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Tanjung enim tourism map website based on geographic information system using leaflet javascript

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ABSTRACT

Tanjung Enim is one of the villages in Lawang Kidul sub-district, Muara Enim Regency, including a geographical area with cross-provincial coverage that has potential tourism resources and tourist attractions. However, the large potential of tourist attractions in Tanjung Enim is not matched by the development of sufficient geographic information system technology. So not many tourists and the general public know about potential tourist attractions. Geographic Information Systems in the form of websites are designed to search for tourist locations and guide tourists to their destination. WebGIS creation using the Leaflet Javascript Library and Open Street Map for map digitization, HTML5, and CSS3 programming languages. The result of this research is the development of a WebGIS which contains 10 tourist attractions with tourist attraction categories, namely natural tourism, artificial tourism, cultural tourism, and culinary tourism. This WebGIS displays information on tourist destinations, history, product details, and presents information interactively to users. The results of functional testing on desktop and mobile devices show that the percentage of system feasibility is 100% with a very good rating.

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1. INTRODUCTION

Tanjung Enim is one of the villages located in Lawang Kidul sub-district, Muara Enim Regency, South Sumatra. Tanjung Enim is home to one of the head offices of a coal mining company, namely PT. Bukit Asam, Tbk (PTBA). Since 2016, PTBA and the Muara Enim Regency Government have initiated the Tanjung Enim City Tourism Program. The goal is to transform Tanjung Enim, from a coal mining region into a tourist destination that contributes to the well-being of the community in the future. The concept of Tanjung Enim as s tourist destination involves not only developing and organizing the city but also integrating it with the natural tourist attractions around the Tanjung Enim area. Up to the present, PT. Bukit Asam, Tbk. has developed numerous tourist attractions in Tanjung Enim, including the Tanjung Enim Zoo & Jogging Track, Coal Museum, and

Klawas Waterpark. Despite the local visitors who have frequented these attractions, many tourists from outside the region are still unaware of the existence of these tourist spots in Tanjung Enim. This is due to the lack of comprehensive information about tourist attractions in Tanjung Enim.

Tourist attractions encompass everything in a destination that possesses allure and appeal for visitors (Jayanti, 2019). Based on the origin of their formation, tourist attractions are divided into two categories: natural tourist attractions and artificial tourist attractions (Arystiana, 2021). Natural tourist attractions are those formed naturally by the environment, such as waterfalls, rivers, beaches, and so on (Putra & Afnarius, 2016). Meanwhile, artificial tourist attractions are those created through human creativity (Suliyanto & Musthofa, 2020). The digital media as a source of information and communication platform for tourists has developed significantly (Bestari et al., 2023). The design of a tourism website can provide a virtual experience for tourists about a destination and has the capability to influence the formation of the destination's image for users (Wardhana et al., 2021). Analysis based on the Communication Effectiveness Grid (CEG) indicates that search engines and dedicated tourism websites are perceived as relevant and important digital communication sources in shaping the image of a tourist destination. (Giglio et al., 2019).

There have been several previous research that utilized websites as a promotional medium for tourist attractions. Hidayat, et al., (2020) designed the Wukirsari Bantul Tourism Village Website using XAMPP as a database manager and several programming languages, including HTML, PHP, CSS, Javascript, and JQuery. Later, Santynawan et al., (2019) designed a tourism application and city tourism for Semarang City based on WebGIS. The preparation of the Melanglang Semarang website's database is done with two methods, namely with PostGIS connected locally to pgAdmin on PostgreSQL, and the configuration of Geoserver as a Map Server. Fitriani et al., (2021) designed a web-based Geographic Information System for tourist attractions in Labuhanbatu using PHP, Xampp, Codeigniter, MySQL database, and Google Maps API to display the map of tourist attractions in Labuhanbatu. Silaban et al., (2022) designed a website for tourist attractions in North Tapanuli Regency and Adityawan, (2022) building a Rengganis Rancabali Crater Tourism Promotion Media Website using the Content Management System (CMS) WordPress. Asmawati et al., (2022) designed a WebGIS for tourist destinations in Polewali Regency, Mandar, using PHP programming language, CodeIgniter framework, Bootstrap, and MySQL database. Sutoyo et al., (2022) designed a tourism website for Jambi City using the prototyping method and tested it using the System Usability Scale (SUS) method. Annisa et al., (2022)) designed a tourism website for Nunukan Regency, North Kalimantan, using PHP, HTML, CSS, Laravel framework, and MySQL database.

