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Spatial Data Inventory and Collaboration System: A Web-GIS Development and Outreach Approach for Matesih Digital Village

Yusfia Hafid Aristyagama[1*], Cucuk Wawan Budiyanto[2], Nurcahya Pradana Taufik Prakisya[3], Puspanda Hatta[4], Febri Liantoni[5], Rosihan Ari Yuana[6]

[1,2,3,4,5]Faculty of Teacher Traning and Education, Informatics and Computer Engineering Education Department, Universitas Sebelas Maret, Surakarta, Indonesia

Email: [1,*]yusfia.hafid@staff.uns.ac.id, [2]cbudiyanto@staff.uns.ac.id, [3]nurcahya.ptp@staff.uns.ac.id, [4]hatta.puspanda@staff.uns.ac.id, [5]febri.liantoni@staff.uns.ac.id, [6]rosihanari@staff.uns.ac.id
*Corresponding author Email : yusfia.hafid@staff.uns.ac.id

Abstract

Developing the potential of foster villages is often hindered by a lack of valid and integrated field data. Matesih Village in Karanganyar Regency possesses significant natural and economic potential, yet it remains under-explored by the research community. This study aims to develop a web-based GIS application as a spatial mapping medium for village potentials and problems to initiate the "Digital Village" concept. The system was developed using the prototyping method, which encompasses three main stages: preparation, application development, and socialization. This application is designed based on the Community of Practice (CoP) framework to facilitate interaction and shared learning between village officials as data providers and researchers as solution providers. The results of this community service indicate that the developed GIS application supports the digitization of village's potential data and has been socialized to village officials to support data-driven policy-making.

Keywords: GIS, Digital Village, Potential, Problen, Spatial, Collaboration.

1. INTRODUCTION

Finding valid facts from the field to support practice is always a major barrier for developing real and casuistic research ideas in community service. Foster villages are also tangible objects for implementative research, and mapping/researching a relevant economic sector can improve the quality of life in local communities via researchers' interventions. But numerous village potentials are very much still hidden and cannot be seen by way of just appearing. Systematic records analysis is needed to locate invisible facts. This documentation gap is a prevalent issue across Indonesian rural areas, as most villages still lack digitized systems for recording local economic and cultural assets, often leading to unoptimized development planning (Julianto et al., 2024). Empowerment serves as a process that enables individuals or groups to shift social and economic power balances, with researchers acting as catalysts who provide stimulation based on factual data processing (Putra, 2007).

Matesih Village in Karanganyar Regency has several potentials covering tourism, nature, agriculture and education. Scientific research works regarding Matesih are limited, despite so many community service activities and people who actively participate in the engagement. Up to date, relevant publications are only covering some aspects like flannel craft training (Khristiana et al., 2018), batik vocational program in Girilayu (Candra, 2019), and and digitalization of UMKM in Gantiwarno Village (Sibawaihi et al., 2025). In addition, there is an urgent need to digitalize village archives other than records relating to the Digital Village concept and as a means of mapping space efficiency for potentials, problems on villages which until now have become undefined discourse in local authorities.

This community service initiative points to a gap that can be filled by an approach utilizing a web-based digital database in the form of Geographical Information Systems (GIS). Some previous research has been conducted using GIS such as mapping of land resources (Gunawan, 2011), out map batik industry centers in Central Java province

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(Taryadi et al., 2019) and suitability agricultural land (Rika et al., 2016). Although, traditional GIS implementations in village settings have often focused on the visualization and dissemination of spatial information without much attention to collaborative knowledge sharing between stakeholders. Many village information systems do not function as interactive spaces in order to enable ongoing discourse and problem solving; they are instead utilized primarily as static repositories. This is the basis for proposing to integrate a Community of Practice (CoP) framework in Web-GIS settings specially that can support participatory collaboration between villages actors officials and researchers. A CoP consists of members from a domain who have knowledge sharing opportunities in order to expand their expertise through continuous learning (Wenger et al., 2002). The application presented is a platform to interactively mobilize various professionals and village authorities with spatial data. This study aims to: 1) design GIS-based village spatial data management application prototype; and 2) socialize the created system on local government element, especially for villages.

2. RESEARCH METHODOLOGY

Tools and Materials. This community service project mainly requires a laptop with technical specifications supporting web development and spatial data processing, plus an internet connection to get access to the online databases. Software support including web browsers (Google Chrome or Mozilla Firefox) for GIS application interface testing. Programming materials that make use of include Matesih Village geoJson spatial data for village zoning. Furthermore, we utilized textual data on village potential and problems, as well as digital archives in the form of PDFs or images obtained through observation and interviews with village authorities.

