WEBGIS-BASED GEOGRAPHICAL INFORMATION SYSTEM FOR MAPPING BAKERY SHOPS IN KISARAN CITY

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Abstract: Bakery MSMEs in Kisaran City play a significant role in the local economy, but their distribution data is still managed manually, making it difficult to access and analyze. This study aims to develop a WebGIS-based Geographic Information System to map and manage bakery MSME data digitally and in an integrated manner. The research methods include field surveys, spatial and non-spatial data collection, system design using UML, development with Leaflet.js and MySQL, and testing using the blackbox method. The results show that the resulting system is capable of displaying interactive maps with location details, business information, and an easy-to-use search feature. This system makes it easier for the government, business actors, and the public to access MSME information and supports data-based economic development planning. With the output in the form of publications in accredited journals, this research is expected to be an effective solution for MSME data management in other regions.

Keyword: bakery; mapping; MSME; WebGIS

Abstrak: UMKM toko roti di Kota Kisaran memiliki peran penting dalam perekonomian lokal, namun data persebarannya masih dikelola secara manual sehingga sulit diakses dan dianalisis. Penelitian ini bertujuan mengembangkan Sistem Informasi Geografis berbasis WebGIS untuk memetakan dan mengelola data UMKM toko roti secara digital dan terintegrasi. Metode penelitian meliputi survei lapangan, pengumpulan data spasial dan non-spasial, perancangan sistem menggunakan UML, pengembangan dengan Leaflet.js dan MySQL, serta pengujian menggunakan metode blackbox. Hasil penelitian menunjukkan sistem yang dihasilkan mampu menampilkan peta interaktif dengan detail lokasi, informasi usaha, dan fitur pencarian yang mudah digunakan. Sistem ini mempermudah pemerintah, pelaku usaha, dan masyarakat dalam mengakses informasi UMKM, serta mendukung perencanaan pembangunan ekonomi berbasis data. Dengan luaran berupa publikasi pada jurnal terakreditasi, penelitian ini diharapkan menjadi solusi efektif untuk pengelolaan data UMKM di daerah lain.

Kata kunci; pemetaan; toko roti; UMKM; WebGIS

INTRODUCTION

Advances in Geographic Information System (GIS) technology have brought about significant transformations in the management and analysis of spatial data. [1]. SIG enables users to efficiently collect, store, analyze, and visualize geographic data [2]. In recent decades, GIS has been widely applied in various fields, such as urban planning, disaster management, transportation, and economic development [3]. Its ability to present spatial information interactively and in real time makes GIS a very useful tool for supporting data-driven decision making [4].

One of the latest innovations in GIS technology is the development of WebGIS, a GIS system that is accessed through a web-

based platform [5]. WebGIS allows users to access geographic data without having to install special software, making it more flexible and easier to use [6]. This technology has been widely used for mapping various objects, such as public facilities, business locations, and population distribution [7]. In the context of MSMEs, WebGIS can be an effective tool for mapping and monitoring the distribution of small and medium-sized businesses, including bakeries, which are one of the fastest-growing MSME sectors in various regions [8].

In Kisaran City, North Sumatra, small and medium-sized bakery businesses have become one of the drivers of the local economy. The number of bakeries continues to grow in line with increasing public demand for bread-based food products [9]. However, to date, there is no integrated system that can map and monitor the development of these businesses. Data on the location, type of product, and business conditions of bakeries is still scattered and managed manually, making it difficult for relevant parties to analyze and plan for the development of MSMEs [10].

The relevant parties that benefit from the proposed system include local government, business owners, the community, and customers. For the government, the system supports the formulation of more accurate, data-driven policies for MSME development. For business owners, it serves as a digital promotion platform that expands market reach and enhances competitiveness. Meanwhile, for the community and especially customers, the system provides convenience in locating the nearest bakery shops, viewing available products, and quickly accessing contact information. Thus, the urgency of this system lies in its role in enhancing transparency, accessibility, and efficiency in interactions between MSMEs, the government, and customers.

The main problem faced is the lack of access to integrated spatial and non-spatial data on MSME bakeries in Kisaran City [11]. This hinders the government's efforts to

formulate MSME development policies, as well as making it difficult for businesses to promote their products and for the public to find their nearest bakery [12]. In addition, the absence of a digital mapping system also makes it difficult for investors to identify business potential in the area. Therefore, a solution is needed that can digitally integrate data on MSME bakeries and present it in an easily accessible form [13].

