

WEBGIS OF MAPPING PASURUAN CITY FURNITURE INDUSTRY USING LEAFLET AND OPENSTREETMAP

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Abstract: Pasuruan is a well-known area for producing furniture products in East Java. The furniture commodity industry is widely spread in this city. This industry is also one of the top products. To boost market interest in the furniture industry in Pasuruan City, which has been affected by the COVID-19 pandemic, and a geographic information system has not yet been developed in an effort to develop the furniture industry, research has been carried out on a web-based geographic information system (WebGIS) mapping the furniture industry in Pasuruan City using Leaflets and OpenStreetMap. The developed furniture industry WebGIS application takes advantage of the open source and dynamic advantages of Leaflet and OpenStreetMap technologies which have provided very decent results on several GIS web-based application systems. In the testing phase with the Blackbox method, the WebGIS application for the furniture industry in Pasuruan City functionally has run well on desktop devices and also run well on simulated mobile devices. Testing was carried out on several types of browsers like Google Chrome and Microsoft Edge. This WebGIS application has been able to map the furniture industry in Pasuruan City so that the distribution of economic activity actors, especially the furniture industry, can be seen throughout the city and each sub-district. It can provide detailed information on furniture industry players in Pasuruan.

Keywords: framework; leaflet; mapping; openstreetmap; webgis

Abstrak: Pasuruan merupakan salah satu daerah yang terkenal sebagai penghasil produk mebel di Jawa Timur. Industri komoditas mebel tersebar cukup banyak di kota ini. Industri ini juga merupakan salah satu produk unggulan. Guna mendongkrak minat pasar akan industri mebel kota Pasuruan yang terimbas pandemi COVID-19, dan belum dikembangkannya suatu sistem informasi geografis sebagai upaya pengembangan industri mebel maka dilaksanakan penelitian tentang sistem informasi geografis berbasis web (WebGIS) pemetaan industri mebel kota Pasuruan menggunakan Leaflet dan OpenStreetMap. Aplikasi WebGIS industri mebel yang dikembangkan memanfaatkan kelebihan teknologi Leaflet dan OpenStreetMap yang bersifat *open source* dan dinamis yang telah memberikan hasil yang sangat layak pada beberapa sistem aplikasi berbasis WebGIS. Pada tahap pengujian dengan metode Blackbox, aplikasi WebGIS industri mebel kota Pasuruan secara fungsional telah dapat berjalan dengan baik pada perangkat dekstop dan juga berhasil berjalan dengan baik pada *simulated mobile device*. Pengujian dilakukan pada beberapa macam browser seperti Google Chrome dan Microsoft Edge. Aplikasi WebGIS ini telah dapat memetakan industri mebel kota Pasuruan, sehingga dapat diketahui sebaran pelaku kegiatan ekonomi khususnya industri mebel, baik seluruh kota maupun tiap-tiap kecamatan, serta dapat memberikan detail informasi pelaku industri mebel di kota Pasuruan.

Kata kunci: framework; leaflet; openstreetmap; pemetaan; webgis

INTRODUCTION

The home industry with commodity furniture is one of the leading businesses in Pasuruan. Unfortunately, this business, which has become Pasuruan's flagship product, has declined in the last few years due to COVID-19. Several efforts were made by the Municipal Government of Pasuruan, such as holding festivals and furniture exhibitions to boost market interest in the furniture industry in Pasuruan City [1]. Similar efforts to improve the economy of Pasuruan City and support the vision and mission of the Pasuruan City government are also urgently needed, such as developing an information system focusing on the furniture industry. Detailed information about the furniture commodity industry needs to be developed to serve as a means of customer information, business expansion by industry players, information for the development of economic potential, and policies in the development of the furniture industry center market by the local government.

WebGIS has been widely implemented to support the development of the industrial world, such as the catering industry [2], MSMEs [3] [4] [5], digital startups [6], tourism [7], etc. Liang Zhou et al. [2] built a GIS web-based catering industry entrepreneurial decision-making system. The system is intended to assist entrepreneurs in choosing a location for a catering business. Efforts to increase the industry through webGIS facilities have been carried out in various regions such as Bangka district [3], Nganjuk district [4], Sidoarjo district [5], etc. In Pasuruan City, East Java, a WebGIS has been developed to map facilities [8] and select business locations [9]. However, the WebGIS has not been developed specifically for mapping the furniture commodity

ty industry in Pasuruan City.