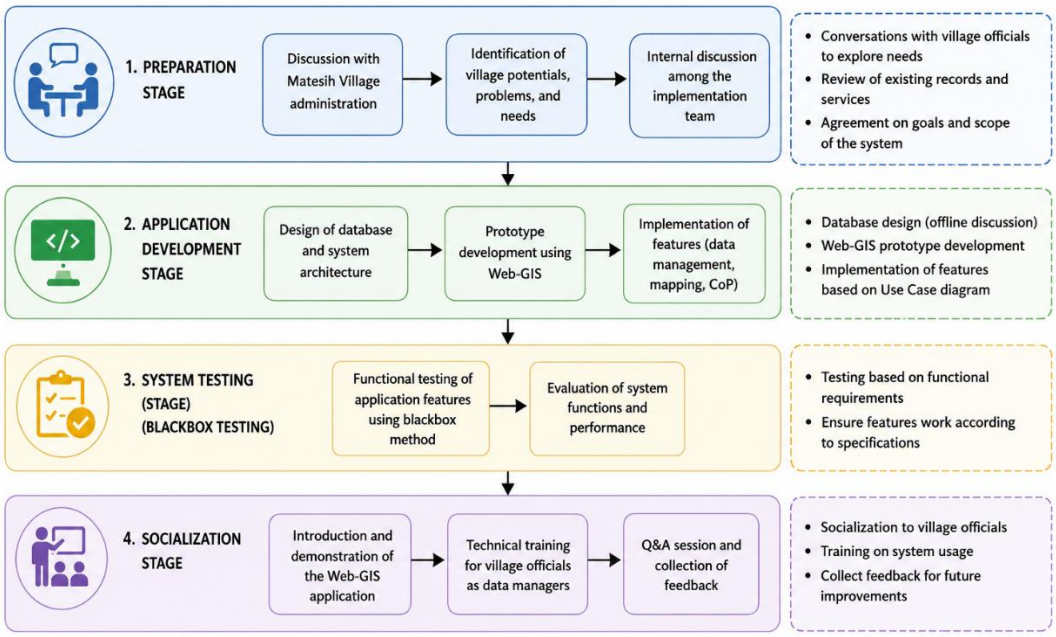

Figure 1. Stages of community service activities.

Implementation Method. This community service activity aimed to conduct training for the officials of Matesih Village, who are the primary managers in managing village data. This system was developed using a dynamic prototyping model to allow requirements of features to change along the way. As shown in Figure 1, the stages of community service activities include:

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1. The preparation stage began with the introduction of the application development team to Matesih Village officials. This stage involved deep discussions to identify village potential and issues, alongside the signing of a cooperation agreement between the researchers and the village.
2. The application development stage followed the prototyping cycle, including communication, quick planning, modeling, quick design, and prototype construction (Gusdevi et al., 2018). The system was designed for three user roles: system administrator, village official, and researcher
3. The functional testing stage was conducted using the blackbox testing method by the internal development team. The testing focused on ensuring that features such as area management, potential/problem coordinate input, discussion attachment management, and role-based access permissions functioned correctly according to the system's Use Case design
4. The socialization stage was carried out after the completion of development and internal testing. Socialization was conducted online through lectures, feature demonstrations, and Q&A sessions to provide technical understanding to village officials regarding independent data management. This process also served as a means to gather initial feedback for future system refinements.

3. RESULTS AND DISCUSSION

This community service project produced a protoype of Web-GIS application that was to apply Digital Village ideas in Matesih village. The activity unfolded in four main stages: preparation, app development, app testing, and socialization.

Preparation Stage. This stage consists of outlining the various potentials in Matesih Village such as tourism, agriculture and education sector that had not applied digital touch yet. Conversations with village officials indicated that there is an immediate need to digitize the villages' historical records and archives as well as some services so they could be spatially mapped. As in Figure 2, the preparation and coordination activities conducted with village representatives. Internal discussions about the database design process were also conducted (Figure 3).

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Figure 2. Discussion during the preparation stage with representatives of the Matesih Village administration.

Application Development Stage. The prototyping model has been used in designing the application since some features were still changing. The system thus developed supports three types of users namely, System Administrator; Village Official and Researcher. It successfully combines spatial data, represented as nursing villages zoning and point based each potential mapping are also included in a GeoJSON format. Core features include: category management; digital archive inventory (PDF/images); and discussion forums based on Community of Practice (CoP) framework enable shared learning. Figure 4 shows the Use Case diagram, which represents how users interact with system functionalities.

