is an essential component in tourism information systems that help tourists determine the optimal route from their starting location to their destination. GIS-based mobile route planning technology for tourism activities has shown a significant increase in travel efficiency and user satisfaction [2]. GIS-based route planning applications are widely used by various parties in tourism activities, including tour operators, tour guides, and individual tourists [2].

Location-Based Services (LBS) have become a crucial technology in modern route planning. LBS utilizes GPS data to determine the user's position and provide contextual information based on that location using latitude and longitude coordinates [3][4][6]. The integration of LBS with WebGIS results in an interactive navigation system that is responsive to real-time conditions, with features such as real-time traffic information and the ability to search for nearby places, which effectively assist tourists in planning their trips [2]. GIS-based route planning systems improve travel efficiency and visitor satisfaction through accurate navigation guidance and valuable estimated travel time information [2].

GIS can be used as a scientific tool to collect, analyze, predict, and visualize geographic data relevant to tourism, including data acquisition, processing, analysis, and interactive map creation [7]. A GIS-based approach using Point of Interest (POI) analysis based on reviews, ratings, and spatial attributes can reveal important spatial patterns and dynamics of tourism [8].

C. Modern Web Technology and Responsive Design

Advances in web technology support the implementation of more interactive and responsive WebGIS. Google Maps API technology has become a popular choice for implementing tourist attraction mapping due to its ease of integration and comprehensive features [3][4][6]. The use of frameworks such as CodeIgniter facilitates the development of efficient and structured WebGIS by utilizing LBS methods for location coordinate integration [3][4][6]. The waterfall model is commonly used in WebGIS system design with stages of requirements analysis, system analysis, implementation, testing, evaluation, operation, and maintenance [4] [5].

Client-server architecture with a Database Management System (DBMS) enables efficient management of tourism data with a spatial database structure [6][8]. The use of open source software such as QGIS (Quantum GIS) provides powerful tools for mapping tourism potential based on WebGIS with comprehensive scoring and GIS analysis, including the creation of thematic maps and heat maps [8][5][10]. GIS technology can manipulate spatial and attribute data to integrate maps and data into a single system [8]. The use of HTML5, CSS3, and modern JavaScript ensures that applications can be accessed from various devices, including smartphones and tablets.

Responsive design is a critical consideration given that the majority of tourists access information through mobile devices [3][4][6].

D. User Experience Design and Hybrid Interface Patterns

User experience (UX) design is a discipline that focuses on creating meaningful experiences for users through thoughtful interaction design, visual design, and information architecture. In digital applications, effective UX design significantly increases user satisfaction, engagement, and adoption rates. Research shows that developing websites or applications using the User Centered Design (UCD) method produces more effective designs because it involves direct user evaluation to accurately meet needs and demands [9]. The UCD method uses descriptive questionnaires for implementation and User Experience Questionnaires (UEQ) for UI/UX design evaluation [9].

Hybrid interface patterns combine paradigms from various application domains to create more powerful and intuitive experiences. Research shows that users familiar with established patterns from popular applications expect similar interaction patterns and mental models in other applications. Applying familiar patterns can reduce the learning curve and measurably increase perceived intuitiveness. In the context of tourism, integrating paradigms from navigation and e-commerce applications creates a platform that combines the strengths of both domains to support tourist travel more optimally [9].

The design-centric approach in tourism information systems recognizes that technical sophistication without attention to user experience results in systems that are not used optimally. The integration of GIS capabilities with thoughtful UX design creates systems that are both powerful and accessible to diverse user populations [9][10]. Web-GIS models specifically designed for tourism resource management and promotion, equipped with dynamic and interactive maps, provide opportunities to manage and promote tourism resources more effectively [8]. Effective systems must provide tourists with the latest information efficiently [9].

III. Methodology

This study adopts a systematic approach consisting of several sequential stages to produce an effective and user-friendly Interactive Bandung Tourism WebGIS. Figure 1 shows a flowchart of the research stages carried out from problem identification to system evaluation.

Figure 1. Research Stages Flowchart

Flowchart of Interactive Bandung Tourism WebGIS Research Stages The research stages begin with Problem Identification to identify the problem of fragmented tourism information faced by tourists. A Literature Review is conducted to examine previous research related to WebGIS, route planning, and user experience design in the context of tourism [1] [2][3][8][4][5][6][7][8][9][10]. The Front-End Development stage produces a Presentation Layer that includes interface design and interactive map visualization.

Data collection is divided into two main components: Spatial Data in the form of tourist location coordinates collected via GPS and verified by Google Maps [3][4][6], and Non-Spatial Data which includes photos and brief information about destinations. The data then goes through Data Processing and is compiled into a Data Layer consisting of JavaScript Object format files to be accessed by the application.

