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Information System for Batik Small and Medium Enterprises (SMEs): Implementation of 3D Maps as a Means of Promotion and Ease of Access to Information

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Abstract— *Competition to improve and optimize existing systems to achieve targeted results in an industrial ecosystem is increasingly fierce. This also applies to the Micro, Small, and Medium Enterprises (MSMEs) in Yogyakarta's batik industry. From the consumer's perspective, access to location information is crucial for evaluating the conditions and products of MSMEs. On the other hand, for MSMEs, an increase in consumer visits translates to higher sales. Facilitating the availability of information is a key strategy to attract more visitors to MSMEs, both through direct visits to physical stores and virtually via online shopping platforms. One critical type of information is spatial data (space/position), which consumers use to locate MSMEs. A technological approach, such as website-based spatial access, is expected to meet this need. This study aims to enhance the accessibility of information for all stakeholders, including consumers and other participants in the batik industry ecosystem. It also enables batik MSMEs to optimize promotional strategies, increasing visitor numbers and product sales. This research applied the concept of 3-dimensional visualization to represent the locations of Batik MSMEs in Yogyakarta City and developed an information system for these businesses. The data includes spatial data and attributes, such as a list of MSMEs and detailed information. The information system was developed by integrating MSME location data with MapboxGL (a web app service) to provide a realistic 3D visualization of MSME locations. The final output is a website-based information system freely accessible online to various stakeholders, including consumers, policymakers, and institutions.*

Keywords*: Batik, MSME, Geospatial Information System, 3D Map, geo-visualization*

I. INTRODUCTION

The rapid development of technology and information has become integral to daily activities, supporting various industries in innovating and optimizing existing systems to achieve targeted results [1]–[4]. This phenomenon is also evident in the Micro, Small, and Medium Enterprises (MSMEs) of the batik industry [5]–[10]. Yogyakarta has many MSMEs spread across various regions, with batik MSMEs being a favorite among the public. [6], [11], [12]. Despite this, many batik MSMEs still rely on offline promotion through physical stores, while others have started leveraging social media and e-commerce platforms. From the consumer's perspective, access to location information is essential for assessing the conditions and products of these MSMEs. Optimally packaged information could attract more consumers to visit physical stores or explore online platforms [13]–[15].

Facilitating access to information is a crucial strategy to increase visits to MSMEs, whether directly (to physical stores) or virtually (via online shopping platforms). Spatial data, such as the geographical location of MSMEs, plays a critical role in enhancing the visibility of these businesses. The concept of geo-visualization, particularly in 3-dimensional (3D) formats, offers a promising alternative to improve the visual appeal and promotional value of such information [16], [17]. Through geovisualization, consumers can physically visit or view photos/videos of batik MSMEs online and visualize the exact locations of these businesses. The integration of 3D geovisualization into GIS offers additional advantages [18]–[23]. By incorporating elevation data and realistic visual models, 3D geovisualization enhances user engagement and provides more comprehensive insights [23], [24]. Recent advancements in software tools, such as QGIS with the Qgis2threejs plugin, have made it possible to create interactive 3D models accessible through web platforms.

This study aims to apply 3D geo-visualization concepts to the locations of batik MSMEs in Yogyakarta City and to develop a website-based information system for these businesses. The expected benefits include creating a modern promotional method that simplifies access to information for consumers and other stakeholders within the batik industry ecosystem. Accessible and comprehensive information is anticipated to enhance the marketing effectiveness of Yogyakarta's batik MSMEs, ultimately increasing visits and sales.

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II. RESEARCH METHODS

2.1 Materials and Tools

The materials used in this study included a sample dataset from 24 batik MSMEs in Yogyakarta City, such as Gee Batik, Puji Batik Antik, and Batik Canting Mas. The tools used for system development included:

Hardware:

a. Laptop with Intel i5-1135G7 processor, 24 GB RAM, and 512 GB storage.

Software:

a. Windows 11 as the operating system.
b. XAMPP version 8 for local server deployment.
c. MySQL as the database server.
d. PHP version 8 and Laravel version 9 as the programming framework.
e. Visual Studio Code as the programming editor.
f. Mapbox GL for 3D map visualization.
g. QGIS 3.22.10 with the QGIS2ThreeJs plugin for 3D visualization.
h. Balsamiq for interface design.
i. Google Chrome as the web browser.