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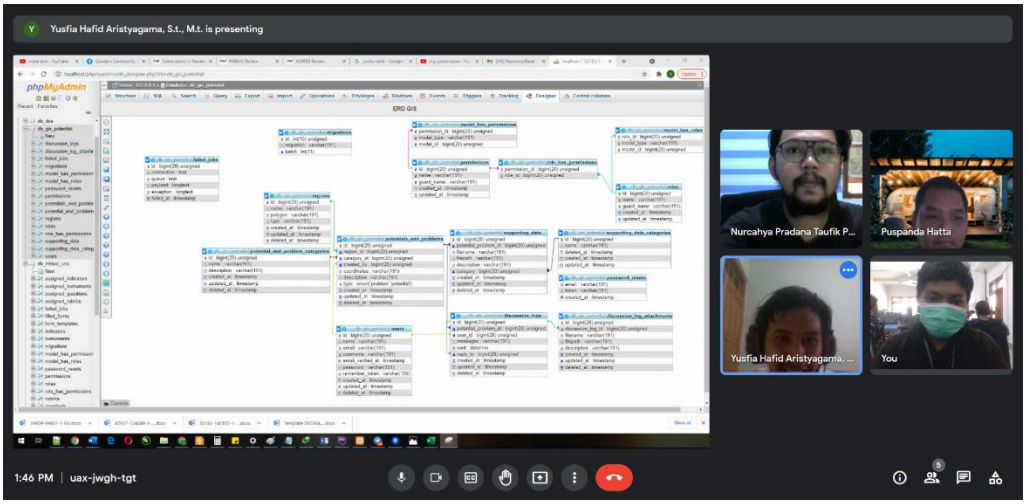

Figure 3. An internal discussion regarding the development of database design was conducted online.

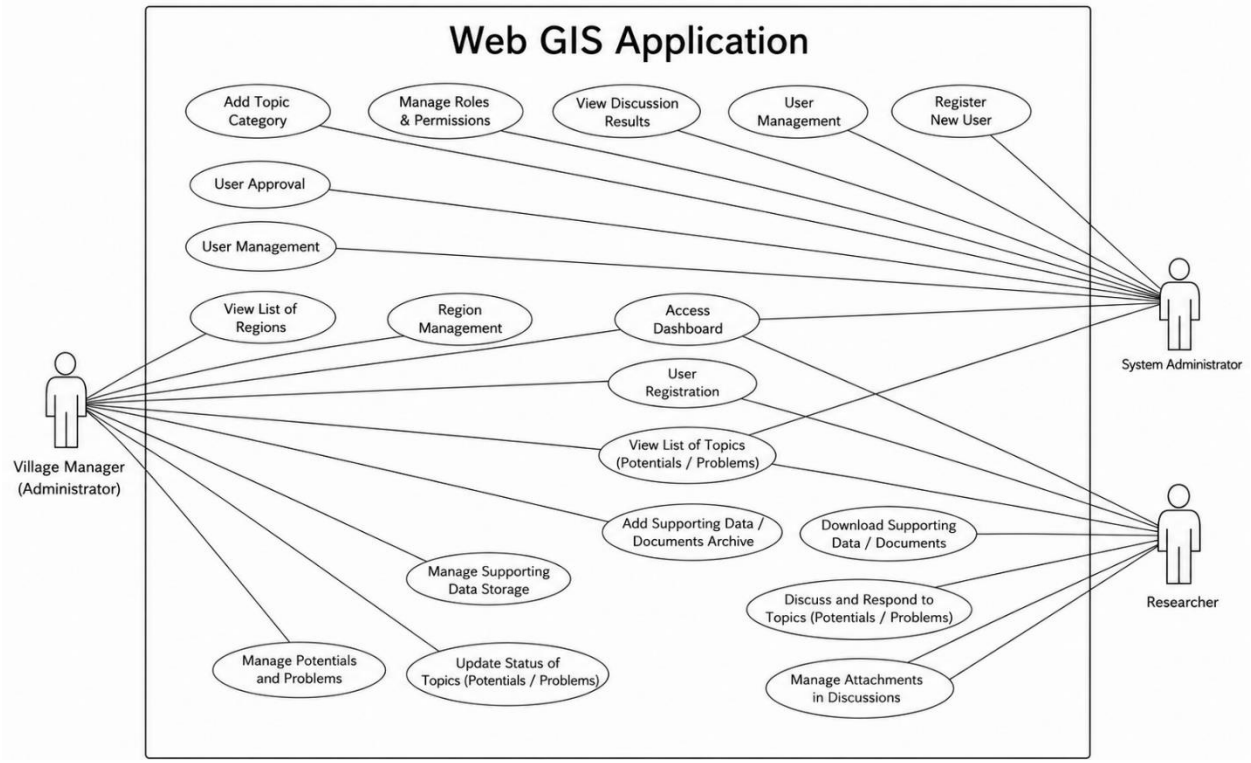

Figure 4. Use Case of a web-based GIS application.

