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Digides: Development of a Web-Based Information System for Village Data Administration and Management Using the Waterfal Method

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ABSTRACT

Villages as the smallest government unit have an important role in public services and data-driven development. However, many villages in Indonesia still rely on manual administration systems that are inefficient, slow, and prone to errors. This research aims to develop DIGIDES, a web-based digital information system designed to support integrated village data administration and management, including modules for population data, financial management, administrative services, and activity documentation. The system was developed using the Waterfall method and tested through the Black box and White box approaches, with all scenarios running well and meeting the functional requirements. The feasibility study showed an ROI of 60.64% in the second year and 118.69% in the third year, which indicates strong economic potential. However, the limitation of this research lies in the scope of testing that is still carried out in a controlled laboratory environment and has not yet involved actual village users in the User Acceptance Testing (UAT) phase.

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INTRODUCTION

Most villages in Indonesia still use a manual administration system which has an impact on slow services, inaccurate data, and low bureaucratic efficiency. Conventional systems of record often lead to data loss, duplication of information, and limited access to data-driven reporting and decision-making [1]. This situation shows that there is a gap between the needs of modern village governance and the digital facilities available today [2].

Digital transformation in governance has become an essential necessity in creating transparent, fast, and accountable public services. The Indonesian government has encouraged the digitalization of villages through policies such as The Village Building Movement and systems Smart Village which seeks to integrate technology in the village public service system [3]. However, at the implementation level, various challenges arise, such as inequality of access to technology, low digital literacy of village officials, and uneven infrastructure [4]. This condition causes the digital system presented to often not run optimally.

Various previous studies have proposed village information systems, but most of them still focus on limited functions such as population administration services or citizen data collection. For example, the Panda System [5] only covers population administration services, while SIPODANG [6] It is still limited to mobile apps with a single feature. System Muara Pangi [7] focus only on population data and correspondence without financial integration. In addition, most of

these systems have not conducted a systematic technical, organizational, or development feasibility analysis.

This study proposes DIGIDES, a web-based information system developed using the Waterfall method. DIGIDES offers a more comprehensive and integrated approach than the previous system. This system includes recording citizen data, administrative services, village financial management, and community communication forums in one platform. Not only that, this system is also equipped with a feasibility study from the technical, economic, and organizational sides, and is tested through the Black box and White box approaches. DIGIDES is expected to be a real solution in accelerating digital transformation that is inclusive, efficient, and in accordance with the real needs of village government.

METHOD

In this study, the development of the DIGIDES information system was carried out using the waterfall, which is a systematic and sequential approach that starts from needs analysis, system design, implementation, testing, to maintenance [8]. The selection of this method is based on its clear and structured characteristics, making it easier for the development team and the village to understand the flow of the system development process. The first stage begins with the identification of the needs and problems faced by the village government in administrative management. Furthermore, a system design is carried out which includes interface design, structure database, as well as workflows. Once the implementation phase is complete, the system will be tested to ensure its functionality is running properly, before finally being fully implemented and evaluated periodically [10].

Methodology Waterfall is one of the classic approaches in software development that follows the SDLC model (Software Development Life Cycle), with a sequence of stages that are carried out in a linear and systematic manner [9]. Each phase in this method is interdependent and must be completed completely before proceeding to the next phase. The main stages in the Waterfall includes: planning, needs analysis, system design, implementation (coding), testing, and maintenance of the system as depicted in Figure 1 [10]. Use of the Waterfall In this application development project, it is based on its advantages in providing a clear process structure, complete documentation, and ease of managing projects that have specific needs that have been determined from the beginning. In addition, this method also minimizes the risk of major changes in the middle of development, making it suitable for applications with a stable scope and needs [7].

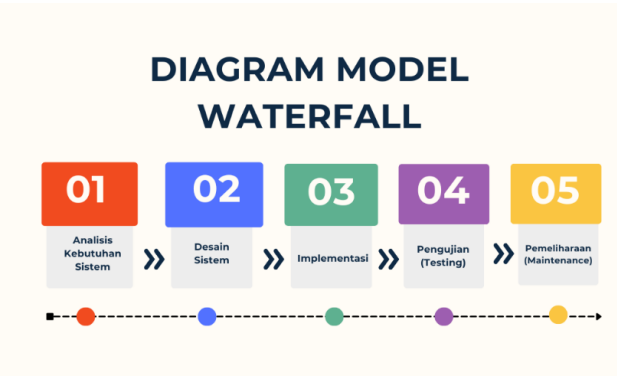

Figure 1. Diagram Model Waterfall

Requirements Analysis

This initial step involves the process of collecting information from users with the aim of understanding their expectations for the system to be developed, as well as identifying existing limitations. Direct communication such as interviews, group discussions, and surveys are the

main methods of obtaining data. The information collected is then analyzed to formulate the system's requirements in detail.