2.2 Procedures

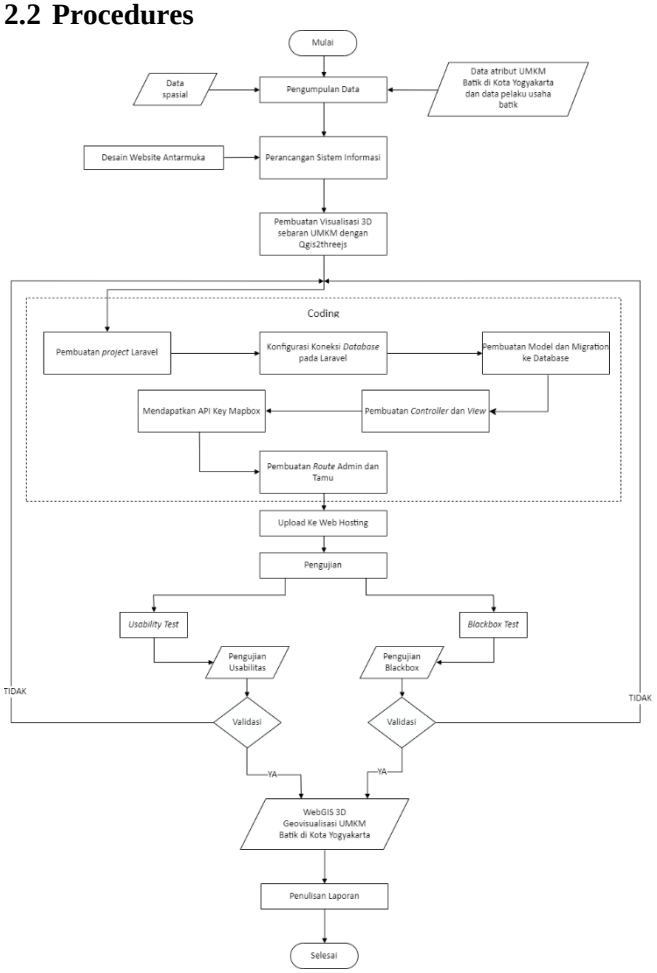

Figure 1. Research Flowchart

2.2.1 Data Collection

Data was collected through online and field surveys, supplemented with interviews to gather information on 24 batik MSME locations. The data included MSME names, geographic coordinates (latitude and longitude), addresses, and business scale of each MSME. The data was converted into shapefiles and enriched with attribute information, enabling detailed visualizations of each MSME location.

2.2.2 Interface Design

The interface was designed using Balsamiq, a prototyping tool for creating wireframes of user interfaces. The homepage was designed to display a 3D visualization of MSME locations using QGIS2ThreeJs and provide online map-based route information. Features included options for users to view MSME details, reset the interface, and access navigation routes.

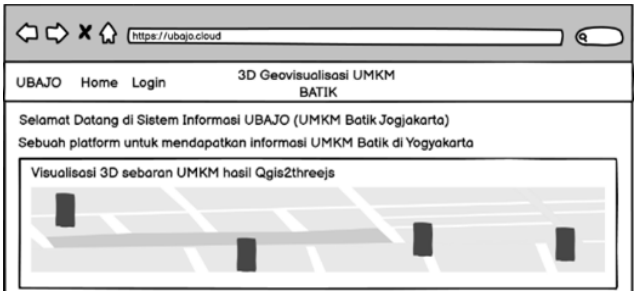

Figure 2. 3D Visualization Homepage Design for Batik MSMEs

The admin uses the admin login form to access the system. This form consists of two fields: one for entering an email address and another for the password, along with a sign-in button to execute the login command. The design of this login form can be seen in Figure 3.