System Testing (Blackbox Testing). This type of functional testing method based on a limited access to the internal development team by using BlackBox Test, is used before socialization stage which will make sure that all modules operated as per Use Case design. Table 1 is a high level summary of the blackbox testing outcome. Blackbox testing results show that all core modules are working according to the use cases designed. Internal testing shows that spatial visualization, archive integration, role-based access management (support for different roles), and collaborative discussion features mostly worked fine without major system failures. The results showed that the application has been functionally feasible to support digital inventory and collaborative village development activities. To note should be the spatial dashboard and discussion forum that were highly used as part of enabled functionalities to collectively

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identify problems. We allow for geographic visualization and discussion-based interaction between village officials with researchers which creates an efficient information exchange when compared to legacy manual documentation systems.

Tabel 1. Blackbox Testing Result

ID	Feature / Function	Test Scenario	Expected Result	Status
		A. General Users/Prospective Users		
1	User Registration	Prospective user fills out the name, email, role, and password form.	Data is saved; a message appears to wait for Admin activation.	Success
2	System Login	Entering an active email and password.	Accesses the dashboard according to the respective role's access rights.	Success
3	Spatial Dashboard	Opening the map and selecting area/topic filters.	The map displays zoning visualizations and potential points accurately.	Success
4	Logout	Pressing the logout menu on the profile dropdown.	The session ends and returns to the main login page.	Success
		B. System Administrator		
5	User Approval	Changing the user status toggle from In-Active to Active.	Approved users can log in to the application.	Success
6	Role Management	Checking/unchecking specific permissions on a role.	User functionality access rights change based on checked permissions.	Success
7	User Management	Editing data, changing passwords, or deleting users.	User data is updated or deleted from the system database.	Success
8	Internal Registration	Admin registers a new user directly (all roles).	A new account is created without the self-registration process.	Success
9	Topic Category	Adding sector categories (Tourism, Economy, etc.).	The category appears as an option when Officials create topics.	Success
10	Discussion Monitoring	Opening the topic list and viewing the entire comment history.	All user interactions are monitored by the admin.	Success
		C. Village Official		
11	Area Management	Creating polygon zoning for borders between hamlets on the map.	The region is saved and serves as a reference for filtering topics.	Success
12	Delete Area	Deleting data for a specific hamlet area.	The region is deleted along with all existing topics within it.	Success
13	Potential/Problem Input	Creating a new topic with a description and location coordinates.	The topic is published and appears on the spatial dashboard.	Success
14	Supporting Data Archive	Uploading documents (PDF/Image) to storage.	The file is saved on the server and is ready to be attached to topics.	Success
15	Data Relation	Attaching archive documents to specific discussion topics.	The document appears in the "Supporting Documents" section of the topic details.	Success
16	Set Topic Status	Changing the status to Open, Closed, or Solved.	The status label on the topic changes visually across the entire system.	Success
		D. Researcher		
17	Data Exploration	Selecting a topic title to view details and the location map.	Information details and supporting documents display perfectly.	Success
18	CoP Interaction	Creating a new comment or replying to another comment.	Messages appear chronologically as a form of shared learning.	Success

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19	Edit/Delete Comment	Updating or deleting a personal comment previously created.	The comment is updated or removed from the discussion history.	Success
20	Discussion Attachment	Adding supporting files to a personal comment.	The file is attached to the comment and can be downloaded by other users.	Success
21	Download Archive	Downloading files from the "Supporting Documents" section.	The file is successfully downloaded to the researcher's device for analysis.	Success

Socialization Stage. The last step was socialization which took place online because during the pandemic as well, technical training for village officials to run the application. Officials were empowered, through demos and Q & A, to update village potential data on their own. In the CoP frame, the application is a catalyst: The village supplies factual data and researchers provide innovative solutions through continuous interaction. Village officials in the socialization session were also exposed to some basic features of the application including geographical input, archive management, and discussions. This activity aims to show that the system can be operated in the context of village administration as an initial step towards digital-based data management. The data mapping and discussion options also allow for more organized communication between village stakeholders and researchers.