Several techniques can be used in building WebGIS. Liang Zhou et al. [2] used JavaScript programming with the ArcGIS API with the additional implementation of the Analytic Hierarchy Process (AHP) method to build an evaluation and analysis model for selecting the location of the catering industry. Whereas [3] used Leaflets, and [4] developed a WebGIS for micro-enterprises in Nganjuk district using OpenStreetMap and Leaflets as base maps. Codeigniter 3 as a PHP language support framework, and Leaflet as a Javascript library. In addition, you can also use the online QGIS and ArcGIS editors, as was done by [6]. Among these studies, they use Leaflet, OpenStreetMap, and CodeIgniter in building a WebGIS, showing that the results of the system built are very feasible.

Based on this background, that: (1) There is a need to boost market interest in the furniture industry in Pasuruan city, (2) The WebGIS mapping of furniture in Pasuruan city has not yet been developed as an effort to develop the industry, (3) Leaflets and OpenStreetMap provide possible results on the web-based GIS system that was built, the authors conducted research on the development of a geographic information system (GIS) for web-based mapping of the Pasuruan city furniture industry using Leaflet and OpenStreetMap.

It is hoped that the web-based GIS application or commonly called WebGIS for mapping the furniture commodity industry in Pasuruan City is expected to be accessible to the wider community to assist the cross-regional customer outreach process, monitoring related agencies and also to develop the furniture commodity industry in Pasuruan City. WebGIS mapping of the furniture industry will also be very useful for

providing detailed information regarding the location of furniture industry actors, the distribution of industries in each sub-district, to the business details of each furniture industry player in Pasuruan City.

METHOD

In developing the WebGIS for the Pasuruan city furniture industry, the waterfall software development model, commonly called the Waterfall SDLC (Software Development Life Cycle) method, is used.

Waterfall Software Development Model

The Waterfall method is a work method that emphasizes sequential and systematic phases. The waterfall is called because the process flows in one direction "down" like a waterfall. This Waterfall method must be carried out sequentially according to the existing stages [10].

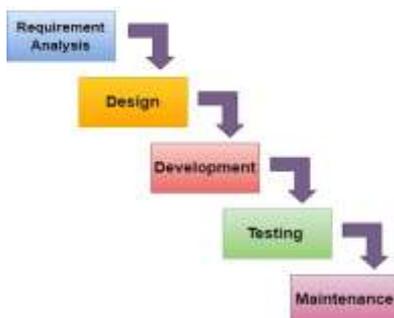


Image 1. Waterfall SDLC

Requirements analysis

In this stage, system requirements are analyzed, such as determining how administrator and user pages are displayed, the features offered, and how information is conveyed to users.

Design

In this stage, the WebGIS design

for the Pasuruan city furniture industry is carried out through drawings of the technology architecture to be used, use case diagrams, physical data models that will describe the system flow and database of the system to be developed, an also user interface design of the WebGIS application.

Development

The development stage is where a web-based geographic information system for the Pasuruan city furniture industry is developed. This implementation phase is adjusted to the design that has been made before. The WebGIS system is developed with several technologies, such as CodeIgniter Framework, Leaflet Javascript library, OpenStreetMap, and MySQL as a database.

Testing

The testing phase is the testing phase carried out to determine whether the results of the implementation process are as expected. In this process, testing is carried out using the Blackbox method, where tests will be carried out that focus on system functionality.

Maintenance

At this stage, maintenance is carried out on the system in connection with errors that may be found and continuously improving the system to meet the expected goals.

Geographic Information System

A geographic information system is a system that provides geographic information or the position of a place on Earth. Geographic information systems have 2 kinds of data, including spatial and non-spatial data or commonly referred to as attribute data.