Leaflet Integration implements a mapping library for interactive map visualization and generates an Application Layer that handles business logic and communication between layers. Program Testing is conducted iteratively with an Error Handling mechanism to ensure that all features function properly using black box testing [4]. If an error is found, the process returns to the testing stage for correction until the system is free of critical bugs. The final stage is System Evaluation to verify the basic functionality and performance of the application that has been built.

A. System Requirements Analysis and User Research

Development began with a comprehensive identification of user needs and an analysis of existing tourism information system issues (Problem Identification). The main needs of tourists include

accurate tourist location information, detailed destination descriptions, contact information, and efficient ways to reach locations [3][6].

Analysis of the existing tourism system identified several critical gaps: information scattered across various platforms [3][4], no integrated navigation support, poorly structured destination catalogs, and limited accessibility on mobile devices. The results of the analysis indicate the need for a system that integrates the following capabilities: (1) displaying interactive maps with markers for tourist locations, (2) providing detailed information on each destination, (3) search and filter features based on categories, (4) determining routes from the user's position to the destination, (5) a responsive, easy-to-use interface, and (6) efficient and engaging information presentation [9].

B. Data Collection and Validation

System data consists of spatial and non-spatial components. Spatial data includes the geographic coordinates of tourist locations collected using GPS and verified through Google Maps, using latitude and longitude formats [3][4][6]. Non-spatial data includes destination names, tourist categories, full addresses, contact numbers, operating hours, price ranges, and destination descriptions [6][10].

Field surveys were conducted at various tourist locations in Bandung City to collect primary data using GPS observation and documentation [5]. Secondary data was obtained from the Bandung City Tourism and Culture Office, official tourist destination websites, and online tourism information platforms. Data validation was carried out by comparing information from multiple sources to ensure accuracy and actuality [8][5].

C. System Architecture Design

C.1 Architecture Client-Side

This system design uses a client-side architecture, where all application logic and user interactions are executed entirely within the browser. This approach ensures fast and responsive interactions without requiring communication with the backend server. This architecture consists of three conceptual layers: the presentation layer (user interface), the map engine layer (mapping engine), and the data layer (locally stored data).

C.2 Hybrid User Experience Design

The interface design adopts a hybrid design approach that combines paradigms from two digital platforms familiar to users: navigation and route planning functionality from map applications, and presentation and discovery of tourism content from e-commerce platforms.

1) Inspiration from Google Maps: The route planning module integrates robust navigation capabilities, giving travelers the ability to determine the optimal route with familiar visualizations.
2) Inspiration from E-Commerce Platforms: Destination catalogs adopt card-based design, filtering capabilities, sorting options, and visual hierarchy that facilitate destination exploration and comparison. This approach is familiar to the majority of modern users and has been proven to increase engagement in the discovery process [9].
3) Design Principles: The system was built with a mobile-first responsive approach, considering that the majority of users access it from smartphones [3][4][6]. Touch-friendly interactive elements and optimized viewport sizing ensure optimal usability on all devices. The design uses the User Centered Design (UCD) method to ensure the interface meets user needs [9]. The cyan and dark navy color scheme is visually calming while improving readability and reducing eye strain.

C.3 Main Modules

The system consists of several integrated modules:

1) Interactive Map Module: Displays a full-screen map with marker clustering for tourist destinations [7][10]
2) Destination Catalog Module: Card-based presentation dengan filtering dan sorting capabilities [9]
3) Route Planning Module: Integration with route services for optimal route calculation and visualization [2]
4) Destination Detail Module: Comprehensive information display for each destinationr each destination [6]
5) Search and Discovery Module: Autocomplete search with powerful filtering mechanisms

D. Technology Implementation

The frontend is built with HTML5 semantic markup for good accessibility. CSS3 is used for styling with a mobile-first responsive design approach. Modern JavaScript with ES6+ features handles interactivity and dynamic content loading.

The mapping functionality integrates the Leaflet.js JavaScript library, which is a powerful open-source library for interactive maps. The base map is provided by the tile service from OpenStreetMap. The HTML5 Geolocation API is used to accurately obtain the user's current position. Tourist destination data is managed in JavaScript Object format, which is loaded directly by the application, ensuring fast performance on the client side.

For route planning functionality, the system integrates the Leaflet Routing Machine plugin. This plugin connects to the external Open Source Routing Machine (OSRM) service to calculate and visualize routes based on the user's chosen mode of transportation (car, motorcycle, or walking).

