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Development of Joomla based Website for Mapping and Location Information of Waste Disposal Sites in Palembang

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Abstract

Waste is a problem that occurs in many areas. Palembang City is no exception, which will contribute 1,180 tons of waste per day in 2023. One solution that can be offered to reduce the amount of waste scattered around is the existence of a website that provides map information and the location of Temporary Waste Disposal Sites (TPS). This website facilitates the retrieval of information regarding local waste disposal sites, enabling individuals to locate them swiftly and effortlessly, thus promoting the proper disposal of waste at designated areas. For website development, researchers will use CMS Joomla and the Phoca Maps extension. The design stages adopt RAD methodology consisting of requirement planning, user design, construction, and cutover. In the functionality assessment, accurate results were achieved for Map Search and locations categorized by Specific Area Categories and TPS Names. The results obtained from this research are that the website provides information on maps and TPS locations. Joomla CMS, along with the Phoca Maps extension, offers benefits in terms of convenience, affordability, and ease of managing maps and location markers. Additionally, this study presents an alternative perspective on the use of Joomla CMS, which is typically associated with text or image content usage.

Keywords: *CMS joomla, phoca maps,RAD, temporary waste disposal sites*

1 Introduction

The waste problem is a complex problem that needs to be of common concern. It is clear that the negative impacts result from waste that is not managed properly. According to various news information or personal experiences that the author has experienced, waste can cause various losses that have a broad impact on the environment, including water, land, and air [1]. Some of these losses include causing flooding, causing unpleasant odors, destroying the view, damaging the environment, reducing the quality of clean water, and spreading waste [2]. Apart from that, if we look at it from a health aspect, waste (microplastics) also has a big role in contributing to various sources of disease such as metabolic disorders, allergies, cell damage, hormonal disorders and triggering the emergence of cancer cells [3].

According to data in 2022 [4], the amount of waste generated in South Sumatra Province has reached 886,632 tons per year. This amount consists of 365,557 tons (41.23%) which are managed and 521,075 tons (58.77%) which are not managed. The largest sources of waste come from household waste (47.05%), traditional markets (22.31%), areas (9.53%), business centers (8.22%), offices (6.09%), and public facilities (5.36%). Meanwhile, Palembang, which is the capital of South Sumatra Province, contributes 1,180 tons of waste per day. If calculated with the population of Palembang which is 1,754,437 million [5], then it can be calculated that the average amount of waste produced by each resident is 0.67 kg per day.

Various efforts to reduce waste have been carried out by the government through the Palembang City Environment and Hygiene Service (DLHK). Several activities have been carried out to maximize the reduction in the amount of waste, starting from the establishment of a Waste Bank [2] and a Reuse, Reduce and Recycle Waste Disposal Site (TPS 3R), issuing appeals, circulars and outreach to reduce plastic waste, maximizing the use of tumblers, as well as limiting the use of plastic bags, to holding outreach and technical guidance regarding waste management [6].

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Despite the many efforts made by the government, not all information regarding these activities reaches the wider community quickly and accurately. One of them is access to information regarding the location of Temporary Waste Disposal Location (TPS). Sometimes because it i

s difficult to access this information, coupled with low awareness of the negative impacts of waste, it causes people to prefer to throw rubbish anywhere. Therefore, the availability of easy access to information on TPS locations can be used as an alternative solution to the waste problem [7], namely by reducing the accumulation of waste haphazardly or illegally. In the end, it is not impossible to minimize the existence of new piles of rubbish because of the TPS locations that have been determined by the authorities.

In conveying information, a website can be a medium that has the ability to convey it quickly, and accurately and reach the wider community. Websites can be built using many tools, including a Content Management System (CMS). Through CMS, the complex website development process can be converted into a simpler one [8]. There are several CMSs that can be used by website developers, including Wix, WordPress, Drupal, Shopify, Joomla, and TYPO3 [9]. Joomla CMS is one of the dominant and powerful CMS [10] with the ability to publish [11] and manage large amounts of information [12], has open source, easy use, the ability to limit user access [13], can be customized, has security support, can adapt [14], supports multiple users to work on the same site [15], used for various content management [16] like text, audio, images, videos and other forms of files [17], and runs on many platforms, both Linux, Windows, and MacOS [18].

By looking at the background above, research will be carried out which aims to design a prototype website with the name Bak Sampah Kito (BSK) as an information website for TPS locations in Palembang City using Open Source CMS Joomla. To complete the functionality of the TPS location website, Joomla CMS will use the Phoca Maps supporting extension that suits content needs. Phoca Maps is used in web design because it has map and location content management features and a good visual appearance. Phoca Map is an extension capable of displaying various maps and locations with OpenStreetMap (OSM) [19]. OpenStreetMap (OSM) is a widely utilized Web GIS product in various applications within geoscience, earth observation, and environmental studies [20], including land cover map validation [21], land use classification [22] [23] [24], navigation and routing applications [25] such as traffic estimation and routing for pedestrians, bicycles, and wheelchairs [26] [27], building and road detection in aerial imagery [28] [29], 3D city modeling [30], indoor mapping [31], and location-based map services [32].

This research will be conducted in three stages that refer to the RAD method, namely Requirement Planning, System Design, and Implementation. RAD is a type of Incremental Software Development that is distinguished by a sequence of brief iterative development cycles**.** This research utilized RAD for its rapidity, suitability for projects with a simple and understandable framework, and generally short development time [33].Through this research, it is hoped that we will get results that can provide insight for waste managers to design web-based information media for maps and TPS locations that are easy, precise, and cheap. Apart from that, the research results can be a useful reference for website developers, especially Joomla-based CMS, to maximize map and location extensions in different cases**.**

2 Literature Review

This section entailed the collection of a number of journal articles pertaining to the objectives of the research. Subsequently, a review of pertinent previous research was conducted to serve as a reference. In the first reference, the focus of this research is the development of a Joomla CMS-based website for the use of accepting new high school students. The website aims to provide information to the public regarding the absence of regional restrictions for registering at the school. The research results show that using the website provides convenience and speed in updating school information [34].