Based on the description above, various methods have been employed to build tourism websites using different programming languages. However, there are still relatively few researchers who develop tourism websites using the Leaflet Javascript library. Therefore, the researchers will design the website using HTML5 and CSS3 programming languages, along with the inclusion of the Leaflet JavaScript library. JavaScript can function across most popular web browsers such as Google Chrome, Internet Explorer (IE), Mozilla Firefox, and Opera. Therefore, the system design is primarily based on JavaScript as it aids in creating interactive and essential website pages. The Leaflet library is currently at version 1.9 and will continue to be developed due to its active community support.

2. RESEARCH METHOD

Prototyping method is employed in the system design, which helps developers and stakeholders gain a better understanding of the actual information system requirements

(Roger & Bruce, 2020). The prototyping method begins with communication with the internal group to determine the overall goals of the software (Nursaid et al., 2020), identify various parameters to be investigated, and outline further details. The prototype iterations are planned rapidly, involving modeling in the form of 'quick design' (Mulyana et al., 2023). The design focuses on the representation of the software aspects needed by users (such as user interface design or display format) (I. S. Hidayat et al., 2023). Implementation occurs concurrently, with the hope that a simple version of the system can be quickly developed and tested with users for evaluation and feedback (Figure 1).

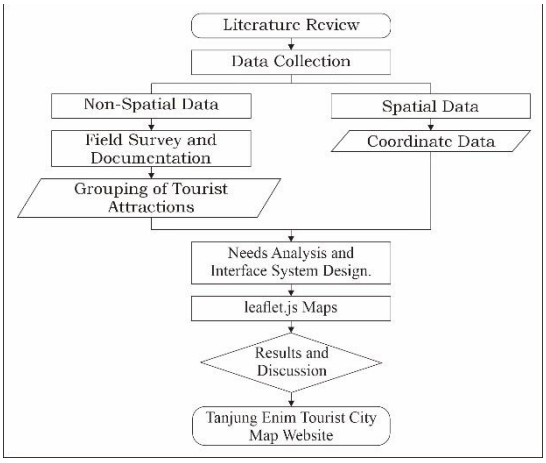

Figure 1 Research Flowchart

The research is conducted in five stages to achieve the research objectives, namely the preparation stage, data collection stage, data processing stage, design planning stage, data analysis stage, and completion stage.

2.1. Preparation Stage

The preparation stage encompasses a literature review on the research location, recent studies related to web-based tourism information systems in Muara Enim Regency, and the preparation of software for modeling. This stage also involves field equipment preparation. The equipment used in this research includes: (1) Personal computer hardware for processing and storing all digital data until the WebGIS is successfully designed; (2) GPS Handheld 64s for marking points of tourist attractions; (3) Microsoft Office for report writing and data processing; (4) Corel Draw for creating flowcharts of research activities and website design plans; (5) Visual Studio Code software for creating and editing CSS and HTML scripts; (6) Leaflet Javascript for building the map interface to be displayed in WebGIS.

2.2. Data Collection Stage

The data collection stage is the process of obtaining initial data (Wahid, 2020). The data used in processing the WebGIS Map for Tourist Attractions in Tanjung Enim includes: 1) Spatial data in the form of an online map from OpenStreetMap Indonesia as the base map and coordinate data from tourist locations collected directly in the field; 2) Non-spatial data such as the names of tourist attractions, documentation, information on public facilities, historical information, and addresses of tourist attractions.

2.3. Data Processing Stage

The data processing stage involves processing the obtained data to derive parameters used for modeling the tourist map website. Data processing includes determining the coordinate points of tourist attraction locations, grouping types of tourist

attractions, visual observations in the field, ease of access to reach tourist destinations, historical descriptions, important information notes, and popular tourist products. This system facilitates tourists in accessing information about tourism and aids in disseminating information widely without constraints of time and space.

2.4. Data Analysis Stage

a. System Analysis

System analysis is one technique to dissect problems and propose new system analysis suggestions (Nuraeni et al., 2023). System analysis is crucial in research to identify the weaknesses of the existing system (Ardhiyani & Mulyono, 2018). The focused process for analysis is the mapping system of the Tourist City's objects, aiming to facilitate and provide accurate directions for tourists. Visitors can view and search for information on tourist destinations in Tanjung Enim, enabling them to easily locate the attractions.

At present, the challenge faced by the Tourism and Creative Economy Agency of Muara Enim Regency is the limited organization of tourist attractions, despite the considerable potential of tourist attractions in Tanjung Enim. This is not complemented by the development of geographic information system technology. As a result, there are still few tourists and the general public who are aware of the potential tourist attractions. Therefore, this issue needs to be addressed by promoting and providing information using a website-based information media.