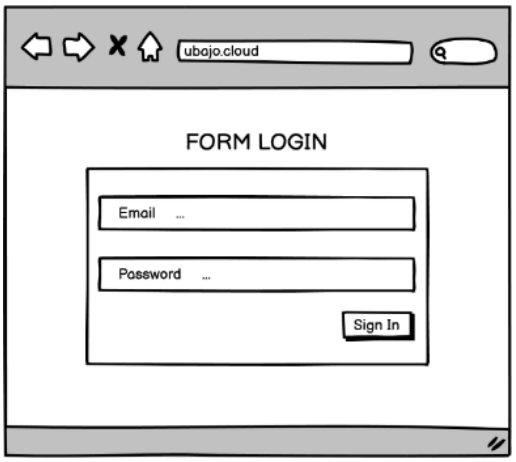

Figure 3. Design Admin Login Form

The homepage on the dashboard is designed to provide an overview and quick access to the website's main features. The homepage design can be seen in Figure 4. The admin data page is where the admin can manage information related to administrators. This page

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displays details such as the admin's name and email. The design of the admin data page can be seen in figure 5

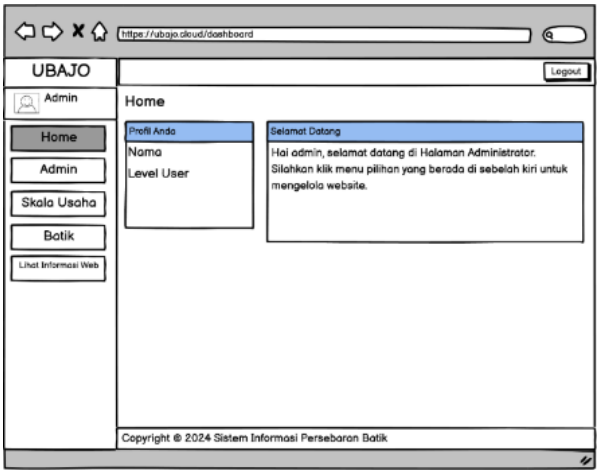

Figure 4. Homepage Design

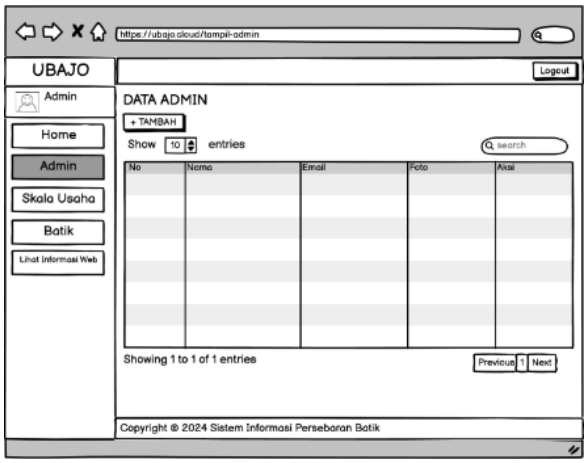

Figure 5. Admin Data Page Design

The admin uses the business scale data page to manage available business scale information. This page only displays the details of the business scale names. The design of the business scale data page can be seen in Figure 6. The admin uses the batik data page to manage batik-related information. This page displays the batik name, coordinates, address, and business scale. The design of the batik data page can be seen in Figure 7.