System Design

Once the system needs are determined, the next stage is to design the structure and technical specifications of the system. This design includes the selection of hardware to be used, the preparation of functional and non-functional needs, and the overall design of the system architecture as a guideline in the next development process.

Implementation

In this phase, the coding of the system is carried out based on the design that has been made. The system is built in a modular manner, starting from small units that are developed and tested one by one. Each unit is independently tested to ensure that each part of the system is working as intended.

Testing and Validation

This stage aims to evaluate whether the developed system is in accordance with the previously set specifications. This process includes several types of testing, such as unit testing (individual modules), integration testing (looking at interactions between modules), and acceptance testing (feedback from users to ensure the system meets their needs).

Maintenance

Once the system is finished building and in use, the final step is to perform regular maintenance. This stage includes fixing errors that arise during use, improving performance, and adjusting to new needs that may arise after the implementation of the system.

Technology Used The development of the DIGIDES system is carried out by utilizing web-based technology. On the backend side, the PHP programming language with the Laravel framework is used to make it easier to manage application and database logic. The frontend side uses HTML, CSS, and JavaScript, with the help of the Bootstrap framework for responsive interface design.

For databases, MySQL is used as a relational database management system. The interface design is designed using Figma for ease of design collaboration. Visual Studio Code is used as a development environment (IDE), while XAMPP is used as a local server and Postman for API testing. The selection of this technology takes into account the availability of resources, ease of implementation, and efficiency of system development.

RESULTS AND DISCUSSION

Once all stages in the Waterfall method have been executed to the maintenance stage, the system is declared ready for functional use. With the entire development process that has been gone from needs analysis, design, implementation, to testing and maintenance, developers are now entering the initial evaluation phase of the overall system readiness. The next stage focuses on system planning (System Requirement), which will assess the feasibility of the system in terms of technical, human resources, and technological readiness that supports the operation of the system [11].

System Requirement

The system developer first conducts an initial evaluation of the system's readiness as a whole. This evaluation includes technical aspects, readiness of human resources, and availability of supporting technology. The goal is to ensure that the system to be developed is really feasible to implement. Therefore, a feasibility study is conducted to assess whether the system can be built

and executed as needed, as well as to identify potential risks from the outset before moving on to the more detailed planning stage [2].

Table 1. System Requirementss

Feasibility Study of Digital Information Systems for Village Data Administration and Management (DIGIDES)
Technical Feasibility Study
The DIGIDES system is considered technically feasible, although there are several risks that need to be considered: Risks Related to Familiarity with Apps: Moderate Risk 1. Users: Some users are quite familiar with how the app operates, but still need more training to improve their understanding. 2. Developers: The development team has good experience in the development of village digital technology-based applications and government administration systems. Risks Associated with Familiarity with Technology: Low Risk 1. Users: Most users are already familiar with the app's supporting technology, although some require further socialization. 2. Developers: The development team is very familiar with the platform, programming language, and IDE tools used in the development of DIGIDES. Risks Associated with Project Size: Low Risk This project requires 6 Man/Month with an estimated development time of 6 months, which is still within the feasibility limit of the project. Compatibility with External Systems: Medium Risk 1. User need for integration: The application needs to be integrated with the national population system or other village administration application to ensure operational efficiency. 2. Technology compatibility: The app has been designed to be compatible with the technology used in village organizations.
Economic Feasibility Study
Based on the cost and benefit analysis, the DIGIDES application shows good potential in improving village administration efficiency and financial transparency. Here is a summary of the results of the analysis: a. Return on Investment (ROI) after 3 years: The estimated ROI reaches 60.64% after the second year and is projected to increase to 18.69% in the third year. b. Break Even Point (BEP): The application is expected to break even within 3.15 years. c. Total Benefits after 3 years: The increase in village income and the reduction in operational costs resulted in a total benefit of Rp. 497,107,438.
Organizational Feasibility Study

Organizationally, the risk of developing this application is relatively low. DIGIDES is designed to support the vision and mission of the village in improving administrative efficiency and community involvement in decision-making. The structure of the development team consists of:

- User/Product Owner: Village Head and Village Apparatus
- Project Manager: Musyrifah Sa'adah
- System Analyst: Andi Azzahfira Putri Suhaoping
- Programs: Faldy
- Business Analyst, Tester: Andi Muftihatul Khaerati

Based on the organizational feasibility analysis, the DIGIDES application is considered feasible to be developed in accordance with the needs and business processes of the related work units.