The next article is research that focuses on developing a medical library portal using the free and open-source content management system Joomla. The research results show that websites built with the Joomla content management system can be used as an excellent source of reference information, bibliographic services and general library collections. Apart from that, content management features also become very important when websites grow larger [12].

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In the next article, a study raises the topic of designing Joomla CMS-based websites for promotional media use. This research produces a website that can increase the popularity and existence of reading houses for people in a city [35]. Coming up in the other article reference, the research focuses on the use of CMS Joomla for use on official higher education websites. The research results reveal that university websites built using Joomla have good stability, and security, and are easy to update. Besides that, using Joomla can shorten design time [36].

The most recent references suggest that the integration of a Joomla CMS-based website with a map location extension allows users to place markers on the map for each article or page of the site. Incorporating maps and geographical locations into a website can significantly improve its functionality. The inclusion of a map serves to convey essential information about the location of a business or office, provides users with the ability to visualize routes, and offers opportunities for virtual navigation of roadways [19]. In last reference indicates that the use of the Rapid Application Development (RAD) Model in software development is particularly advantageous for projects characterized by a straightforward and comprehensible framework. It consists of requirement planning, user design, construction, and cutover [33].

RAD was first introduced by James Martin in the 90s. James Martin believes that the RAD model is more flexible and adaptable to changing user demands and needs and ensures the quality of rapid development with minimal costs [37]. The RAD Method enables researchers to quickly design, analyze, and implement system alterations. This research is focused on understanding the current knowledge management system and prioritizing the development of efficient and effective solutions through the strategic use of appropriate system development methodologies [38]. Figure 1 illustrates the various stages involved in the implementation of the RAD method.

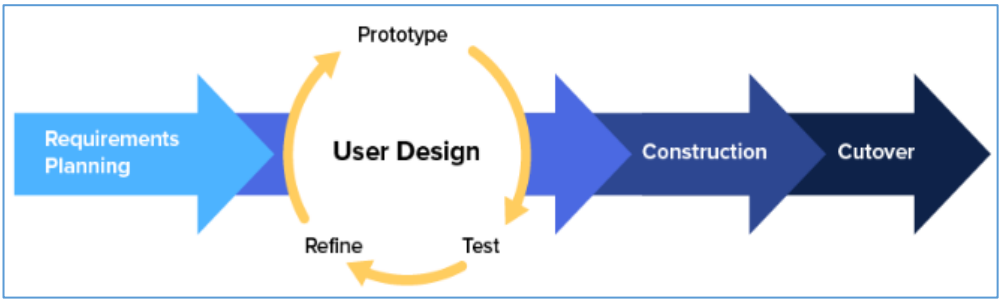

Figure 1. RAD method

This research project, which focuses on the development of a map-based website and location information using Joomla, has the potential to make a significant contribution to the field of web development. By combining the capabilities of Joomla with those of GIS technology and RAD Method, this research can facilitate the creation of innovative and useful web-based applications for a variety of sectors.

3 Research Method

In this research, data was collected through direct and indirect observation. This observation aims to observe an object to obtain accurate information about that object. Direct observation is carried out by directly viewing and observing the location of the waste disposal site (TPS) and matching the location with the coordinates on the map. Meanwhile, indirect observation was carried out by viewing information sourced from the internet related to the use of maps and location features supported by CMS Joomla. In order to web development, Rapid Application Development (RAD) will be used. The RAD method employs an iterative approach, with a particular focus on the rapid completion of development cycles [39]. The research flow plan to be implemented in this study is illustrated in Figure 2.

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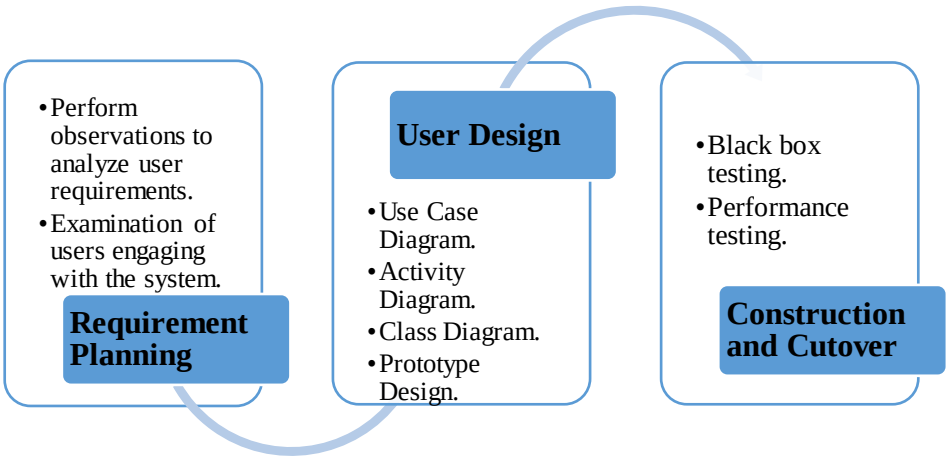

Figure 2. Reseach flow

RAD stages are divided into four parts: requirement planning, user design, construction, and cutover. In the first stage, an analysis will be made of what needs to be prepared in the development of BSK. The next stage is the activity of defining user needs which is carried out repeatedly until the best results are obtained. Furthermore, the results of the definition will be translated into a data model. Data modeling will be described using Unified Modeling Language (UML) diagrams such as use case and activity diagrams. The results of defining the model and process flow will then be applied to the design provided by CMS Joomla. In the final stage, testing of the BSK design is carried out.