The solution offered in this study is the application of a WebGIS-based Geographic Information System (GIS) for mapping MSMEs bakery shops in Kisaran City. By utilizing WebGIS technology, the locations of bakery shops can be mapped digitally and equipped with detailed information such as business name, address, product type, and business conditions [14]. This system also enables spatial analysis, such as identifying areas with the highest concentration of bakeries or areas that still require MSME development [15]. In addition, WebGIS can be accessed by various parties, including the government, business actors, and the community, thereby increasing the transparency and efficiency of MSME data management [16].

Based on the above description, this study was designed to develop a WebGIS-based Geographic Information System (GIS) for mapping MSMEs of bakeries in Kisaran City. Through this research, it is hoped that a platform can be created that is capable of providing integrated, accurate, and easily accessible spatial and non-spatial data. Thus, this system not only supports the development of MSMEs, but also contributes to better economic development planning in Kisaran City.

Previous studies on MSME information systems generally focused on providing product information or business profiles without integrating them with web-based location. Furthermore, some studies were developed within a limited scope and did not emphasize real-time accessibility for customers. This research addresses that gap by presenting a web-based information system that integrates MSME data with

location-based services, enabling customers to easily locate shops, view products, and interact with business owners. The novelty of this study (state of the art) lies in the implementation of a system that not only supports MSME promotion but also provides added value for customers and local government by facilitating data-driven decision-making.

METHOD

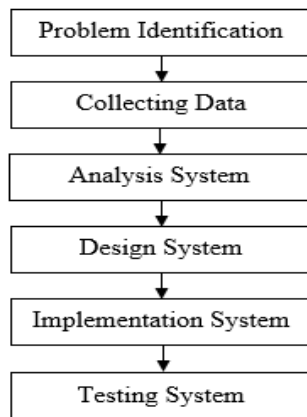This study has several stages, which can be seen in Figure 1 below.

Image1. Research Stage

Explanation of the research stages:

Problem Identification

At this stage, the researcher examined the conditions of bakery MSMEs in Kisaran City that still face challenges in promotion and customer information dissemination. The main problems identified were the lack of digital promotion media, unintegrated data recording, and customers' difficulty in finding store locations. Identification was conducted through direct observation and preliminary discussions with MSME owners.

Collecting Data

Data were collected using two methods: questionnaires and interviews. Questionnaires were distributed to 50 customers to understand their information needs regarding products, store locations, and services. Interviews were conducted with 10 bakery MSME owners to gather data on business profiles, types of products offered, marketing obstacles, and expectations for the system. Additional supporting data, such as store location coordinates, were obtained through field surveys.

Analysis System

The collected data were analyzed to define the system requirements. Functional requirements included features such as store search, LBS-based map display, and product catalogs. Non-functional requirements were also defined, such as mobile accessibility, system response speed, and data security. This analysis served as the basis for the system design.

Design Sistem

Based on the analysis, the system was designed using a web-based architecture. The design included a database structure to store MSME, product, and location information; a user interface design to ensure customer usability; and integration of Location-Based Service (LBS) features to display store locations in real-time.

Implementation System

In this stage, the design was implemented into a web-based application. The implementation process included database development, coding of main features (MSME registration, product catalog, store search, and mapping services), and integration with map APIs to dynamically display store locations.

Testing System

The completed system was tested using the black-box testing method to ensure that each feature worked as intended. Testing involved representatives of MSME owners and customers to assess information clarity, ease of access, and system speed. The results of testing were then used to evaluate whether the system met stakeholder needs and was ready for operational use.

RESULT AND DISCUSSION

Design System

The system design was carried out to describe the general design of the WebGIS for mapping MSMEs in Kisaran City before the implementation stage. This design aims to ensure that the system can meet the functional and non-functional needs of users. The following is the WebGIS design using a use case diagram.
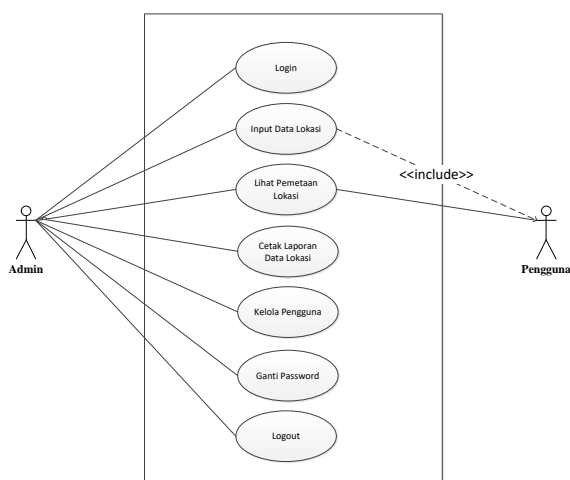

