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Development of a Geographic Information System Using Location-Based Services to Monitor the Progressing Batik Industry

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Abstract: The proliferation of batik industries in Sleman has left outsiders confused due to the lack of specific information and limited accessibility. To address this issue, a web-based application and Geographic Information System (GIS) with Location-Based Service (LBS) technology were developed. The system's purpose is to assist users in finding batik industry locations in Sleman, offering route information and other essential details.This system also facilitates monitoring of industry development, product types, customer visits, and reviews. Developed using the Systems Development Life Cycle (SDLC) method, the system's design is presented through a detailed data flow diagram.System testing included beta testing and Mean Opinion Score (MOS) assessment involving 15 respondents, resulting in an impressive score of 4.66 out of 5. The system operates effectively, simplifying the search for batik industry locations and providing information on routes, addresses, and contact details for batik shop owners in Sleman..

Keywords: Geographic Information System, Location Based Service, Progressing Batik Industry, Means Opinion Score, SDLC

I. INTRODUCTION

The batik industry from year to year will continue to grow rapidly, the interest of foreigners in batik continues to increase after batik was recognized by UNESCO on October 2, 2009. If we look at the numbers, there are 10 top countries that are the export market for Indonesian batik in 2022, citing excerpts of data from the Central Statistics Agency (BPS) in 2022 the export value of Indonesian batik reached US $ 31 million or around Rp. 392.74 billion with a volume of 987.71 thousand kilograms. The exported goods are of course taken from several batik industry cities such as the city of Sleman. Sleman City is one of the batik producing areas in Yogyakarta. Batik produced in the city of Sleman has very high characteristics and quality.

In addition, the diversity of Sleman batik makes it one of the unique categories of art products, in various regions in Indonesia there are various batik motifs and meanings created, including in the city of Sleman Yogyakarta. This expertise has great potential in the batik industry, if balanced with the rapid development of technology today and by looking at the rapidly growing batik exports, the batik industry at this time needs information technology that can summarize the development of the batik industry and to monitor the development of the batik industry, information about the batik industry in the city of Sleman is still very lacking, branding is still done by distributing posters and this method is still less efficient and not widespread in a wider scope in the sense that information on the development of the batik industry is only conveyed to the Sleman community, in contrast to residents outside the Sleman area who only rely on google, google maps as a tool or tool to see the development of the batik industry and google maps or google very rarely update the information so that information on the development of the batik industry will be difficult for people outside the Sleman area to monitor.

With this fact, the batik industry in the city of Sleman needs an information system that can visually describe the development and location information of the batik industry, so that it will reduce the difficulty of seeing the development and location information of the Sleman batik industry which over time has grown and advanced, with the lack of information making it difficult to find batik shops, especially in the Sleman Yogyakarta area and this system will make it easier for users to monitor the development of the batik industry and find information. Because the branding of the batik industry is still done in a simple way and is not balanced with technology, this research will utilize location-based service technology to find the location of the batik industry quickly and precisely. Location-Based Service (LBS) is a location-based information service that has many benefits and makes it easier to find the location to be visited. LBS combines three technologies, namely GIS, internet services, and mobile devices. Many studies have used LBS methods in a variety of different fields, one of which is in the field of transportation that helps in finding locations.

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LBS has a useful function to find a specific location by utilizing Global Positioning Service (GPS) technology which is widely known as GPS. Location-Based Service applications can also be used to select specific locations. With this combination, the LBS application will be able to determine the best route to connect the user's location with the desired destination.

Based on the problems that have been described, the researchers raised a research topic, namely the geographic information system of the batik industry in the Sleman area, Yogyakarta using the web-based Location Based Service (LBS) method. *The* development of this batik industry geographic information system is expected to provide an overview of the map, development, assessment or position of the batik industry in the Sleman area, so that the information offered is interesting and useful for users who need a batik industry mapping system.

This web mapping was created using the native PHP programming language, Visual Studio Code software, and MySQL database. This research aims to produce a search and monitoring system for the development of the batik industry that will help users from outside the city of Yogyakarta and natives of the Sleman area in finding the best quality batik shop according to user needs. This batik industry geographic information system is built with various supporting menus that will provide detailed information to users.