Spatial data is graphic data of a

place on the Earth's surface. Spatial data is spatial, which can be described using vector data models such as coordinate points, lines, or polygon areas, and raster data models such as pixels. Non-spatial or attribute data describes information on spatial data (object descriptions), either in the form of tables or text sentences.

In general, the development and implementation of WebGIS will support disseminating of spatial data information. So even ordinary people will be able to have access to data and GIS analysis results [11].

WebGIS is the development of a web-based GIS application that is integrated with one another [12]. The WebGIS system for the furniture industry in Pasuruan City was developed with several supporting technologies, such as the CodeIgniter framework with the PHP programming language, the Javascript library Leaflet, OpenStreetMap, and the MySQL database.

The Codeigniter framework has a Mode-View-Controller (MVC). Codeigniter provides a collection of libraries for frequently performed tasks, and it is very easy to access the libraries available in Codeigniter. With Codeigniter, we focus on project development and minimize the amount of code to be written [13].

The Leaflet is a Javascript library used to support the development of interactive web-based maps. Leaflet works efficiently across all desktop and mobile platforms, is extensible with many plugins, has a beautiful, easy-to-use and well-documented API, and a simple and easy-to-read source code [14].

OpenStreetMap (OSM) is a web-based project to create a free and open map of the whole world, built entirely by volunteers by conducting surveys using GPS, digitizing satellite imagery, and collecting and liberating publicly availa-

ble geographic data [15]. The advantages of OpenStreetMap are that it is rich in spatial data, does not depend on other applications, is always updated/real-time [16].

RESULT AND DISCUSSION

The WebGIS application has 2 types of user roles, including general users who are WebGIS users who incidentally are the general public, where these users can access several application features such as finding the location of a furniture industry business based on desired criteria and viewing details of industrial businesses particular furniture, look at the distribution of the furniture industry in Pasuruan City, both as a whole and per sub-district. The second type of role is the administrator user with access rights to perform data management, such as adding furniture industry data and editing and deleting data.

Image 2 the main page of the Pasuruan City Furniture Industry WebGIS page, which can be accessed by general users. The main page describes the mapping of the distribution of the furniture industry in the city of Pasuruan as a whole.



Image 2. WebGIS Main Page for the Pasuruan City Furniture Industry

Users can search for certain furniture data on the sidebar menu by writing the Furniture Name and District. The process of searching for furniture data on the WebGIS Mapping the Pasuruan City Furniture Industry can be seen in Image3.

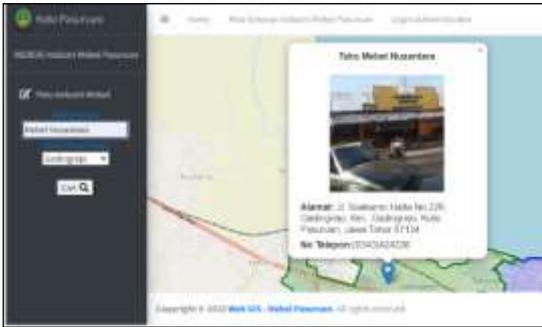


Image 3. Furniture Industry Data Search Page

Detailed information can be accessed through pop-ups containing address information, telephone numbers, and photos of furniture industry data. Information pop-ups will appear on markers according to the geographical location of the furniture industry, as shown in Image 4.



Image 4. Furniture Information Detail Page

Users can also access a map of the distribution of the Pasuruan city furniture industry by sub-district, as shown in Image 5.



Image 5. Distribution Map of the Furniture Industry Based on Certain Districts

In managing furniture industry data, a login process is required first as an administrator user. Here is the administrator login page.



Image 6. Administrator Login Page

After going through the login process, administrators can manage furniture industry data, such as adding furniture industry data and editing and deleting data. The Administrator Dashboard page can be seen in Image 7.



Image 7. Furniture Industry Data Management Page

User administrators can manage furniture data and monitor the furniture industry distribution map through the Furniture Industry Map menu on the Administrator page. The following is one of the data management processes,

namely data input for the furniture industry.