Analysis Results

The analysis process is carried out to identify system needs, both from the functional and non-functional sides. Functional needs include core services provided by the DIGIDES application, non-functional needs related to system quality which include aspects of availability, security, performance, compatibility, and ease of access. Details of these non-functional needs are presented in Table 2.

Table 2. Non-Functional Needs

Non Functional Requirements		
ID	**Parameter**	**Explanation**
NFR-001	Availability	The app must be available 24/7 with a minimum uptime of 99.9%.
NFR-002	Reliability	The system failure rate should not exceed 0.1% during operation.
NFR-003	Ergonomy	The user interface should be intuitive and responsive on mobile/desktop devices.
NFR-004	Portability	The app must be compatible with Chrome, Firefox, and Safari browsers.
NFR-005	Server Load	The server must be able to handle 1,000+ concurrent requests without any performance degradation.
NFR-006	Response Time	The system response time is ≤3 seconds for all operations.
NFR-007	Security	Data encryption with HTTPS and RBAC for admins.
NFR-008	Language of Communication	All content is in Indonesian.

Table 3. Functional Needs

Functional Requirements		
ID	**Parameter**	**Explanation**
FR-001	User Registration	New users can sign up by filling out a form that includes a name, email address, and password. Successful registration grants access to the app's features.
FR-002	User Authentication	Registered users can log in to the app using a valid username and password. Successful authentication grants access to the user's dashboard and other features.
FR-003	Forgot Password	Users who forget their passwords can reset their passwords by entering their registered email address and following the link sent to the email.
FR-004	Citizen Data Management	Admins can add, edit, and delete villagers' data. Citizens' data includes names, NIKs, addresses, and other information.
FR-005	Village Financial and Budget Management	Admins can record village income and expenses, as well as generate financial reports automatically.
FR-006	Community Discussion Forum	Villagers can participate in discussion forums to discuss village-related topics. Admins can moderate discussions.
FR-007	Administrative Services	Residents can apply for administrative services (making certificates) online. Admins can process the request.
FR-008	Citizen Data Search	Admins can search for citizen data based on certain criteria (name, NIK).

After defining the functional needs (Functional Requirements) and non-functional (Non-Functional Requirements), the next step is to describe the interaction between the user and the system in the form of Use case diagram. This diagram serves to visualize the main scenarios that will be executed by actors in the system [12] [6], so that it can help in understanding the scope of functionality that has been designed on the DIGIDES system.

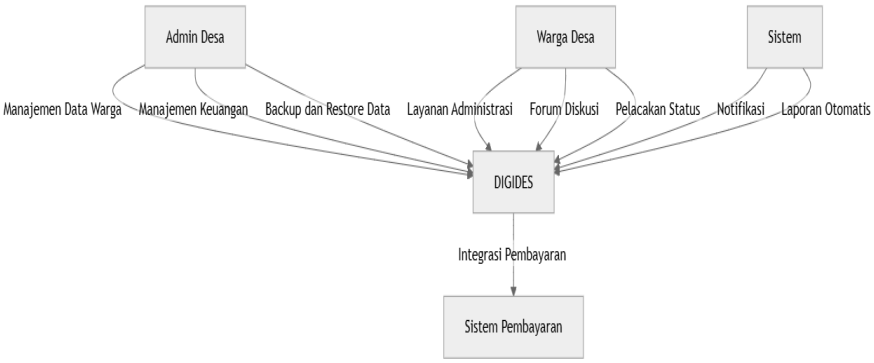

Figure 2. Use case diagram

a. User Registration Use Case: New users register for the system by filling out the registration form (name, email, password). If the data is valid, the system creates a new account and displays a success message.
b. Use Case Login: Registered users log in using username and password. If valid, the system directs the user to the dashboard.
c. Use Case Forgot Password: Users who have forgotten passwords can reset their passwords by entering the registered email. The system sends a password reset link to the user's email.
d. Citizen Data Management Use Case: Village Admins add, edit, or delete citizen data. Citizens' data includes names, NIKs, addresses, and other information.
e. Use Case Village Financial Management: Village Admins record village income and expenditure and produce financial reports.
f. Use Case Administrative Services: Villagers apply for administrative services (making a certificate). The admin processes the request.