Testing the functionality of the website thoroughly is done through black box testing. The functionality of the website, which focuses on input and output faults, will be tested using the Black Box method. By testing the website's functioning without looking into its core operations, this method makes sure that the website responds to user inputs and outputs appropriately and accurately.

4 Results and Analysis

4.1. Requirement Planning

Based on observations obtained directly, the problem is that there needs to be several TPS points in the same area. This is necessary for people around the area to find an alternative TPS if the intended TPS is full or exceeds the waste storage capacity. In addition, a feature is needed to add points in real-time when determining the location of TPS. Table 1 details the needs, requirements, and actors involved.

Table 1. Requirements details

No.	Requirement	Actor	Use Case
1.	Users can search for polling station locations based on polling station names or specific areas.	User	Finding TPS Location
2.	Users can manage content based on specific category names.	Admin BSK	Manage A Content Category
3.	Users can manage location maps based on specific areas.	Admin BSK	Manage Maps Based on Specific Area
4.	Users can manage polling station location markers.	Admin BSK	Manage Markers for TPS Location
5.	Users can manage articles containing maps and polling station location information.	Admin BSK	Manage Articles Containing Maps and Locations

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4.2. User Design

4.2.1. Use Case Diagram

There are 2 actors, namely Admin BSK and User. The diagram shows 6 use cases, namely Login, Manage A Content Category, Manage Maps Based on Specific Area, Manage Markers for TPS Location, Manage Articles Containing Maps and Locations, Logout, and Finding TPS Location. Figure 2 below shows the use case diagram of BSK. Website visitors, referred to as user, can access TPS maps and locations without the necessity of logging into the system. In contrast, Admin BSK / administrators must first log in to manage article categories, area-specific location maps, markers, and articles that include maps and locations.

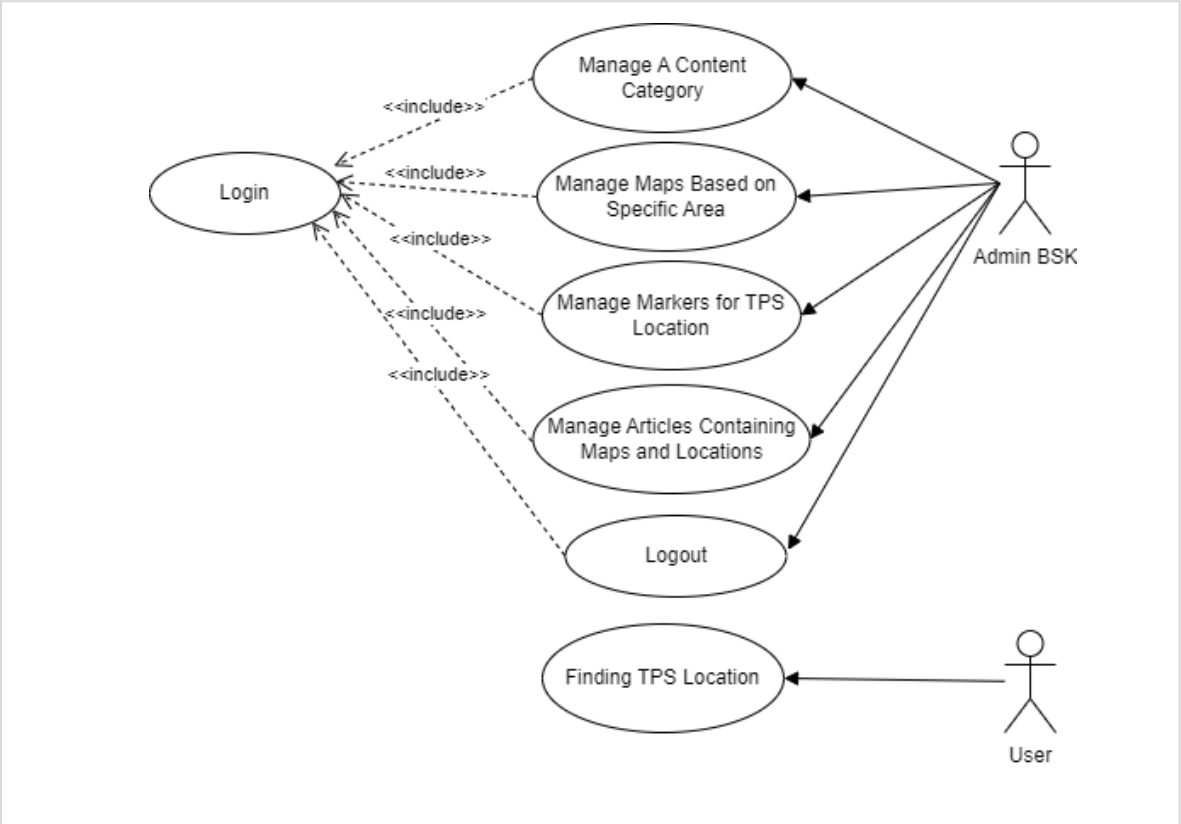

Figure 2. Use case diagram of bak sampah kito

4.2.2. Activity Diagram

To model the system, an activity diagram is created with the aim of describing the activities or workflow of the system. In the context of developing a Joomla-based website, various activity diagram designs are employed to oversee articles that incorporate map content and Phoca map locations. These include the Manage Content Category Activity Diagram, the Manage Map Based on a Specific Region Activity Diagram, the Manage TPS Location Marker Activity Diagram, and the Manage Article Containing Map and Location Activity Diagram. Below are three examples of the activity diagrams that will be created.

Figure 3 illustrates the Activity Diagram for Managing Markers in TPS Location. To create a marker, The administrator initially selects the Phoca Maps extension from the inventory of installed extensions to create a marker. Subsequently, markers may be generated, removed, modified, and published.