This GIS design will include a display of batik shops based on the ranking of each batik shop, product type, number of customer visits and customer reviews. The developed system can also be used by the local government or the community to monitor the development of the batik industry, thus the community will find it easier to monitor and select high-quality batik shops. In addition, this system will utilize Location-Based Services (LBS) to provide information about the closest route to the batik industry that users want to access.

II. LITERATURE REVIEW

Yan He, Jiageng Chen (2021) conducted research on the topic of user location privacy protection mechanism for location-based services. This research is combined with internet of things technology to ensure system authentication security and then design a new location privacy protection mechanism based on existing privacy. This research produces a location-based service privacy security system when exchanging information on an insecure network, the essence of the research conducted is to provide a strong authentication system and security guarantees for location-based services.

Beatriks Dian Teang, NM Faizah, and Widyat Nurcahyo (2023) conducted research on web-based tourism information systems with the Location-Based Service (LBS) method. This research produced a website that contains tourism information, making it easier for tourists to find information about tourist attractions in the research location, as well as information on lodging in the local area.

However, the system developed in this research is considered less attractive because of the less attractive appearance, especially for tourism systems which are generally equipped with attractive images of tourist attraction locations in the area. In addition, the existing information content is also still incomplete so that it can result in a lack of information for tourists who are interested in the area.

Nuvriasari Audita, Wicaksono Gumirlang (2023) conducted research that discussed the importance of online marketing to increase innovation and interest in the batik industry in Yogyakarta, the researchers analyzed that by presenting information, developing content on online marketing and balanced with online marketing in the Yogyakarta batik industry can increase reader or customer interest and can increase curiosity about the Yogyakarta batik industry.

Firmansyah Yoki, Udin (2018) developed an academic information system that utilizes the SDLC method as a website development model, system development is carried out using the SDLC model which is carried out with a structure and it is conveyed that the SDLC development model is very suitable for developing information systems because the model works sequentially and completes development properly.

III. RESEARCH METHODS

In this study the authors used the System Development Life Cyle model for website development. This development model has several advantages including structured processes and stages from the beginning to the end of development. The stages of this model are depicted in Figure 1.

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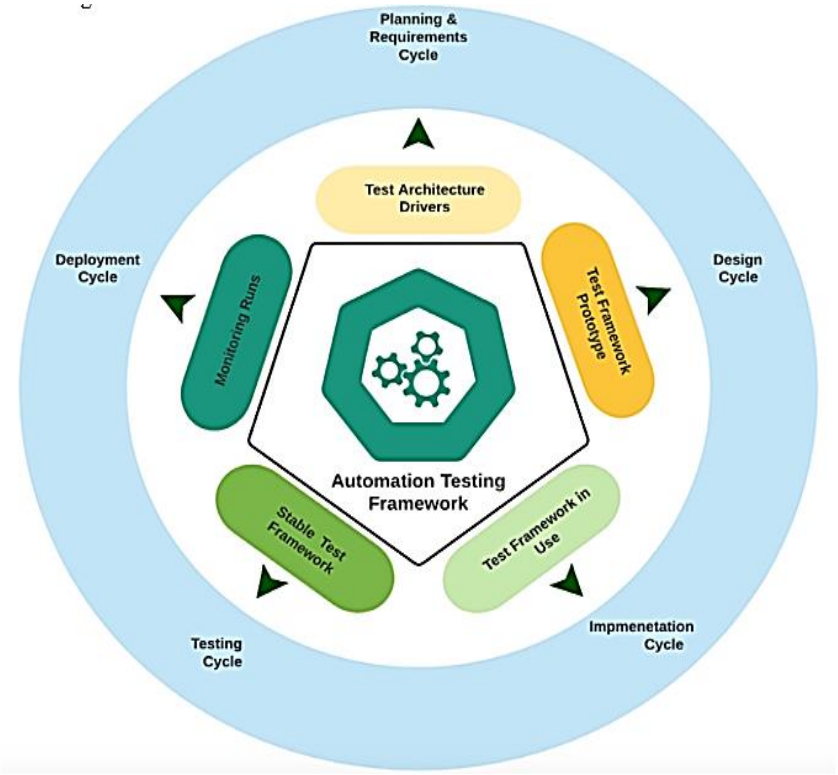

Figure I SDLC Stages

IV. DISCUSSION RESULT

4.1 System Requierment

User needs by observing the current system and conducting surveys by going to the field to observe and conduct interviews with the aim of obtaining data such as problems that are often faced then the data is analyzed for use in research. Based on the results of surveys and interviews conducted in several batik shops, there are several problems that are often faced by users and these problems are used as benchmarks for developing features that will be developed on the system and that will overcome these problems.