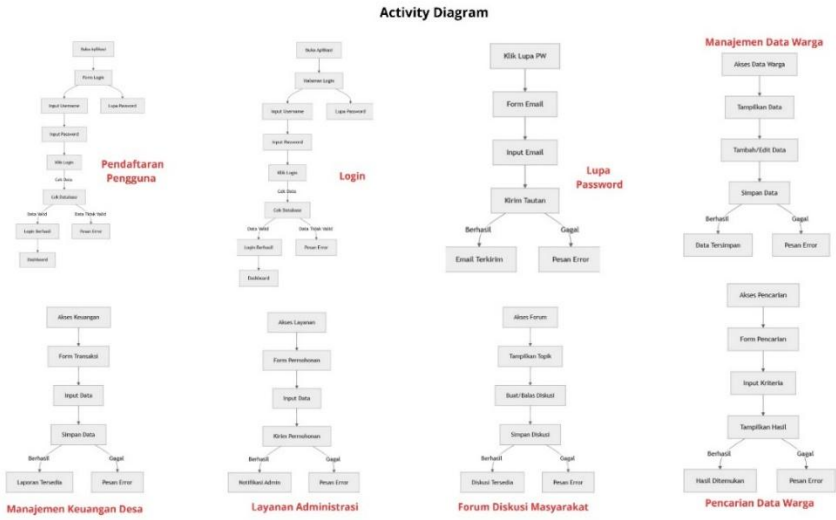

Figure 3. Activity diagram

Figure 3 is an activity diagram that describes the flow of activities in the village information system, covering several main features such as user registration, login process, administrative services, village financial management, community discussion forums, and management and search of citizen data. Each process is described sequentially from user input

to system output, such as validation results, data storage, and error messages in the event of failure. These diagrams help clarify the logic flow in the system, so that feature development and implementation can be done in a structured and efficient manner.

Design

The results of this system design stage include the design of the Use Case Design and the Class diagram & User interface (UI) design which is tailored to the needs of the DIGIDES system.

1. Use Case Design and Class diagrams

   For the system design stage, a modeling approach is used using Unified Modeling Language (UML) to visually describe the structure and relationships between classes in a system [13]. One of the models used is Class diagram which represents the blueprint of the system in the form of attributes, methods, and relationships between relevant entities, as shown in Figure 4.