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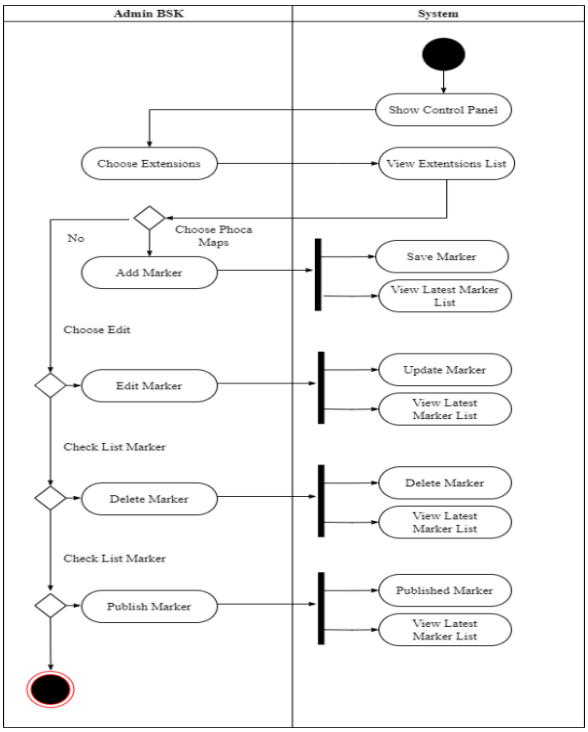

Figure 3. Activity diagram of manage markers for tps location

The next activity diagram is the management of articles containing maps and locations. Figure 4, shows the activity of filling in the article using the Map Id obtained from the map creation in the previous activity.

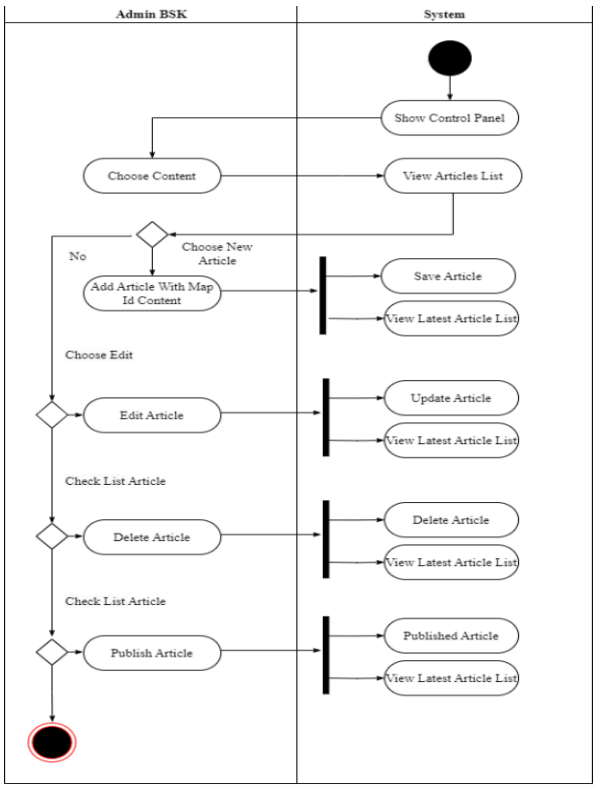

Figure 4. Activity diagram of manage articles containing maps and locations

The last activity diagram in Figure 5 is the Finding TPS Location activity diagram which shows the activity of searching for TPS locations based on certain areas or specific names of TPS.

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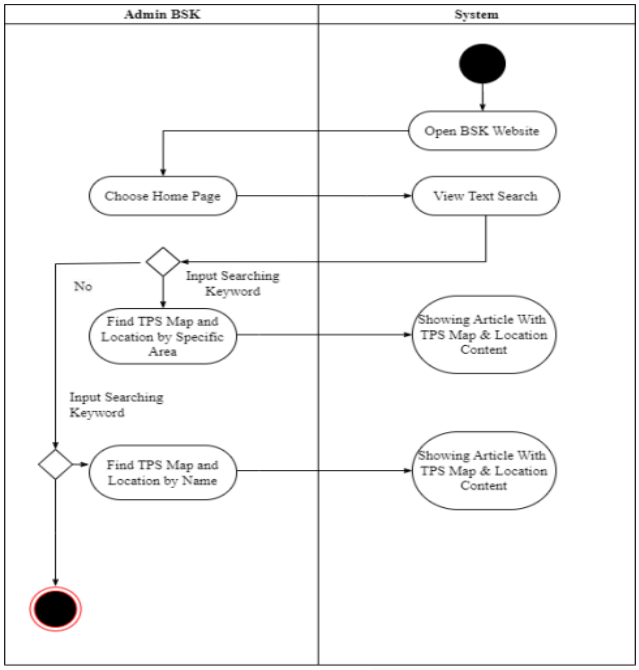

Figure5. Activity Diagram of Finding TPS Location

4.2.3. Class Diagram

The interplay among the various components utilized in the creation of this website encompasses the Content Category, Article, Phoca Maps – Maps, Phoca Maps – Markers, and Ajax Search classes. The Content Category class is intrinsically linked to the Article class, as every article is required to belong to a specific category. This category subsequently serves as the designation for the particular TPS search area. Furthermore, the Article class is associated with the Phoca Maps – Maps class, given that the article's content will include a map. Additionally, the Phoca Maps – Maps class is connected to the Phoca Maps – Markers class, since each map will feature multiple markers indicating the precise locations of the TPS. Moreover, the Article class is related to the Ajax Search class, as the search keywords for TPS locations will correspond with articles that contain maps and markers. Figure 6 Class Diagram of BSK represents the interactions among these components.