TABLE I. USER REQUIREMENTS

Needs	Intended for
Information on the existence of the batik industry in the sleman area (route information, complete address)	User
Store information (name. store rank, contact, opening hours, closing hours)	User
Information about goods available in an industry (batik offered)	User
Information on the development of the batik industry	User
Map information of batik industry in sleman area	User

The developed batik industry geographic information system will have two parties who will use the service, namely users and admins who will manage shop data on each shop that has been inputted on the system and will update information according to changes that occur in the batik shop. Updated information will be displayed on the web page.

Users are individuals who will use the developed system, users can view detailed information from batik shops if the user has a registered account on the system,

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Admin is a type of user who can access data directly on the system that has been developed, this type of user can perform several actions on web pages, the display for the admin will be different from the display for ordinary users, on the admin display will be equipped with actions to manage data on the web.

4.2 System Design

This stage is a system design process that is developed to determine the process and also the data that will be needed by the system. This process will describe everything related to the system to produce a system that is ready to use. The system design will start from the system architecture which describes the objects related to the developed system, can be seen in Figure 2.

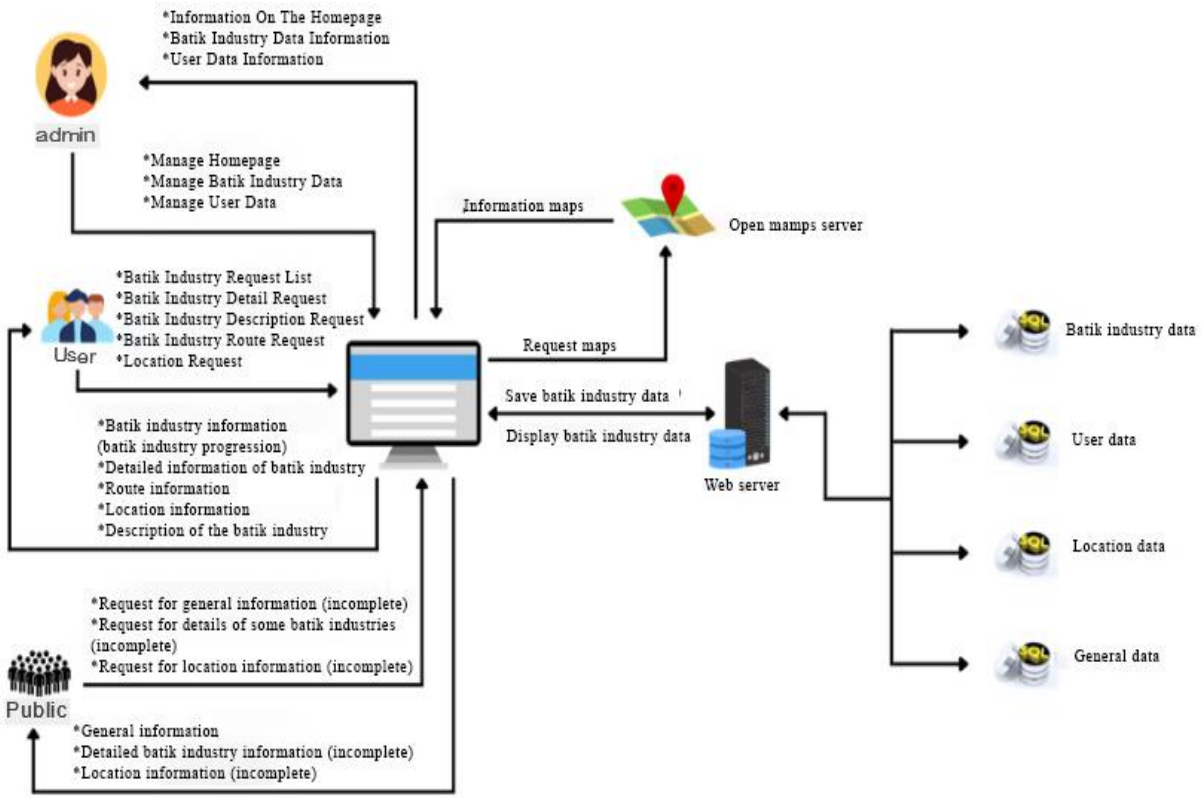

Figure II. System architecture

The architecture described has 3 external entities, namely the public, which is a user who can access the system directly, users, namely users who can see more information than the public because they have an account and register and log in, search for batik shops.