E. Functional Testing

The final stage of the methodology is system testing focused on functional verification. Testing is conducted using the black box method, where system functionality is tested based on requirement specifications without looking at the internal code structure. Testing scenarios include verifying the accuracy of destination marker placement, ensuring that the filter and search features work correctly, and validating that the route planning function works according to user input. In addition, compatibility testing is performed to ensure that the application runs consistently across major browsers.

IV. Results and Discussion

A. Architecture System

The Bandung Interactive Tourism WebGIS System is implemented using a client-side architecture. All application logic, from interface rendering and data loading to map functionality, is executed entirely on the user's browser. Tourism destination data is stored in static .JSON file format, which is accessed directly by the application. This approach simplifies the development and deployment process and ensures very fast response times for user interactions because it does not depend on server-backend communication.

B. Features and Functionality with Hybrid UX Design

The main result of this research is a functional prototype with features whose application logic flow is summarized in the flowchart in Figure 4. The following is a description of its main functionalities:

B.1 Interactive Map Display with Leaflet.js

The system displays an interactive map of Bandung City using the Leaflet.js library with a base map from OpenStreetMap. Tourist destinations are displayed as custom markers. To overcome visual density, the Leaflet.markercluster plugin is implemented to automatically group nearby markers when the map is zoomed out.

B.2 Route Planning Fitures

Inspired by navigation apps, users can plan routes. This feature is implemented using the Leaflet Routing Machine plugin connected to the OSRM (Open Source Routing Machine) service. Users can specify a starting point (via search or the “My Location” feature using the Geolocation API), select a destination from the map, and choose a mode of transportation (car, motorcycle, or walking). The system then visually displays the route on the map.

Figure 2. Route Planning

The system successfully implemented an optimal route determination feature with three main components: geolocation input (Origin and Destination), route weighting criteria (vehicle type and toll road options), and results visualization

B.3 Destination Discovery (Catalog and Search)

Inspired by e-commerce platforms, the system provides a catalog of tourist destinations. The search feature is equipped with autocomplete functionality powered by the Nominatim API, allowing users to search for locations easily. Each destination on the map can be clicked to display an interactive popup containing brief information.

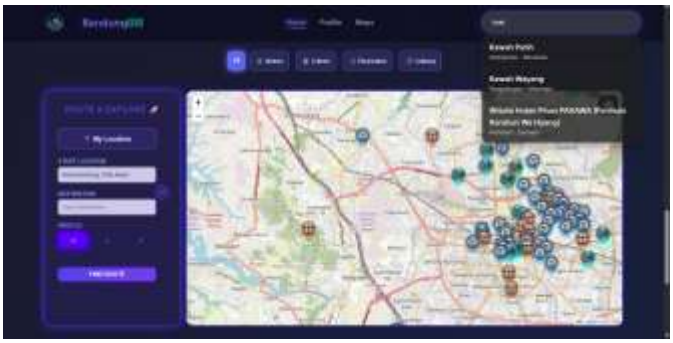

Figure 3. Searching

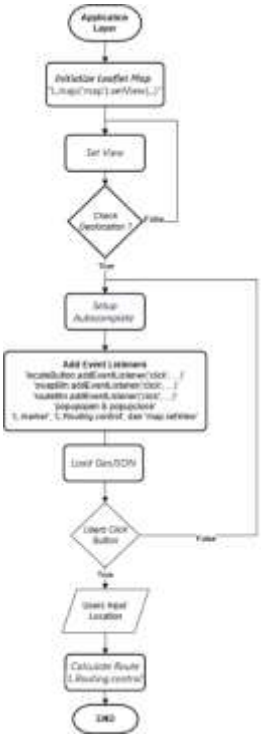

Figure 4. Flowchart Leaflet Map Implementation

C. User Interface with Hybrid UX Pattern

C.1 Design Philosophy

The interface adopts a hybrid UX pattern that combines established paradigms from navigation applications and e-commerce platforms [9]. From navigation applications (Google Maps), the system inherits an intuitive map-based interface, clear directional information display, and efficient route selection mechanisms [2][3][6]. From e-commerce platforms, the system inherits efficient product catalog search, visual card-based information presentation, powerful filtering/sorting capabilities, and social proof elements such as ratings and reviews.

The User Centered Design approach was applied to gather descriptive information that formed the basis for the UI/UX design guidelines [9]. This method focuses on user needs as the main guide in every design decision, with the aim of producing more effective outputs [9].

C.2 Layout Architecture

The main layout of the map page uses a two-panel format: a static control panel on the left and an interactive map area that fills the remaining space on the right. The control panel contains all input functionality, such as determining the starting location and destination, as well as transportation mode options. A card-based design is used consistently to present information, such as in the pop-up that appears when a marker on the map is clicked.