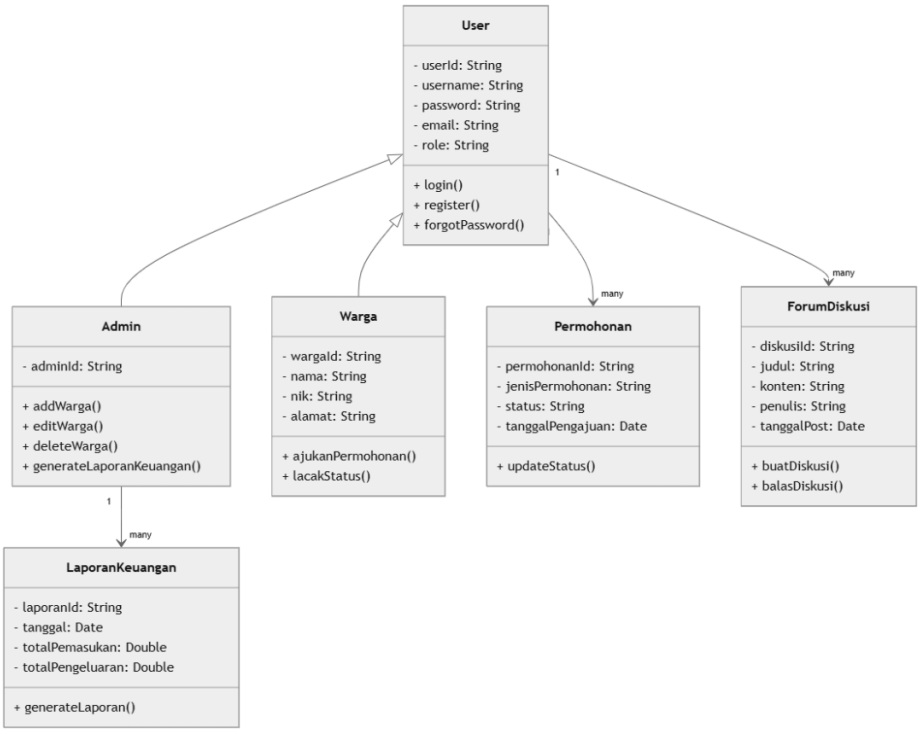

Figure 4. Class diagram

Enter the sequence chart (Sequence diagram) Visual representations commonly used in software development to illustrate how objects in the system interact and exchange messages over time [5]. This diagram helps clarify the order in which messages are sent between objects as well as the resulting responses [14] which is particularly useful in designing communication between processes that conform to formal protocols, especially in the detailed design stage of software development.

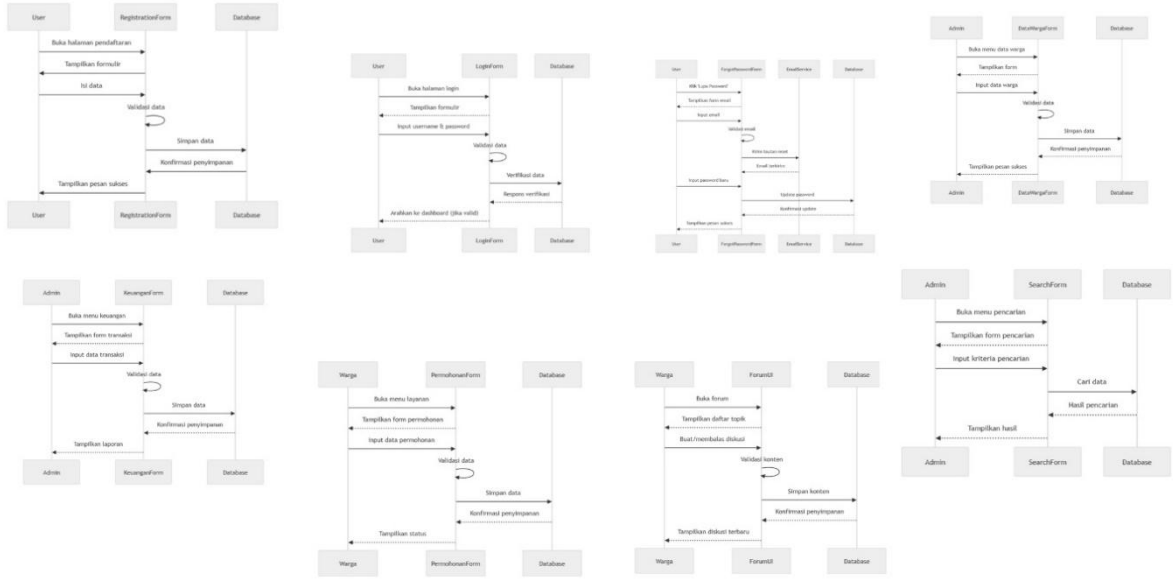

Figure 5. Sequence diagram

2. Desain User interface (UI)

At this stage, the user interface (UI) design is done using platform Figma, a digital design tool that supports direct online collaboration [15]. The UI design is designed with ease of use and consistent appearance in mind so that users can interact with the system efficiently [16]. Every interface element, from the registration form to the service display, is designed to be responsive and accessible, while supporting clear navigation of key features in the DIGIDES system.