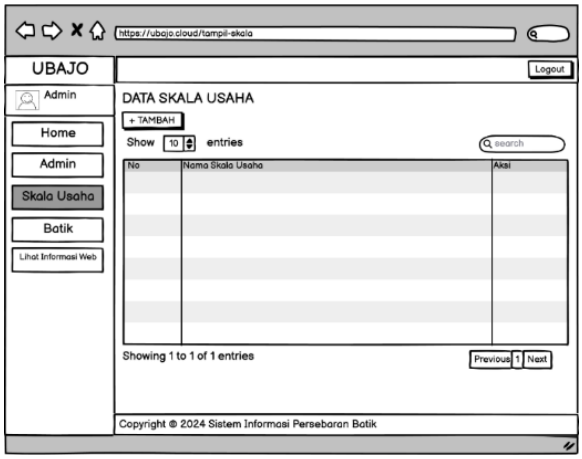

Figure 6. Business Scale Data Page Design

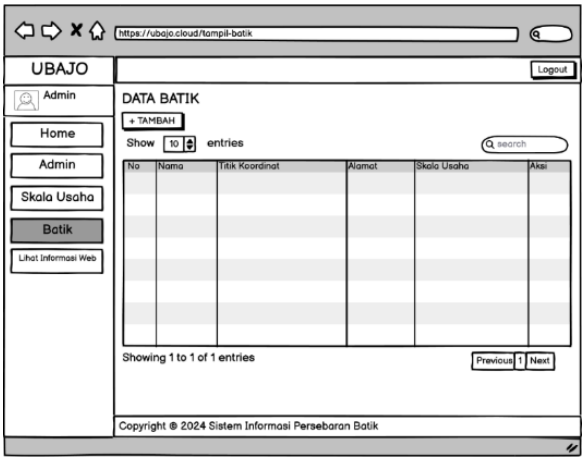

Figure 7. Batik Data Page Design

2.2.3 3D Visualization

The 3D visualization of MSME locations was created using QGIS software and the QGIS2ThreeJs plugin, which supports WebGL technology and the JavaScript library Three.js. The exported 3D visualization results (Figure 8) were integrated into the WebGIS system, enabling users to access spatial information online.

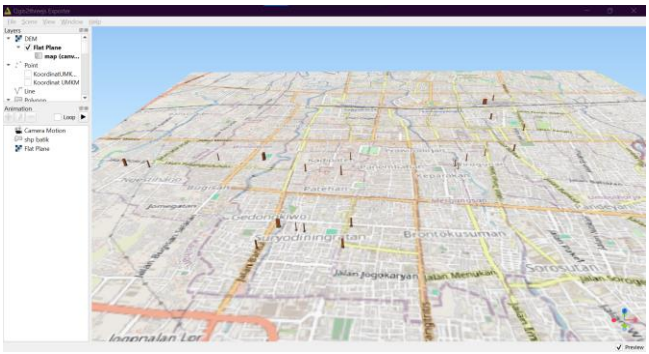

Figure 8. Creation of 3D Visualization of MSME Distribution Using qgis2threejs

2.2.4 Coding and Web Development

The system's backend was developed using PHP and Laravel. Initial steps included creating a Laravel project, setting up the database, and establishing

connectivity with PHPMyAdmin. The MVC (Model-View-Controller) architecture guided the development, with controllers managing data flow and views handling the user interface. Mapbox API integration enabled interactive maps, while routes were configured to support admin and public interfaces. The completed system was uploaded to a hosting service via CPanel for public accessibility.

2.2.5 System Testing

System testing comprised usability and functional:

a. Usability Testing: Conducted with 30 respondents using a Likert scale questionnaire to assess user satisfaction and system effectiveness.

Table 1. Admin Questions System Testing

No	Question	Options
1	The system can improve the effectiveness of managing batik distribution.	Skala Likert: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
2	The system makes it easier for the admin to manage batik data.	
3	The system helps the admin in mapping batik locations.	
4	The system meets the admin's expectations.	
5	The system can be operated with minimal steps.	
6	The system can be used without difficulty.	
7	The system can be used easily, both in occasional and routine situations.	
8	The admin learns quickly how to use the system.	
9	The information delivery is easy to understand and comprehend.	
10	The admin is satisfied with the system.	

Table 2. User Questions System Testing

No	Question	Options
1	This system has provided the accurate information needed by users.	Skala Likert: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree
2	The system makes it easier for guests to view routes.	
3	The system meets the guests' expectations.	
4	The system can be operated with minimal actions required.	
5	The system can be used without difficulty.	
6	The system can be easily used in both occasional and routine situations.	
7	Users learn quickly how to use the system.	
8	The information delivery is easy to understand and comprehend.	
9	Users are satisfied with the system.	

b. Functional Testing (Blackbox Testing): Evaluated system functionalities, including login verification, data input for admin and MSMEs, and map display. Test scenarios ensured the system met the expected data accuracy and usability criteria.

III. RESULT AND ANALYSIS

3.1 Batik MSME Locations in Yogyakarta

This study identified the distribution of 24 Batik MSMEs in Yogyakarta City. The location data was collected through online and field surveys and interviews with MSME owners. The MSME locations were presented in shapefile format, which included key attributes such as the MSME name, address, geographic coordinates, and business scale. Data processing results revealed that Batik MSMEs are distributed across various strategic areas in Yogyakarta City, with some locations clustered closely, making them easily accessible to consumers. This location information served as the basis for creating 3D visualizations and integrating them into a web-based information system.