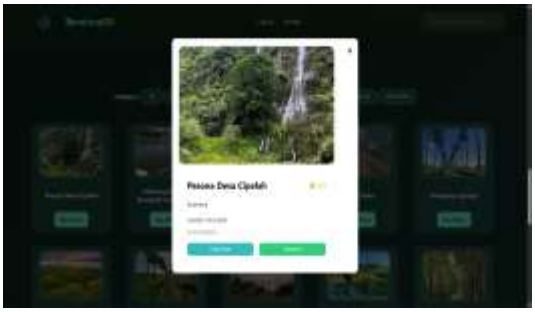

Figure 5. Card-based design

Card-based design is used consistently to present information: destination cards in list view, route guidance cards in navigation mode, and information popup cards in map interactions [9]. The size and spacing between cards use a grid system for visual alignment and responsive adjustment across different device sizes [3][4][6].

C.3 Visual Hierarchy and Typography

The color scheme uses cyan as the primary accent color paired with a dark navy background, creating high contrast that supports readability. White text is used for primary information, gray for secondary information.

Typography uses a readable sans-serif font family with a regular size hierarchy: 32px for page titles, 20px for section titles, 16px for main text, and 14px for supporting information. Line spacing of 1.5 ensures comfortable reading on various screen sizes.

Interactive elements have distinct visual states: default, hover, active, and disabled. The hover effect uses subtle scaling transformations or color shifts to clearly indicate interactivity.

C.4 Feedback and Accessibility

The loading indicator shows when the app is fetching data, providing clear feedback to the user. A skeleton screen is displayed to enhance progressive loading.

D. Functional Verification

System testing was conducted using the black box method to verify that all key features functioned according to specifications. Functional verification ensures that: (1) all destination markers from the .JSON file are successfully loaded and displayed on the map, (2) the marker clustering feature works when the zoom level is changed, (3) the route planning function successfully calculates and displays the route after the starting point and destination are entered, and (4) the autocomplete search feature provides relevant location suggestions.

E. System Analysis

E.1 Significant Advantages

1) Fast Performance: Due to the client-side architecture, interactions such as zooming and clicking are highly responsive.

2) Innovative Hybrid UX Design: By combining paradigms that are familiar to users, such as the map interface from navigation applications and the browsing patterns from e-commerce platforms, this system has succeeded in creating an intuitive and easy-to-use experience. Users do not need a long learning curve because they can apply existing mental models to navigate and find information, thereby significantly reducing barriers to using the application.

3) Open-Source Implementation: The use of Leaflet.js, OpenStreetMap, and OSRM demonstrates the effectiveness of utilizing free and reliable open-source technology.

E.2 Limitations and Areas for Improvement

1) Limited Data Scalability: Since data is stored in static .JSON files, adding or updating data requires manual intervention in the code. This system is not suitable for very large or frequently changing data.

2) Dependence on External Services: Routing and search functionality depend entirely on the availability of the OSRM and Nominatim public services.

3) No Server-Side Features: The absence of a backend means there are no features such as user accounts, search history storage, or review systems.

V. Conclusion and Future Work

A. Conclusion

This research has successfully designed and implemented a prototype of the Bandung Interactive Tourism WebGIS. This system effectively addresses the problem of information fragmentation often faced by tourists by providing a centralized platform that integrates destination information, interactive map visualization, and route planning functionality in a cohesive interface. Built with a client-side architecture, this application demonstrates responsive performance by running all logic on the user's browser and loading data from static .JSON files.

The main contribution of this research lies in the application of a hybrid user experience (UX) design approach. By combining familiar paradigms from navigation applications for route planning and e-commerce platforms for destination discovery, this system has succeeded in creating an intuitive and easily adopted user experience. This design-centered approach proves that the effectiveness of a tourism information system depends not only on the technical sophistication of GIS, but also on interface design that takes into account the mental models of users.

B. Development Recommendations

Based on existing limitations and system potential, here are some key development suggestions for the next iteration:

1. Dynamic and Real-Time Data Integration. Add integration with third-party APIs to present data in real time, such as traffic information, weather forecasts, and crowd levels at a destination. This will provide users with more contextual and accurate information when planning their trips.

2. Enhanced User Participation Features. Enrich the system with more in-depth user-generated content features, such as detailed reviews, ratings, and photo uploads from visitors. Social features such as sharing travel plans can also be added to increase interaction between users.

3. Expansion of Coverage and Multilingual Support. Gradually expand geographical coverage from regional to national scale. In addition, the implementation of multilingual support is very important in order to reach a wider international tourist audience.

4. Implementation of the Analytics Module. Developing an analytics dashboard for tourism stakeholders. This module can visualize data on tourist visitation trends and patterns to support better decision-making and strategic planning in the tourism sector.

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