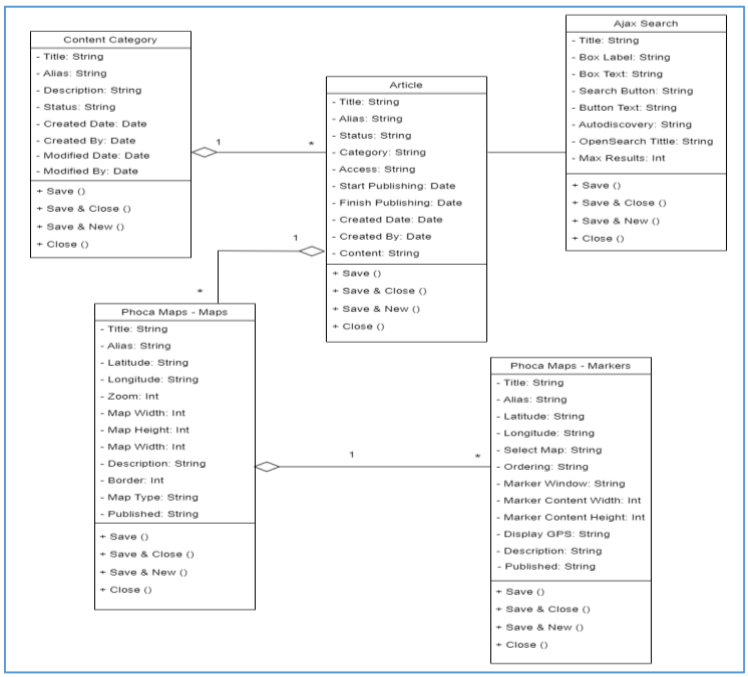

Figure 6. Class diagram of BSK

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4.2.4. Prototype Design

A prototype design was utilized as an initial visual representation to guide the experiment. This design served as a precursor to the final website appearance. The following interface designs were developed for both BSK administrators and website visitors. Figure 7 depicts the interface for specifying particular location map areas.

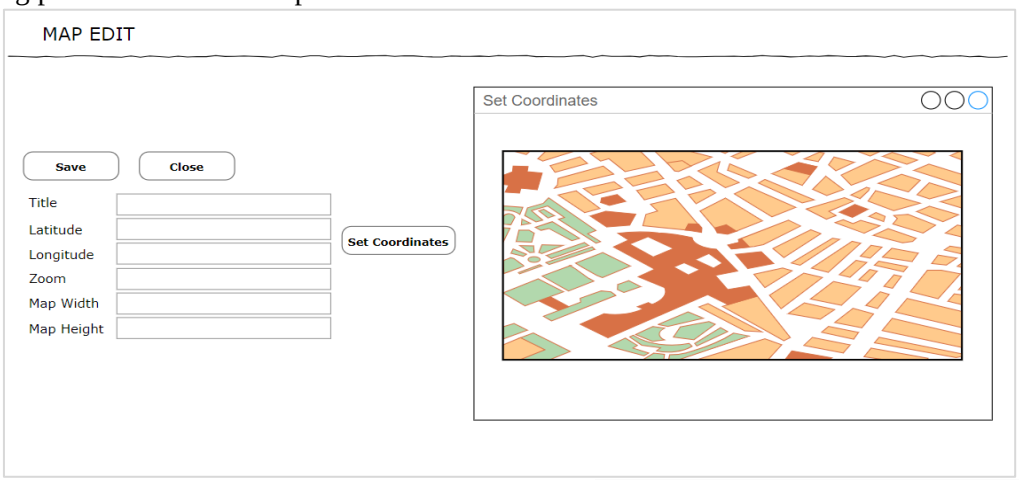

Figure 7. Prototype design of activity diagram of manage maps based on specific area

Figure 8 illustrates the interface design for managing TPS map markers. Markers are TPS location points that are located on the previously created map of the location area. More than one marker can be made and placed on the map of the same location or region. Markers represent specific TPS locations pinpointed on a pre-existing map of the designated area. Multiple markers can be added to a single map, indicating various points within the same location or region. Marker creation can be facilitated by GPS-enabled devices, such as Android smartphones.

GPS technology, a satellite-based system, provides real-time location data and navigation capabilities [40]. By utilizing longitude and latitude coordinates, GPS delivers precise geographic information about the user's position. While GPS is highly effective in outdoor environments, its accuracy may diminish in indoor settings [41]. At this stage, markers are made based on the longitude and latitude coordinate positions of the TPS location. Making markers must be in accordance with the map location created in the previous stage. In order to enhance the information regarding the availability and capacity of waste storage, the BSK administration has the option to incorporate this data into the description available on Phoca Maps. The accuracy of the information presented on the website is directly proportional to the timeliness of the updates made by the BSK administration.

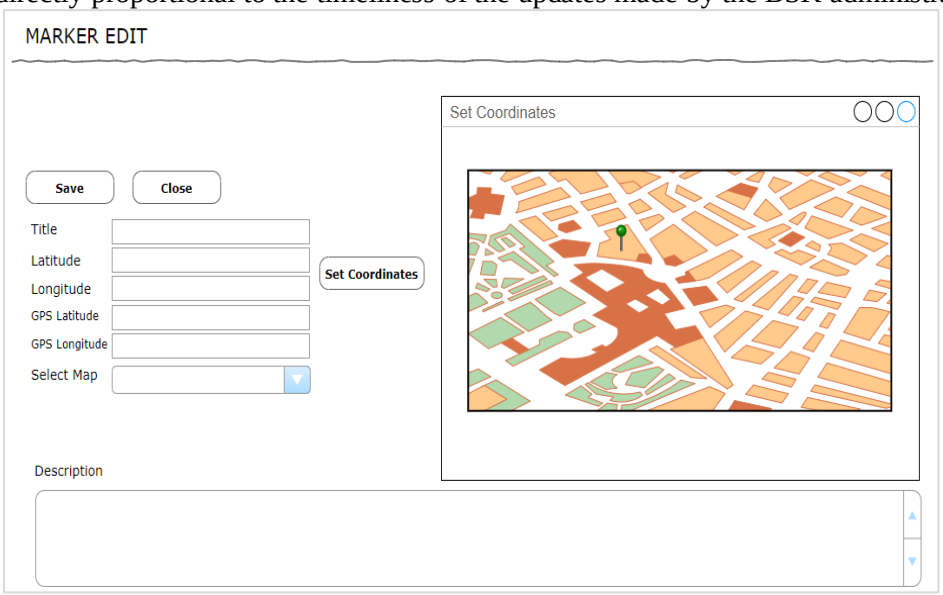

Figure 8. Prototype design of activity diagram of manage markers for TPS location

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Following the completion of the TPS map and marker search interface design, the TPS location search design was established, as shown in Figure 9 below.