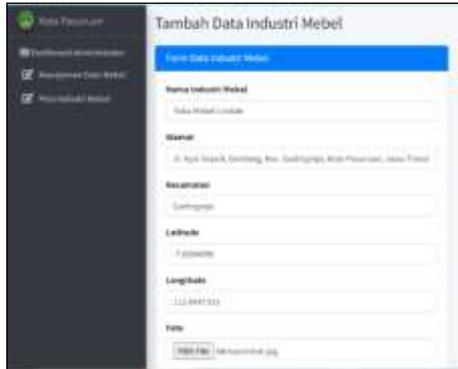


Image 8. Furniture Industry Data Input Page

Test Results

The testing process is carried out using the Blackbox testing method. This method is a test that focuses on system functionality. In the testing process, the system is expected to be running well.

The device used as a test device is a desktop device and also a simulated mobile device with several browsers, such as Google Chrome and Microsoft Edge.

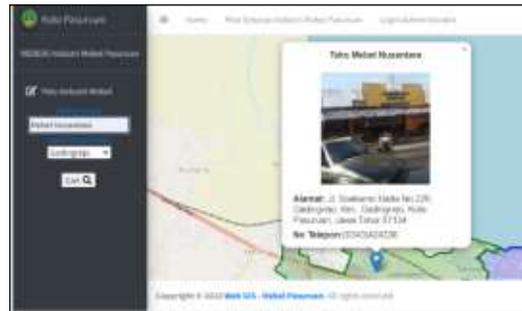


Image 9. WebGIS on Desktop Devices

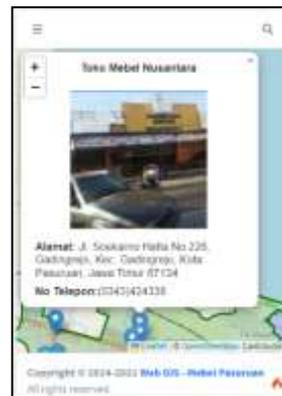


Image 10. WebGIS on Simulated Mobile Devices

Table 1 is the result of Blackbox testing of the WebGIS application for the Pasuruan city furniture industry on the side of general users.

Table 1. Blackbox Testing Results on General Users

No	Functionality	Desktop Devices	Simulated Mobile Devices
1	Access the main WebGIS page	Successful	Successful
2	Looking for the location of the furniture industry	Successful	Successful
3	Accessing information on the distribution of the furniture industry in the city of Pasuruan	Successful	Successful
4	Accessing information on the distribution of the furniture industry by sub-district	Successful	Successful
5	Displays detailed furniture industry business information	Successful	Successful
6	Access the map view	Successful	Successful
7	Accessing furniture industry location markers	Successful	Successful

Table 2. Blackbox Testing Results on the Administrator User

No	Functionality	Desktop Devices	Simulated Mobile Devices
1	Administrator login	Successful	Successful
2	Added furniture industry data	Successful	Successful
3	Edit furniture industry data	Successful	Successful
4	Deleting furniture industry data	Successful	Successful
5	Access the map on OpenStreetMap	Successful	Successful
6	Carry out the process of inputting coordinates for the location of the furniture industry	Successful	Successful

In the Blackbox test results, the WebGIS application for the Pasuruan furniture industry has worked well on desktop devices and run well on simulated mobile devices. Testing was carried out on several types of browsers, such as Google Chrome and Microsoft Edge.

CONCLUSION

Based on the results of the design and development of a WebGIS application for mapping the furniture industry in Pasuruan City based on Leaflet and OpenStreetMap technology, it can be concluded that the WebGIS application for the furniture industry in Pasuruan City in terms of functionality can run well on desktop devices and can also run well on simulated mobile devices. The system can run on various browsers like Google Chrome and Microsoft Edge. Leaflet technology, which is open source, can be implemented well as a library that bridges web-based application systems to be able to access OpenStreetMap, a free and opensource world map to produce a WebGIS application that can display maps of the distribution of the furniture industry in Pasuruan city interactively.

The developed WebGIS application system has also been able to map the furniture industry in Pasuruan City so

that the distribution of actors in economic activity, especially the furniture industry, can be identified throughout the city and each sub-district. It can provide detailed information on furniture industry players in Pasuruan City.

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