3.2 Batik MSME Information System Based on 3D Mapping

Creating a 3D map visualization began with incorporating spatial data into Geographic Information System (GIS) software, Quantum GIS, and integrating it with available attribute data. The 3D visualization was developed using QGIS software and the QGIS2ThreeJS plugin (version 2.7.3). This plugin supports 3D visualization using WebGL technology and the JavaScript library three.js.

The visualization process started by importing a base map to identify building shapes for each MSME location. The base map was Open Street Map, obtained via the Open Layers plugin in the same software. Digitization was performed by geometrically defining

areas to represent 2D building outlines. To create the 3D model, building height data was added as an attribute for each feature. Using the QGIS2ThreeJS plugin, extrusion was applied based on the building height values. Blue was selected as the color to represent the 3D shapes of the Batik MSME buildings.

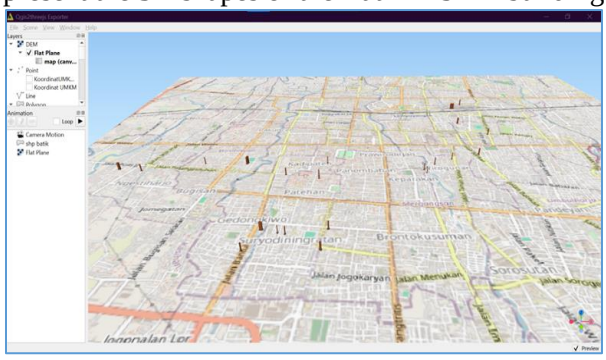

Figure 9. 3D Visualization of MSME Distribution

3.3 Information System Result

The Batik MSME distribution information system is named UBAJO (UMKM Batik Jogja) (Figure 11). This web-based system includes a 3D visual map that highlights business locations. The resulting display is interactive, featuring representations of business structures. This functionality lets users quickly locate businesses and access comprehensive details about Batik MSMEs. Users can interact with the map through zooming, dragging, and rotating. On the left side of the interface, there are two icons for modifying the display. The first icon, resembling a stack of layers, allows users to adjust the opacity of each data layer. The second icon provides navigation information to guide users in interacting with the map canvas.

The name UBAJO was chosen for its simplicity and practicality. It is an acronym for UMKM Batik Jogjakarta, making it both straightforward and representative of the system's primary purpose. The system is designed as a foundational tool, allowing for future enhancements and expanded functionalities. As new features are added, the system's name may also evolve to reflect these updates.

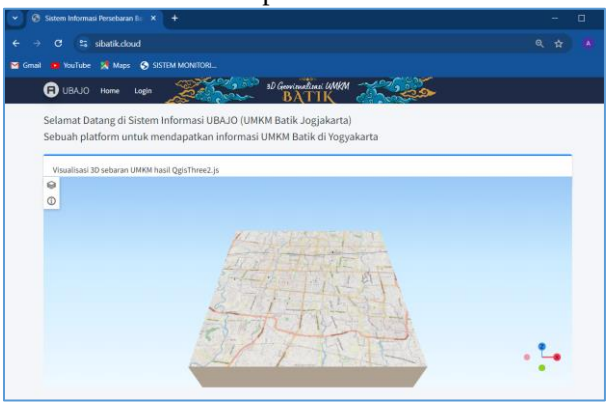

Figure 10. Results of a Website-Based Information System

VI. CONCLUSION

The advancement of technology and information has enabled improvements in the presentation of information, including geospatial information. This concept has been successfully implemented to present information about the locations of Batik SMEs in Yogyakarta City. By integrating spatial and non-spatial data, this information system not only provides an appealing visual representation but also delivers information that is more accessible and understandable for various stakeholders. A web-based information system featuring 3D geospatial models has been developed to enhance the process of presenting integrated spatial and non-spatial information. Through this system, users can easily explore the locations of Batik SMEs virtually, view detailed information, and obtain routes to their desired destinations. This research is expected to serve as an initial step toward developing geo-visualization applications to enhance the promotion and development of the Batik industry in Yogyakarta.

THANK-YOU NOTE

We sincerely thank our research team for their hard work, dedication, and collaboration throughout our research. Your expertise and commitment were invaluable in successfully creating the 3D Map-Based Information System for Batik MSMEs to enhance consumer information accessibility.

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