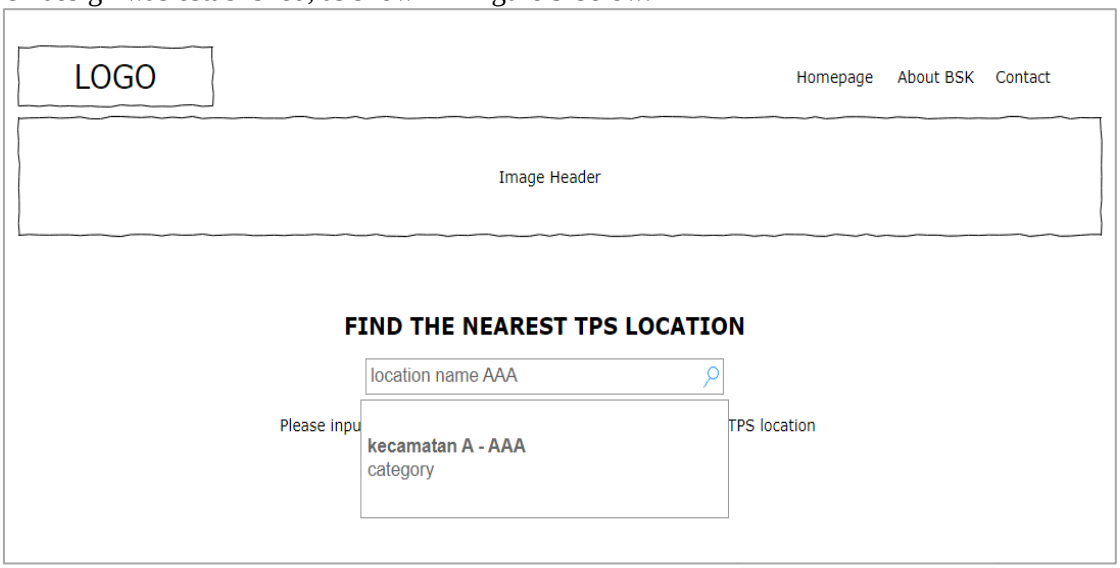

Figure 9. Prototype design of activity diagram of finding TPS location

4.2.4. Construction and Cutover

The subsequent phase entails the construction and evaluation of the system, where feedback will be gathered through testing activities. Testing aims to ensure that the system is ready for use by end users. The purpose of user acceptance testing is to identify and resolve potential issues. At this stage, BSK is tested using blackbox testing to check the features and their functionality. The map and location search interface shown in Figure 10 is designed to provide users with a comprehensive and user-friendly way to search for locations within a specific area, such as the Palembang city area. This interface allows users to filter their searches by various area category, ensuring that they can find the exact locations they are looking for.

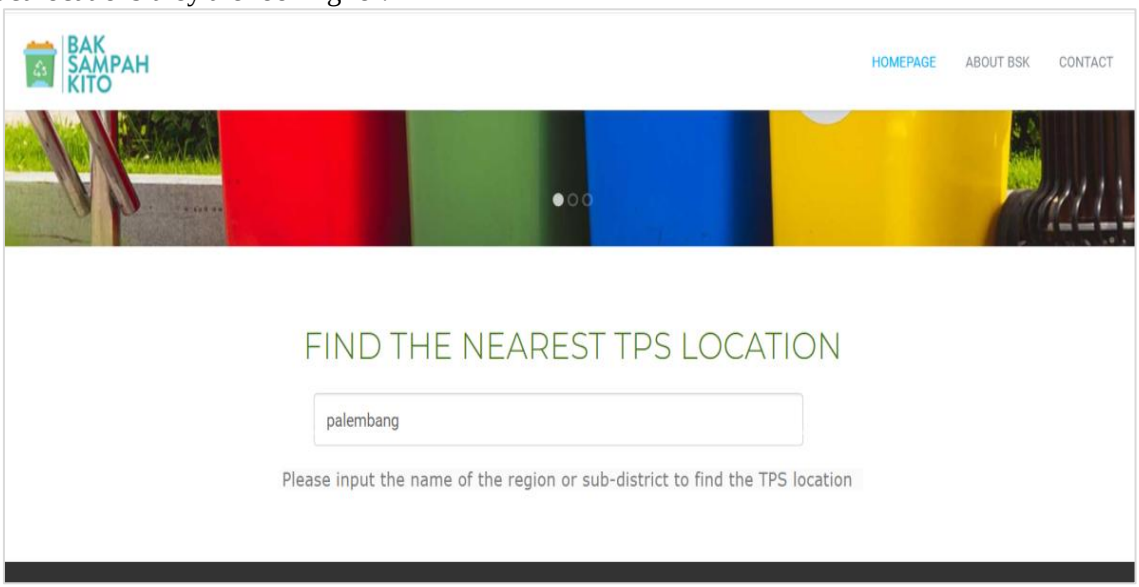

Figure 10. Specific area category search page display

Figure 11 illustrates the results page for searching maps and locations based on specific area categories. This page provides a comprehensive overview of the search results, allowing users to quickly identify and navigate to the desired locations. The layout is designed to be user-friendly, with clear headings and intuitive navigation.