With the increasing advancements in technology, there is a growing demand for obtaining information quickly and accurately. So that way, a system is needed to expedite the processing of data related to promotion and information provision. The promotion and information provision, presented in the form of a website, are developed to facilitate the processing of information within the Tourism and Creative Economy Agency of Muara Enim Regency.

b. System Requirements Analysis

System requirements analysis is a crucial stage in developing a system (Sulistiani & Setiawansyah, 2020). In this stage, user requirements can be defined as they will impact the creation of a system (Ardhiyani & Mulyono, 2018). Accurate understanding of requirements will result in a system that meets the needs (Saputri & Mulyono, 2019). Therefore, proper requirement definition is a critical factor in the success of system development (Madhrozji & Effiyaldi, 2019). In system analysis, the identification of system requirements is divided into two parts (Aziz & Fauziah, 2022).

The First is Functional System Requirements(Aziz & Fauziah, 2022). Functional system modeling depicts the processes or functions that the system must perform to meet user needs. Based on the requirements, it is known that the users utilizing the system are only visitors. Therefore, the main functions to be performed in processing the web-based tourism information system as a promotional media for Tanjung Enim Tourist City are as follows: (a) Search Function, (b) View Information Function, (c) Social Media Function, and (d) Visitor Traffic Function.

The second is Non-Functional System Requirements(Aziz & Fauziah, 2022). Based on the existing functional system requirements, the system is expected to be designed to have the following: (a) Usability: User-friendly in achieving feasibility goals with effectiveness, efficiency, and satisfaction in using the Tanjung Enim Tourist Object Map website, (b) Functional: Easy access to information that can be done 24 hours a day, (c) Flexible: Ease in finding the needed data due to well-organized structure and compatibility across various platforms.

2.5. Research Object Data Analysis

The considerable potential of Tanjung Enim Tourist City is a significant attraction for domestic tourists, supported by public facilities and tourism facilities completeness

ranging from 80% to 100% for each tourist destination. The observational results of the research objects in Tanjung Enim amount to 10, and this data is then categorized into 3 types: cultural tourism, human-made tourist attractions, and culinary tourism, as shown in the table below (Table 1).

Table 1 The recapitulation of data and coordinates for the research objects.

No	Tourist Attractions	Area Spots	Types of Tourist Attractions	Coordinate Data UTM Zone 48S	Geographic Coordinate Data
1	Coal Museum	Museum, coal park (miniature heavy equipment, Muntik), underground train, canoe boat, mines in 3 countries, replica of Musi Bridge, musical, culinary, and Tanjung Enim Square	Cultural Tourism and Artificial Tourism	366073, 958501	-3.753646, 103.793923
2	Sriwijaya Park	Miniature of Kuto Besak Fort, Belido Fish, Pulo Kemaro Pagoda, Muara Takus Temple, Grand Mosque, and Monpera Monument	Cultural Tourism and Artificial Tourism	365847, 958492	-3.754395, 103.791893
3	Tanjung Enim Zoo and Jogging Track	Jogging area, Mini Zoo, giant bird park, and children's playground	Artificial Tourism	365833, 958502	-3.753567, 103.791782
4	Klawas Waterpark	Water attractions, food court, and souvenir shop	Artificial Tourism	366207, 958828	-3.723649, 103.795466
5	Botanical Garden	Indonesian Fruit Plants	Natural Tourism and Artificial Tourism	365792, 958516	-3.752304, 103.791396
6	Culinary Tourism Park	Karang Asam Field and Talang Jawa Field	Culinary Tourism	366090, 958337 366177, 958424	-3.76845, 103.794 -3.76059, 103.795
7	Kujur Monument	Playground and Culinary Spot	Cultural Tourism and Culinary Tourism	366744, 958546	-3.74956 103.799
8	Sentra Industri Bukit Asam (SIBA) Center	Community Empowerment Institution in the Village (LPMK) Tanjung Enim Village, Management Office, Educational Outlet, SIBA Kopi, SIBA Bonsai, SIBA Jamur, SIBA Songket, SIBA Rajut, SIBA Batik, dan SIBA Rosella	Cultural Tourism and Culinary Tourism	366586, 958602	-3.74444 103.798
9	Tanjung Enim Welcome Monument	Photo Spot	Cultural Tourism and Artificial Tourism	366298, 958838	-3.72306 103.796
10	Monpera Monument	Photo Spot and Culinary	Cultural Tourism and Artificial Tourism	366328, 958517	-3.75210 103.796