Discussion. The GIS-based CoP framework adds more value than the traditional methods of village information systems. This system does not only serve as a static mapping tool; it is also dynamic collaborative medium. Figure 5 shows the main interface of developed Web-GIS application. An example of an implemented spatial discussion interface we used is shown in Figure 6. Internally, internally, for over two years already conducting successful blackbox testing on the "V1-Release" system that's stable enough to be a long-term well beyond this initial release. By creating a collaborative platform for actual field data, this system helps researchers identify real research issues while also achieving the local government vision of Digital Village. This application is developed to see the possibilities of Web-GIS technology as a medium for digitalizing and arranging village spatial information. The inclusion of discussion functionalities within the system brings a collaborative dimension that might facilitate communication between village administrators and researchers. The system helps promote more systematic digital recording of spatial information about villages.

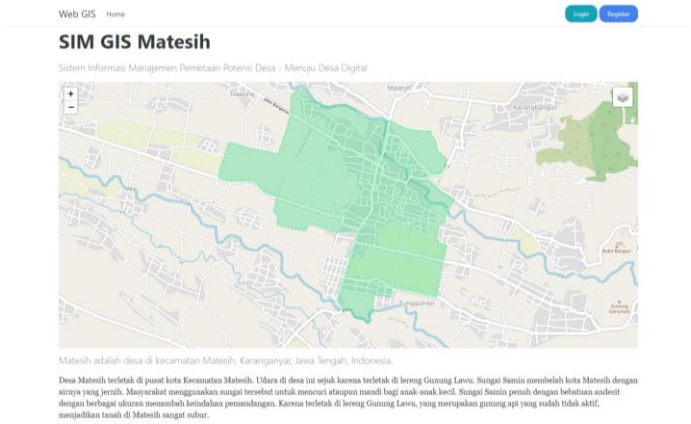

Figure 5. Homepage of the GIS application.

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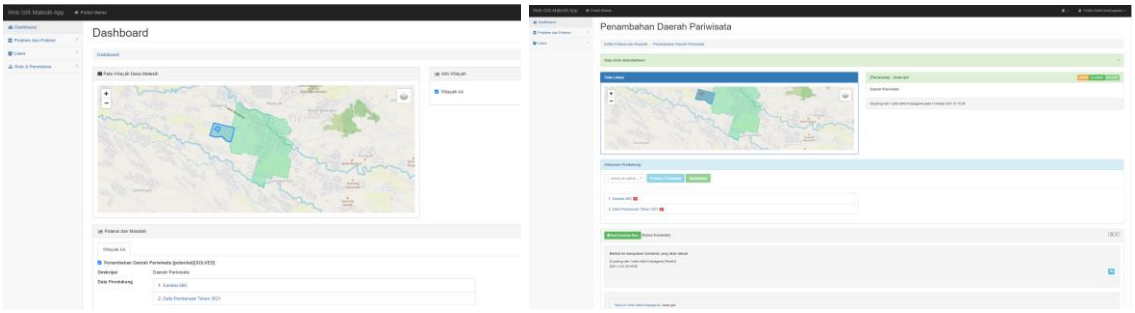

Figure 6. (a) Example of dashboard area (b) Example of the Web-GIS interface for managing village spatial information.

This study is limited to prototype development, functional testing, and initial socialization activities. The evaluation process has not yet included quantitative usability assessment or long-term implementation analysis involving broader stakeholders. Therefore, the reported results primarily reflect the functional readiness of the developed system.

4. CONCLUSION

The output of this community service project is a web-based GIS prototype for village potential and problems spatial mapping. Functional testing proved that the key functionalities worked as they should according to use cases. The implementation and socialization activities show that the system is applicable in terms of environment village administration as an initial step toward a digital village. This program is one of the tangible steps to make the "Digital Village" concept, which has not yet been realized out of local government discourse. Integrating the Community of Practice (CoP) means that this system will become a joint platform for village officials with researchers, it will be a vehicle to communicate so as to make direct feedback and continuous learning in helping the development process of villages. The project was carried out systematically in three phases: preparation, prototyping model and socialization. After socialisation and training, village officials could run the system without assistance, with outcome data available on-demand and feedback on how to improve in the future. The implementation results show that the system is able to support the digitization of village's potential data, as well as facilitate communication between the users. The integration of GIS and Community of Practice concepts provides opportunities for sustainable digital village development through spatially supported decision-making.

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