In the visitor architecture image, it can be seen that there are several data flows, namely general information data, location data, store information data. In the user system there are data flows such as route data and store data. In contrast to the flow of the admin system, there are data flows such as homepage data, user data, store data. The information contained on the web page will be managed by the web server then the information data will be retrieved in the system storage.

The web server used to develop the system has the main function to process or send a file according to user requests through several predetermined protocols. The development of the mapping system will use open street maps to create open maps and graphics as geographic information that will be received by users. Open street maps are freely available open geographic maps that work based on satellite navigation.

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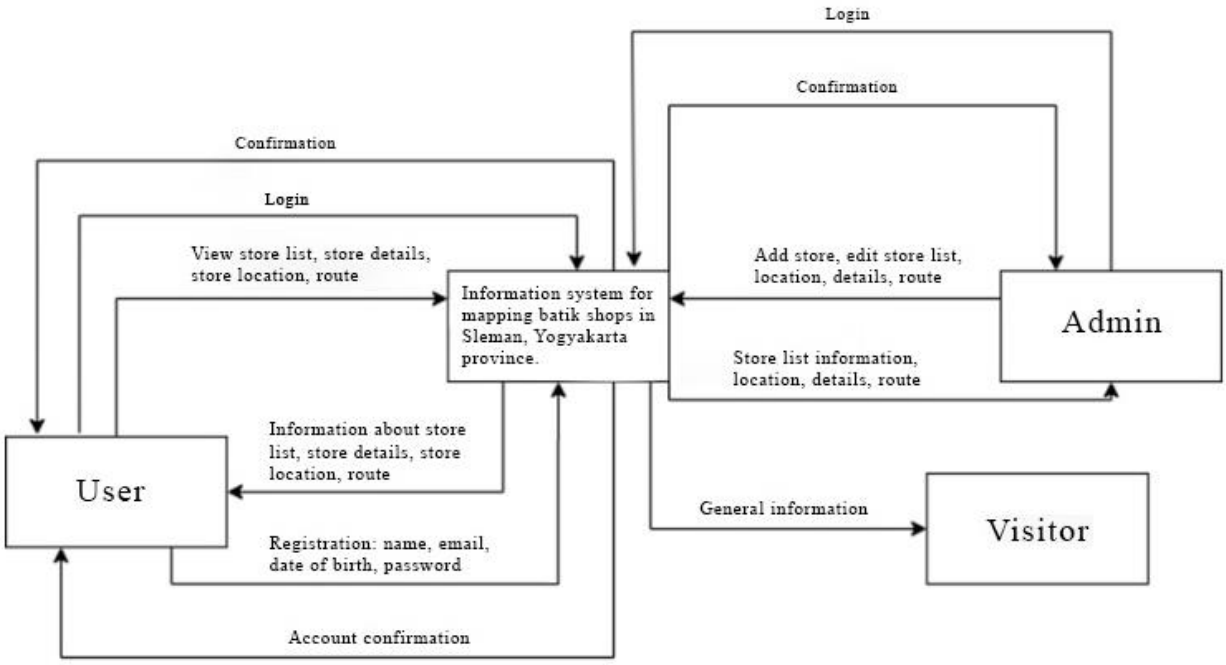

Figure III. Data flow diagram

Users are required to have an account before entering the developed system by registering on the web page that has been created and the required data is filled in the registration column, the user data that has been registered will then be saved into the data storage used in the development of the system with a password that has been equipped with a hash feature that can secure the user account password so that no one can use the account that has been registered except the user himself. When the user successfully creates an account on the developed system, the user will get a confirmation that the user data has been successfully stored in the storage.

4.3 System Implementation

This stage is the last stage of the SDLC development model where at this stage testing will be carried out using beta testing by distributing questionnaires to 15 respondents by showing how the developed system works and respondents are required to answer several questions given by the researcher based on the results of testing the system that has been done. Aiming to determine the level of respondent satisfaction and the quality of the system developed from the user's side. In the test carried out will consider the speed and success factors in accessing the system being tested, the speed of the system will be tested when the system is accessed simultaneously and the number of more than 15 people who will access the system simultaneously. by considering the system speed factor will ensure the system runs smoothly and efficiently for users.