2.6. System Feasibility Analysis

System feasibility analysis includes conducting functional testing. System feasibility analysis is conducted to test the relationship between the created application program and other elements in the information system. Each test will be calculated for its feasibility percentage based on descriptive analysis techniques. Descriptive analysis is a statistical method used to explain data by describing it, thereby drawing conclusions from a group of data (Santynawan et al., 2020). Software feasibility analysis uses the following calculations:

$$feasibility\ percentage = \frac{observed\ score}{expected\ score} \times 100\%$$

Furthermore, once the feasibility percentage is obtained, conclusions can be drawn into qualitative data using a conversion table, as shown in the following table (Table 3).

Table 2 The conversion of feasibility percentage

feasibility percentage	Criteria (predicate)
81% - 100%	Excellent
61% - 80%	Good
41% - 60%	Fair
21% - 40%	Poor
< 20%	Very Poor

2.7. Completion Stage

The completion stage is a compilation of data results from the data analysis process to form a harmonious unit in building a model and final conclusion. After all analyses are conducted, the final conclusion can be formulated, which is the design of the Tanjung Enim Tourist Object Map website based on a geographic information system using Leaflet Javascript.

3. RESULTS AND DISCUSSIONS

3.1 System Design

The Geographic Information System (GIS) is operated using web browser software with an internet connection as the link between the client and server. The rapid design modeling (quick plan) for the Tanjung Enim Tourist Object Map Information System begins with system design and extends to its implementation, utilizing Leaflet Javascript. he Leaflet Js library has comprehensive features both in its core library and in its community, providing plugins that can support Leaflet(Santynawan et al., 2019). The system requirements analysis resulted in several user needs, including adding image displays of tourist objects, information displays, and tourist object maps on the website.

The initial configuration of Leaflet.Js is done by creating an .html file and writing the source .js (Javascript) and .css (Cascading Style Sheet) files from Leaflet.Js in the head section of the .html file for map initialization. The .js and .css files from the tile layer, which functions as the base map from Open Street Map, as well as plugins used in the creation of this website, are also included in the head section of the .html file. In the body section of the .html file, adjustments are made regarding which layers will be displayed on the map page, layer control feature configuration, Leaflet Routing Machine plugin configuration, and marker creation for all research object points (tourist objects). The script creation and code addition using plugins from Leaflet Js are done in the body section of the .html file, covering all tourist object points used as research objects. The script creation and code addition use plugins from Leaflet Js that can be developed according to needs. The following is the basic script used on the main page (Figure 2).

```
<script>
    // Inisialisasi peta Leaflet
    const map = L.map('map').setView([-3.7536456350464618, 103.79392322804827], 17);

    // Tambahkan layer tile dari Opensteetmap
    const tiles = L.tileLayer('https://tile.openstreetmap.org/{z}/{x}/{y}.png', {
    maxZoom: 19,
    attribution: '&copy; <a href="http://www.openstreetmap.org/copyright">OpenStreetMap</a>'
    }).addTo(map);

    // Fungsi untuk menambahkan marker dengan tombol di dalam popup
    function addMarker(lat, lng, title) {
        const marker = L.marker([lat, lng]).addTo(map);

        const popupContent = `
            <div>
                <h4>${title}</h4>
                <button class="btn btn-modern btn-rounded btn-primary mb-2" onclick="openGoogleMaps(${lat},
            </div>`;

        marker.bindPopup(popupContent);
    }

    // Contoh: Tambahkan beberapa marker dengan tombol untuk membuka Google Maps
    addMarker(-3.7536456350464618, 103.79392322804827, "Museum Batu Bara");

    // Fungsi untuk membuka Google Maps ketika tombol diklik
    function openGoogleMaps(lat, lng) {
        const googleMapsUrl = `https://www.google.com/maps?q=${lat},${lng}`;
        window.open(googleMapsUrl);
    }
</script>
```

Figure 2 script html with Leaflet Js

3.2 User Interface Page

User interface of the system, serves as a means to connect users with the system, implemented in components such as menus and buttons. The system that has been built is a responsive website with an attractive and organized display, accessible on various devices with different screen resolutions. This WebGIS will be available online at the domain www.tanjungenimwisata.id. The tourist object information system presents information in the form of spatial data, including a map of Tanjung Enim highlighting the locations of tourist objects. The website will display the desired objects along with textual attributes and photos that support the information presented in the system.