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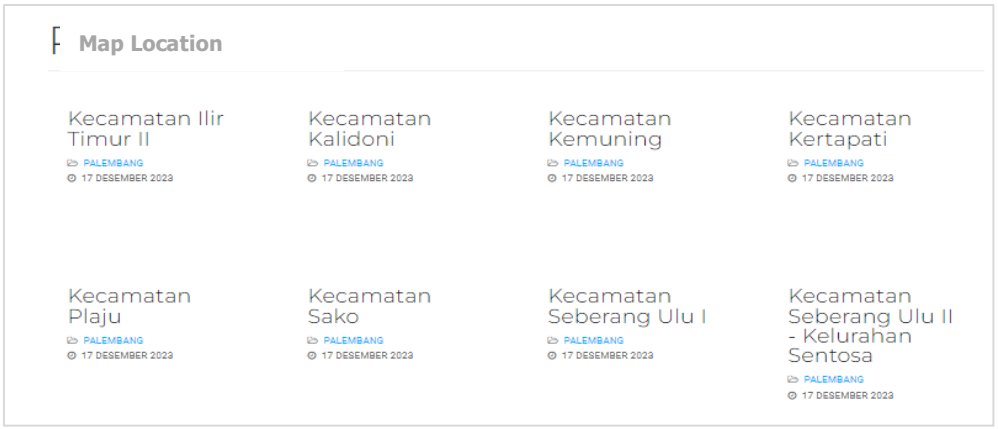

Figure 11. Specific area category search page display

Figure 13 displays the results of selecting a link from a pre-selected list of specific area categories. This page provides a detailed and focused view of the selected category, allowing users to delve deeper into the specific locations and information they they want to find.

Figure 12. Display of link results one specific area category

The results of testing map functionality and location search based on specific area types are shown in Table 2 below. This table provides a comprehensive summary of the test results, highlighting the map feature's effectiveness in locating and displaying relevant locations within the specified categories.

Table 2. Test map and location search functionality based on specific area categories

Testing Activities	Expected realization	Test result	Conclusion
Enter the category name in the search text.	Displays map and location data based on categories appropriate to the input	According to Purpose	Valid
Pressing the name of the selected category.	Displays a list of map and location data based on the selected category name.	According to Purpose	Valid
Enter the category name in the search text	Displays map and location data based on categories appropriate to the input.	According to Purpose	Valid

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Additionally, the effectiveness of the search results remains a critical issue. To assess this effectiveness, performance testing was performed using the Google Lighthouse tool, which includes measurements of First Contentful Paint (FCP) time, Speed Index, Largest Contentful Paint (LCP), Total Blocking Time (TBT), and Cumulative Layout Shift (CLS) [19]. The findings reveal a performance score of 82 for mobile devices and 88 for desktop devices. Figure 13 below presents the performance results for mobile devices.

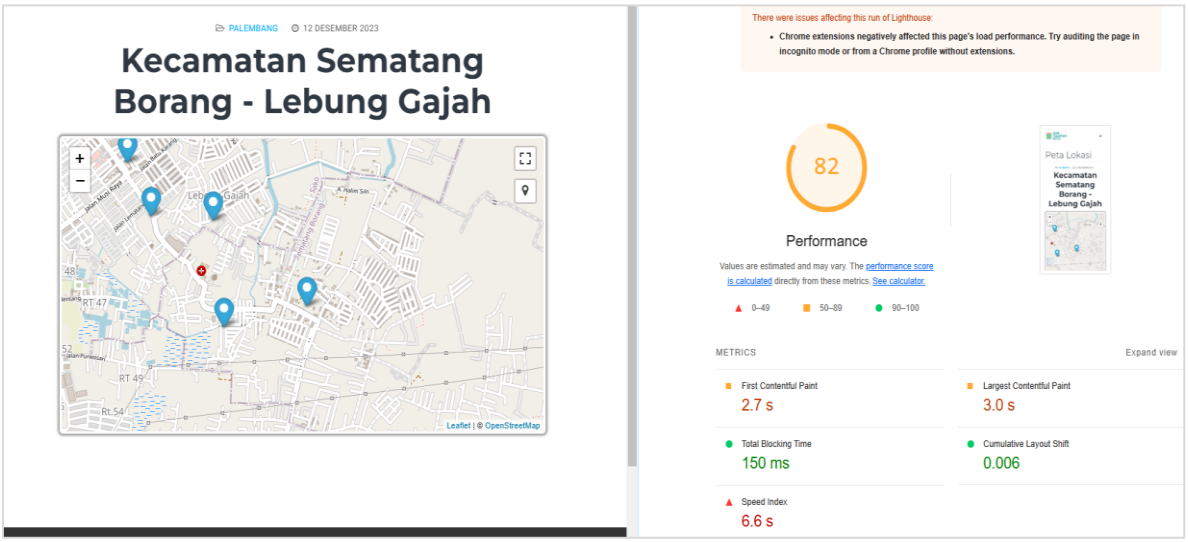

Figure 13. Performance results for mobile devices

Figure 14 depicts the map and location search interface of the article, which allows users to search for specific TPS locations by name. This interface integrates maps with detailed location information, enabling users to quickly locate and navigate to the desired TPS locations with ease.