The developed batik shop mapping web will have 2 parties who will use the service, namely the user and the admin who will manage the shop data of each shop that has been inputted into the system and will update the information according to changes that occur in the batik shop. The updated information will be displayed on the web page.

4.3.1 Interface Design

After going through the design stage using the SDLC model, then enter the next stage, namely system development. The following are the core results of the geographic information system development:

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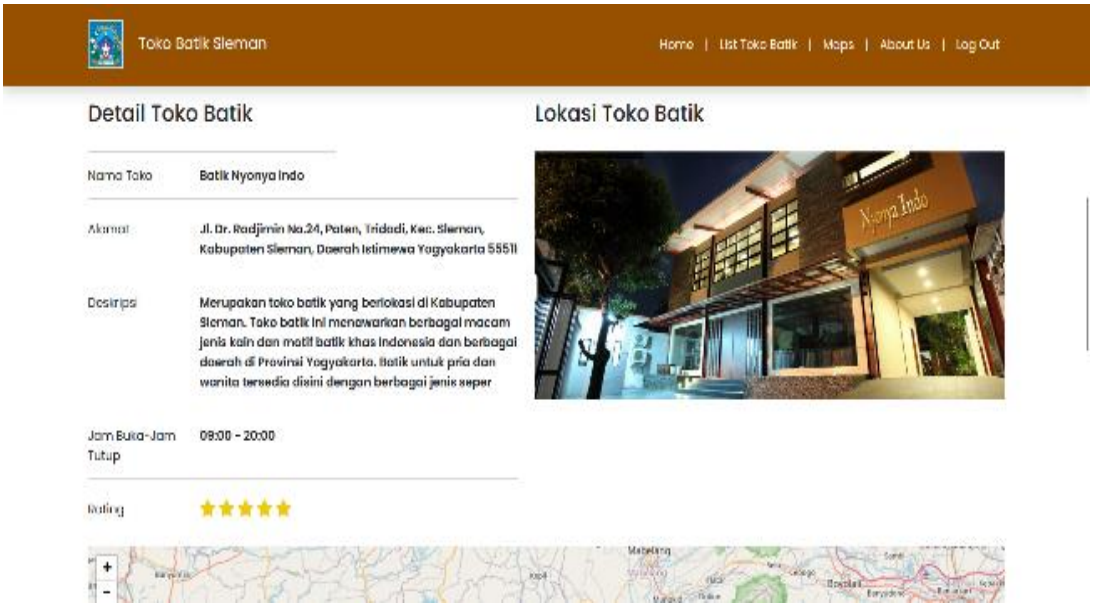

Figure IV. Shop detail page

In this study, several menus will be developed on the system, users can access the menus on the developed system, the menus on the system include the *maps* menu to view location points and monitor the development of the batik industry in the Sleman area, on this menu users can clarify the map by *zooming in* and road information around the shop will be clearly visible and users will indirectly know the direction to take when heading to the location because the location description is clearly visible on the menu. Not only that menu, there are several other menus such as a list of shops that display a list of several batik shops in the Sleman area accompanied by photos of the shop, on this page users can search with certain keywords to find the information needed by the user if the user wants to see detailed information about the development of the batik industry that has been selected, the user can enter the shop details menu which displays complete information and developments from the batik industry. The information available on this page is contact information, information on opening hours, closing hours and not forgetting the location point image displayed under a complete description or description of the development of the batik industry which can provide more detailed information from the location point of the batik industry that has been selected by the user by zooming in on the available map page.

On the about us page if the user feels that the information on the development of the Sleman area displayed on the web is lacking, the user can enter the about us menu page which provides more complete information about the development of the Sleman area and a brief history of the area and also on the home page which provides interesting information for users to enjoy which serves to provide an overview of the contents of the web before the user enters the core menu menu of the developed web.

4.3.2 Testing

The geographic information system for batik shops developed by researchers was tested using beta testing using Means opinion score (MOS) testing. The MOS method is one method that can be used for testing that is easy and commonly used because by using this method researchers can find out the functionality of the system that has been developed. by involving several respondents.