3.3 Homepage Website

The homepage is the page that opens when users first visit the Tanjung Enim Wisata website. This page displays the name and logo of the website, a welcome message on the homepage, and various designs that showcase tourist objects comprehensively (Figure 3). At the top, there is a navigation menu for tourist objects, online maps, and contacts. When clicked, the system will display a new page.

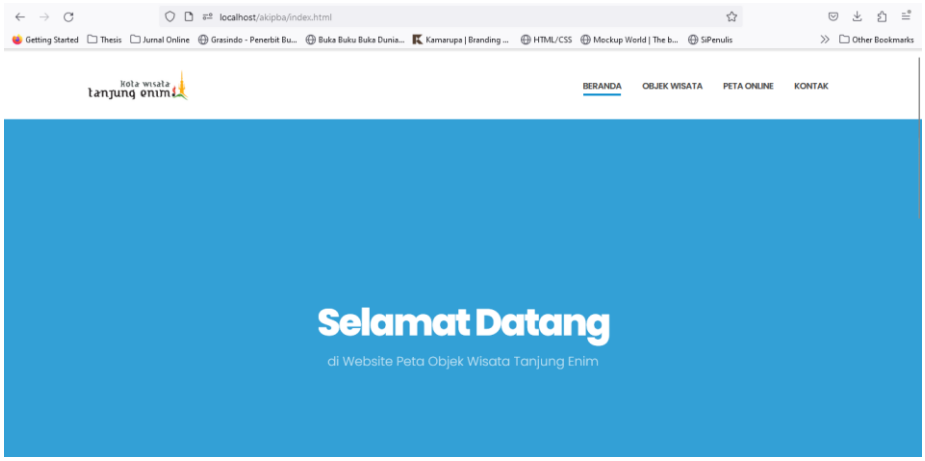

Figure 3 homepage website Tanjung Enim Tourism

3.4 Objek Wisata Page Website

Objek wisata page website contains a menu with categories of tourist attractions: natural attractions, man-made attractions, cultural attractions, and culinary attractions. This page displays iconic photos that link to the gallery pages of Tanjung Enim's tourist destinations, categorized according to the type of attraction. If users want to view or obtain information about a tourist destination, they can click on one of the options, and the system will display information about that specific attraction (Figure 4).

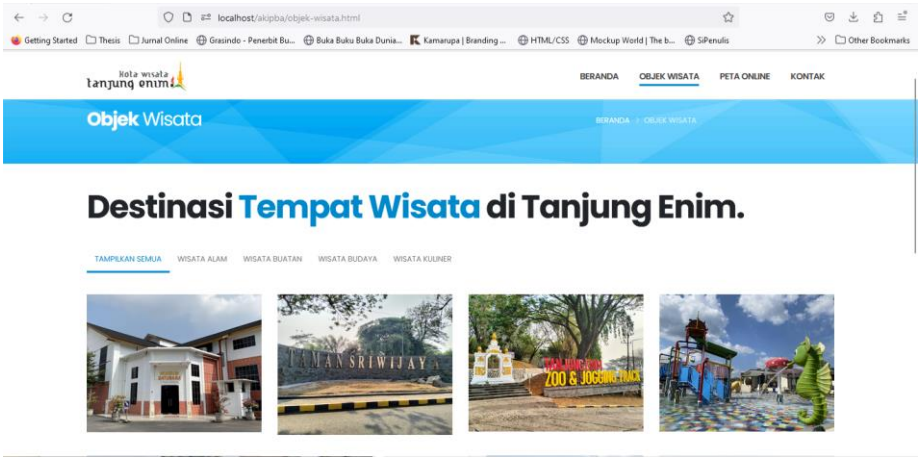

Figure 4 Display of objek wisata page

3.5 Peta Online Page Website

Peta online page website provides location guidance for tourist attractions in Tanjung Enim and allows users to search for locations based on the chosen categories of tourist attractions. The map is highly interactive, allowing users to pan, zoom in and out, and switch between different map types. If a user wishes to view or obtain information about a tourist destination, they can click on the marker, then select 'Navigate to Location,' and they will be directed to the destination (Figure 5). The map includes a routing feature that can be used both to navigate from one tourist attraction to another and from a tourist attraction to specific nearby facilities. Various layers can be displayed, starting from the tourist attraction layer only, tourist attraction layer with routes, overall public facility layer, to public facility layers grouped by type.