Image 2. Use Case Diagram WebGIS

Scenario Use Case Diagram

Prior to system development, a use case design was created to describe the interaction between users and the system. The use cases were developed based on survey and interview findings with customers and MSME owners, ensuring that they represent the actual needs to be addressed by the system. Each use case scenario explains the actors involved, the interaction steps, and the expected system output. This modeling process helps clarify and structure the system workflow. The detailed use case scenarios are presented in Table 1 and 2.

Table 1. Scenario Use Case

Use Case Name	Actor	Description
Login	Admin, User	Authentication process for login into the system.

Use Case Name	Actor	Description
Input Data Location	Admin	Entering spatial and non-spatial data for bakeries.
View Map Location	Admin, User	Displaying an interactive map of bakery locations.
Print Data Location Report	Admin	Displaying an interactive map of bakery locations.
Manage User	Admin	Managing user account data.
Change Password	Admin	Change the Admin account password.
Logout	Admin	Log out of the system.

The system testing results demonstrate that the integration of Location-Based Service (LBS) into the web-based application effectively improves customer convenience in locating bakery shops, viewing available products, and accessing information in real-time. This finding is consistent with [1] who revealed that web-based information systems can support MSME promotion effectiveness and expand market reach.

It is also supported [2], who emphasized that digital information systems positively impact customer access to product information. Furthermore, [3] found that integrating location-based services into public information applications enhances both access speed and information accuracy. Therefore, the findings of this research reinforce the evidence that implementing a web-based system with LBS integration has practical urgency in improving MSME promotion while facilitating customer access to business information.

Implementation System

Registration Menu

This menu is used to register as a new user by filling in the username and password in the fields provided.

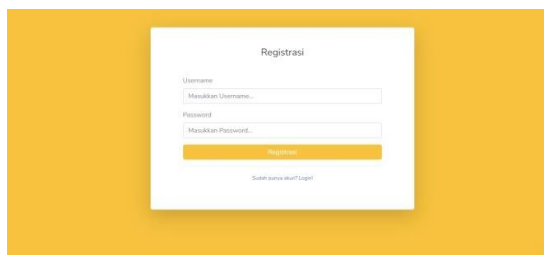Image 3. Registration Menu

Input Location Menu

In this menu, the admin inputs the locations of any UMKM Toko Roti (bakeries) in the Asahan Regency area. The data entered includes the location name, location address, operating hours, payment methods, telephone number, and photos of the bakery.
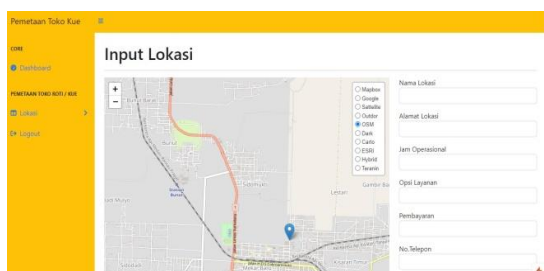

Image 4. Input Location Menu

Mapping Location Menu

After the admin inputs the location coordinates, users can see where MSMEs, especially bakeries, are located in the system. Markers are provided to make it easier to see the location points.
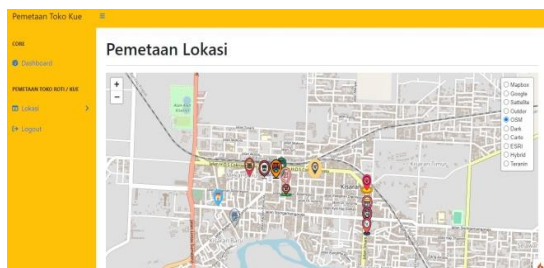

Image 5. Mapping Location Menu

Detail Mapping Location Menu

When the coordinates have been entered, information will be displayed to the user. The information displayed corresponds to what was entered previously.
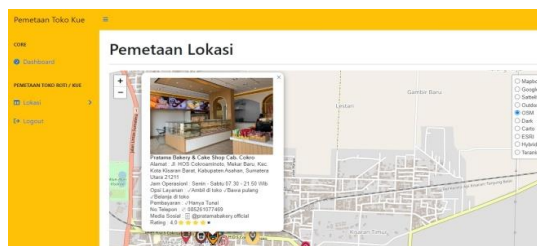