The results of the tests that have been carried out can be seen in Table 4. MOS testing is a testing strategy that is often used to measure the quality of the system developed. This test is carried out by involving several respondents to try the system that has been developed, to determine the quality of the geographical information system of the batik industry will involve 15 respondents who will try the system directly, including 15 respondents consisting of 7 students, 4 batik shop employees, and 4 members of the general public. The test method used has a rating scale which can be seen in Table 3**.**

The results of the test conducted with 15 respondents can be seen in Table 4 which is accompanied by an assessment of each respondent on the implementation of web-based location-based services for mapping the batik industry in the Sleman area can be accessed at the link:
https://docs.google.com/spreadsheets/d/1_nhhLu5wwa5K_WLDLw7qu0ebDZwsk1N9exDWsqaU4kA/edit?resourcekey#gid=57886833

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The conclusion of the MOS test results obtained a value of 4.66 on a scale of 5. This value can show that the quality of the web that has been developed is good and can be used to find information on batik shops in the Sleman area. The web display is attractive with a combination of colors and letters that match the theme of the web itself. The score from the MOS test carried out has a value range of 4 or 5 which proves that the system can be categorized as a good system and can be used by users.

TABLE II. AVERAGE OPINION SCORE

MOS Score	Quality	Apply
5	Outstanding	Invisible
4	Good	Clearly visible but not distracting
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Verry Annoying

To calculate the test results using the MOS method, a certain formula will be used, based on the assessments expressed through 15 research subjects on each question given and will be calculated using the Equation 1 formula.

$$\mu_{Pi} = \frac{\sum^{Si\ Bi}}{n} \qquad (1)$$

Description:

μ_{Pi} = Averagevalue of the question attribute
Si = Number of respondents participating in the assessment
Bi = Question weight
n = Number of respondents

Then the next stage is to look for test conclusions obtained through the calculation of MOS which can be seen from the total average score on the attributes of each question using a certain formula which will be explained in equation 2.

$$MOS = \frac{\sum_{i=1}^{k} \mu_{Pi}}{k} \qquad (2)$$

Description:
MOS = Average result of question attributes
k = Number of question attributes

Researchers used the standard answers that are the provisions of the MOS method and used by other studies as in table 3

TABLE III DESCRIPTION OF MOS ANSWERS

Answer	Description
ST	Strongly agree
S	Agree
TS	Disagree
TH	Don't know
STS	Strongly disagree

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TABLE IV MOS CALCULATION RESULTS

Question	ST	S	TS	TH	STS	Total	μ_{Pi}
Question 1	11	4	-	-	-	15	4,73
Question 2	11	4	-	-	-	15	4,73
Question 3	10	5	-	-	-	15	4,66
Question 4	9	6	-	-	-	15	4,6
Question 5	9	6	-	-	-	15	4,6
Total Score	50	25	-	-	-	75	23,32
Final MOS test							4,66

Where is the Statement:

Statement 1: The user *interface* or display of the batik shop mapping system on the link above is easy to understand and use.
Statement 2: The existence of this batik shop mapping system will help people to find information on batik shops in the Sleman area.
Statement 3: The combination of colors and fonts in this mapping system is good and appropriate.
Statement 4: With this mapping information system, it will be very easy for prospective buyers to find the location of high-quality batik shops in the Sleman area.
Statement 5: You will use the mapping information system to help you find information on batik shops in the Sleman area.

V. CONCLUSIONS

A geographic information system that uses a location-based service approach is an information technology developed based on user needs that presents information about the batik industry in the area of information and monitoring of the batik industry, information on the location point of batik shops in the Sleman area and is also presented using location-based service technology that can provide information or an overview of the development of the batik industry in the Sleman area and is accessed by users anywhere Based on observations that have been made on the geographic information system web for monitoring the Sleman Yogyakarta batik industry, conclusions can be drawn, namely: The web that has been built is a dynamic web that can be run by users on any operating system. Then the web is built with data obtained by directly visiting the batik shop. Based on testing conducted using the alpha type and then using the MOS method, the developed system is in accordance with user needs and is well implemented. After testing involving 15 respondents using the mean opinion score (MOS) test method, it gets a value of 4.66 on a scale of 5 which indicates that the system is feasible to be implemented directly to users and is categorized as a good system, this type of testing has proven that the system is suitable for use and is implemented properly to users and the system runs according to user needs.

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