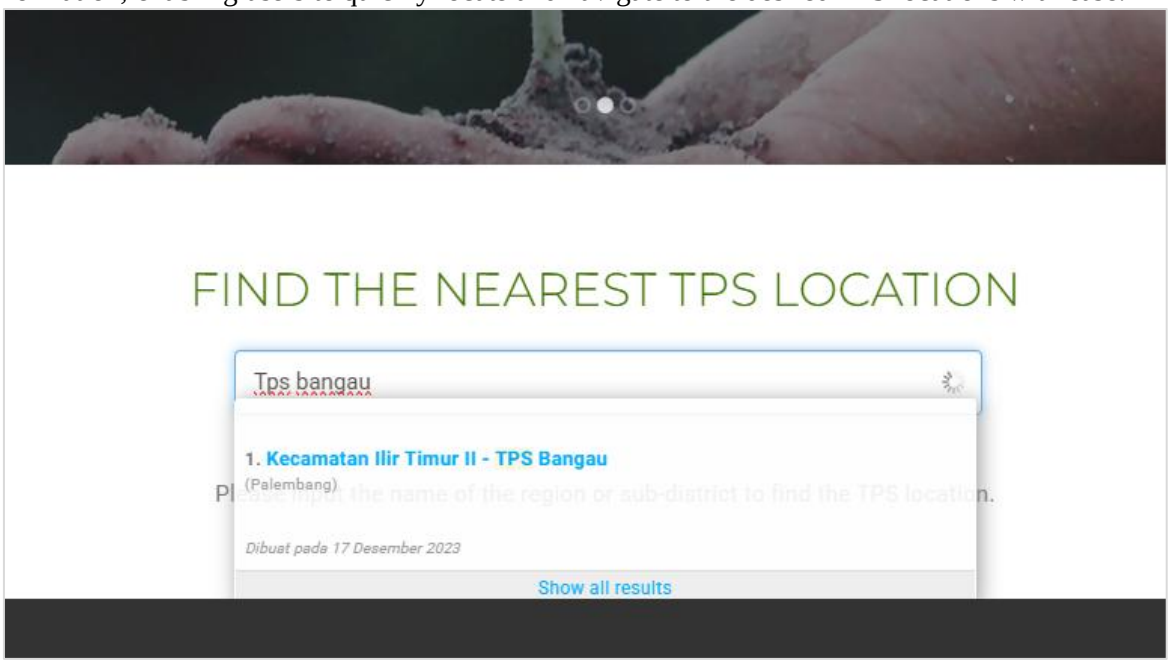

Figure 14. Search page display based on TPS name

Figure 15 below illustrates the map and location search results page, providing a comprehensive overview of the search results. This page provides information that allows users to quickly identify desired locations based on their search criteria.

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Figure 15. Search results page display based on TPS name

The results of the test map and location search functionality based on the TPS name are shown in Table 3. This table explains a detailed summary of the search outcomes, highlighting the effectiveness of the search functionality in locating and displaying relevant TPS locations based on their names.

Table 3. Test map and location search functionality based on TPS name

Testing Activities	Expected realization	Test result	Conclusion
Enter the TPS name in the search text.	Displays map and location data based on the TPS name that matches the input.	According to Purpose	Valid
Pressing the name of the selected TPS.	Displays articles containing map and location based on the name of the selected TPS.	According to Purpose	Valid

Performance results reveal a score of 66 for mobile devices and a score of 84 for desktop devices. Figure 16 presented below depicts the performance outcomes specifically for desktop devices.

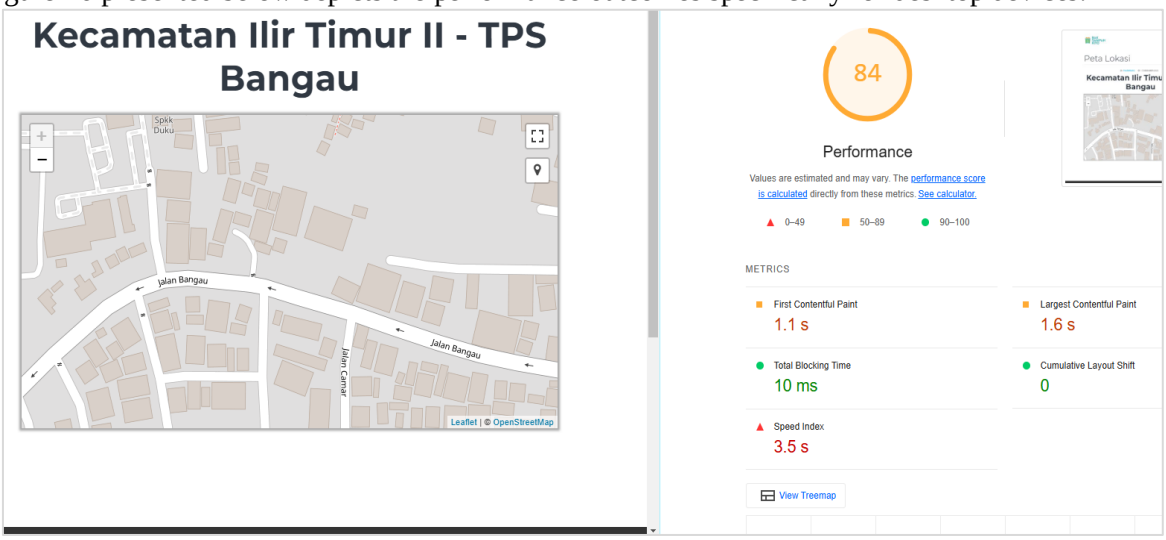

Figure 13. Performance results for desktop devices

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5 Conclusion

The findings from the research underscore the practicality of the BSK Website, which is designed with an accessible interface and management system that allows for the quick and accurate presentation of map data associated with TPS locations. These results are in accordance with the research goals, which aim to establish a TPS information website based on geographical mapping and location specifics. Furthermore, the general functionality tests support these findings, indicating that the website operates successfully. This research offers an alternative viewpoint regarding the application of Joomla CMS and the types of content it can manage. The scope of processable content extends beyond the traditional text and images typically examined in earlier studies, incorporating elements such as maps and geographical data. The integration of TPS maps and location details, facilitated by Joomla CMS and the Phoca Maps extension, presents numerous benefits, including enhanced ease of development, practicality, and cost-effectiveness in design. The forthcoming challenge that requires focus is the necessity for managers to consistently oversee and disseminate information that remains current. Data regarding the availability or capacity of waste storage must be accurate and aligned with the real-time conditions observed in the field.

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