Image 6. Detail Mapping Location Menu

Data Location Menu

In this menu, administrators can manage location data, such as changing previously entered information and deleting locations that are already registered in the WebGIS system.
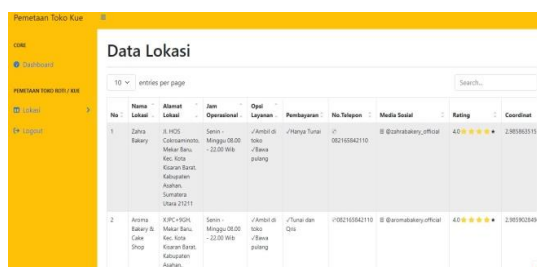

Image 7. Data Location Menu

As shown in Table 1, each use case scenario describes the roles of the actors and the flow of interactions within the system. These scenarios serve as a reference in designing the core functions, such as MSME location search, product catalog management, and access to contact information. By establishing these use cases, user requirements can be mapped more clearly, ensuring that system development is focused on features that are truly essential for both customers and MSME owners.

In the implementation stage, the web-based bakery MSME information system was developed by emphasizing the main user needs identified from surveys and interviews. The LBS-based map feature was designed because customers reported difficulties in quickly locating bakery shops. This feature allows customers to instantly view the nearest shop's position through digital map integration.

Next, the product catalog feature was developed based on input from MSME

owners who wished to display product variations and prices more transparently to customers. This directly addresses the gap in previous studies, which generally focused only on business profiles without providing product details.

In addition, the contact and store information feature was designed to facilitate direct communication between customers and business owners. This resolves the problem of limited manual promotion, which previously relied heavily on face-to-face interaction or word-of-mouth.

Thus, each implemented feature is not merely a user interface display but a solution closely aligned with user needs and research findings. It addresses the identified research gap, namely the lack of accessible information and limited promotion media for MSMEs.

Testing System

After the geographic information system has been designed and developed, the next step is to test the system using the Blackbox method. This test aims to ensure that every function in the system runs according to the specified requirements and specifications.

The Blackbox method was chosen because it focuses on testing the functionality of the system without looking at the internal structure of the code, so that it can assess whether the system responds correctly to the given input and produces the expected output.

The testing was carried out directly by internal stakeholders, namely Deskranasda Asahan. This was done to obtain feedback from end users regarding the accuracy of features, ease of use, and the suitability of the system to the workflow in the field. For more detailed test results, see Table 3 and 4.

Table 2. Blackbox Testing

Testing	Types of Testing	Testing Result
Input Data Location	Input Coordinate and Upload Photo	Successful
View Map Location	Click Marker Location	Successful
Print Data Location Report	View Report and Convert To Excel	Successful
Manage User	Select Register User and Make Change Data	Successful
Change Password	Change User Password	Successful
Logout	Click Logout Menu	Successful

As shown in Table 2, the testing results indicate that all the main system features were successfully executed according to the test scenarios, with no significant errors found. This demonstrates that the system is capable of performing its core functions, including displaying MSME information, product catalogs, LBS-based locations, and business contact details. The successful blackbox testing confirms that the developed system has met the functional requirements defined during the analysis and design stages and is ready to be used by end users.

CONCLUSSION

This study successfully developed a web-based information system for bakery MSMEs integrated with Location-Based Service (LBS), addressing the problems of limited promotion and customer access to information. The system provides store location search, product catalog, and contact information features, enabling customers to find bakery MSMEs quickly and accurately. The results of blackbox testing indicated that all core functions performed according to user requirements, confirming that the system meets the research objectives and delivers real benefits to both MSME owners and customers.

The system serves not only as a digital promotion medium for MSMEs but also as a decision-support tool for stakeholders through data-driven insights. Therefore, this research highlights the practical urgency of applying web and LBS technologies to strengthen MSME competitiveness.

Suggestions: Future research may enhance the system by developing a mobile application for broader accessibility, integrating online payment systems, and adding sales data analytics to support business strategy planning. Furthermore, more comprehensive evaluation methods, such as testing with a larger user base, could be conducted to measure the system's effectiveness more thoroughly.

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