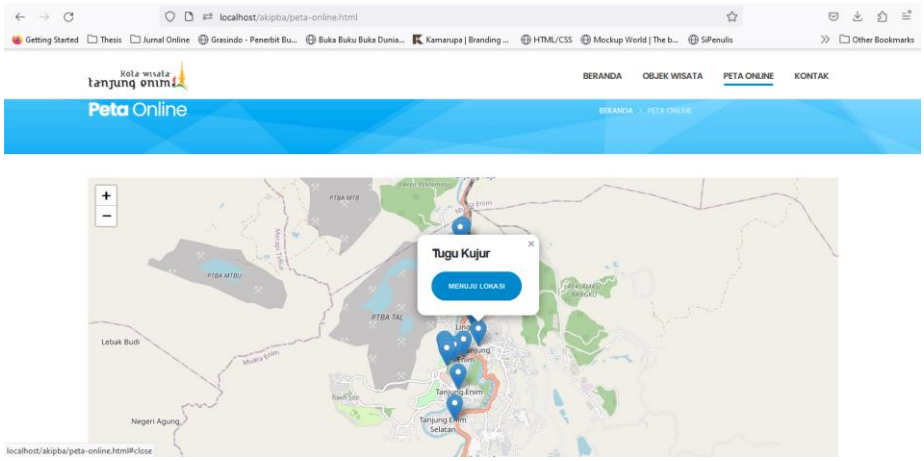

Figure 5 Display of peta online website

3.6 Functional Testing

Functional testing involves testing each feature available in WebGIS. The testing is conducted by experimenting with each feature to determine whether the designed features are functioning correctly or not. This testing is also performed to address errors and validate that user input conforms to the application's usage guidelines. If a feature runs successfully and produces the expected results, a score of 1 is assigned; if it fails, the score is 0 (Table 4). The following are the results of the feature testing conducted.

Table 3 Functional testing website

No	Scenario Testing	Expected Results	Device	Result	Score
1.	Viewing the homepage of Tanjung Enim Wisata website	The system displays the homepage of Tanjung Enim Wisata and several photos of tourist attractions.	1. Desktop 2. Handphone (*merk) - Apple - Samsung - Xiaomi - OPPO - Realme - Vivo - Huawei	succeed	1
2.	Viewing all tourism destinations	The system displays all categories of tourist attraction objects (natural attractions, artificial attractions, cultural attractions, and culinary attractions)		succeed	1
3.	Viewing detailed location information for tourist destinations by clicking on one of the tourist attractions	The system displays detailed information about the selected tourist attraction		succeed	1
4.	Viewing the entire list of natural attractions.	The system displays the complete list of natural attractions and interesting information about natural attractions.		succeed	1
5.	Viewing the entire list of artificial attractions.	The system displays the complete list of artificial attractions and interesting information about artificial attractions.		succeed	1

No	Scenario Testing	Expected Results	Device	Result	Score
6.	Viewing the entire list of cultural attractions.	The system displays the complete list of cultural attractions and interesting information about cultural attractions.		succeed	1
7.	Viewing the entire list of culinary attractions.	The system displays the complete list of culinary attractions and interesting information about culinary attractions.		succeed	1
8.	Viewing the online map based on the name of tourist destinations (natural attractions, man-made attractions, cultural attractions, and culinary attractions)	The system displays maps and provides routes for tourist attractions directly connected to Google Maps		succeed	1
9.	Viewing Contact	The system displays contact information that can be reached by users, such as email addresses		succeed	1
10.	Viewing social media	The system creates hyperlinks to selected social media platforms.		succeed	1
Total					10
Score Maximum					10
Functionality Test Feasibility Percentage					100%

Based on the system testing results, all scenarios using both desktop and mobile devices ran according to the requirements, obtaining a total score of 10 with successful testing results.

4. CONCLUSION

The results of the functional testing indicate that the tested WebGIS can be used on various web browsers such as Mozilla Firefox, Google Chrome, and Microsoft Edge, with a feasibility percentage of 100%, indicating an excellent predicate. This is evidenced by the layout that is suitable for both desktop and mobile devices. Information about tourist attractions will always change according to the development and increase in the number of visitors. The future development of the Tanjung Enim Wisata Object Map website could collaborate with the Tourism Office of the Regency for the addition of data and other supporting features. Additionally, this research has limitations in terms of data storage. Spatial data, such as coordinate data in this system, is not stored in a spatial database like PostgreSQL, which is capable of storing spatial data. Therefore, we hope that future researchers can utilize the PostgreSQL database for data storage, both spatial and non-spatial data.

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