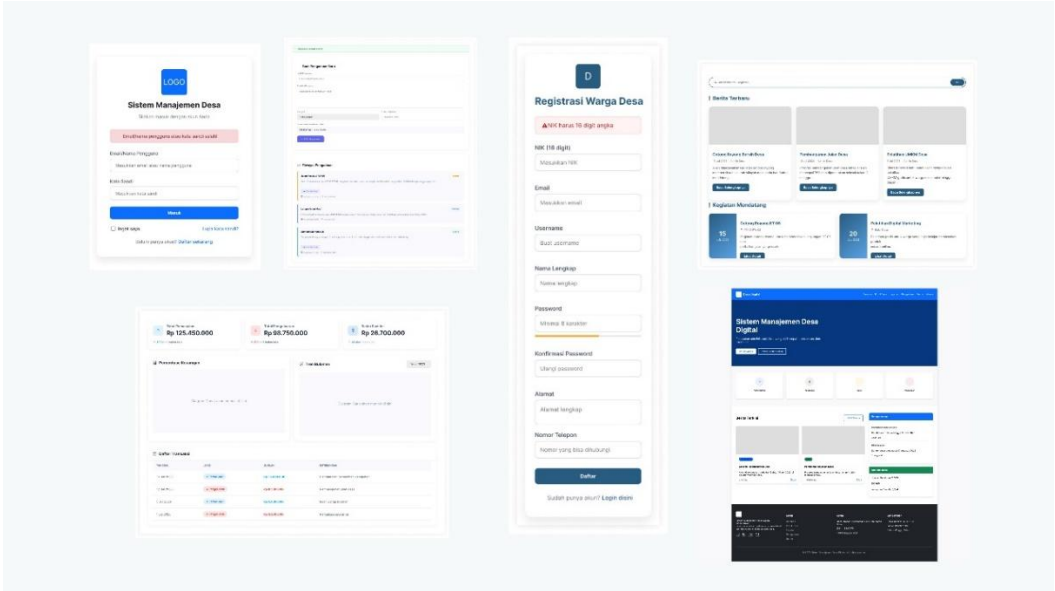

Figure 6. User interface (UI) design

The view seen in the image is the result of the design of the village digital information system interface (DIGIDES), which includes several important features such as login, citizen registration, main dashboard, and transaction information. Each element is designed with a simple yet informative interface, to make it easier for users to interact with the system. The

login and registration pages provide complete and clear fill forms, while the dashboard presents various administrative and statistical information relevant to village activities in a concise and easy-to-understand manner.

The development process of this system follows the flow of the waterfall method, which is carried out sequentially starting from the collection of needs, design design, implementation, testing, to the maintenance stage. In the early stages, user needs such as convenient data access, account security, and ease of information management are identified in detail. After that, the results of the analysis are used as the basis for designing the system and user interface as shown. Implementation is carried out by changing the design into an executable application, then thoroughly testing its functionality. After the system is declared to be running well, the maintenance stage is carried out to ensure that the service remains optimal and can adapt to changes in needs in the future.

Implementation Results

a. Coding Results

Register

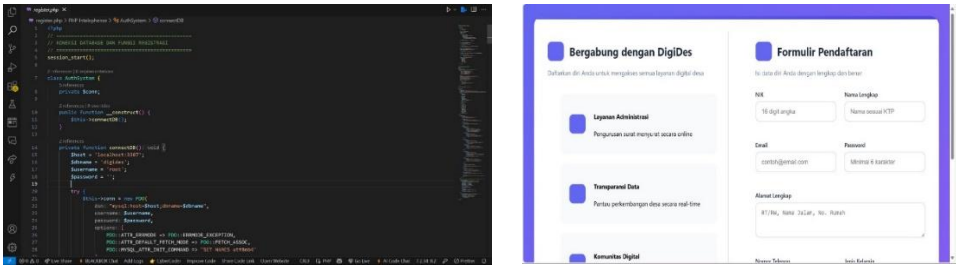

Figure 7. Register Page Code and UI Display

Login

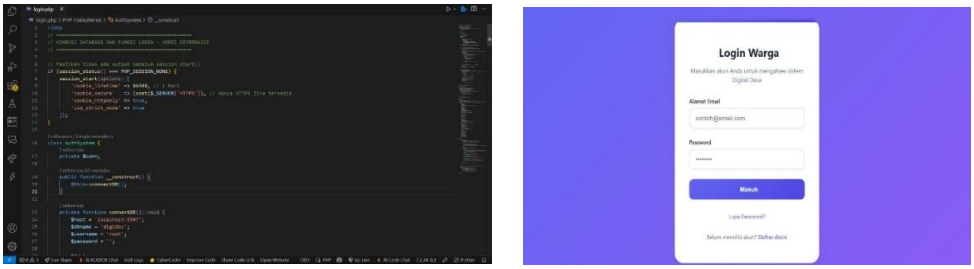

Figure 8. Login Page Code and UI Display

Porch

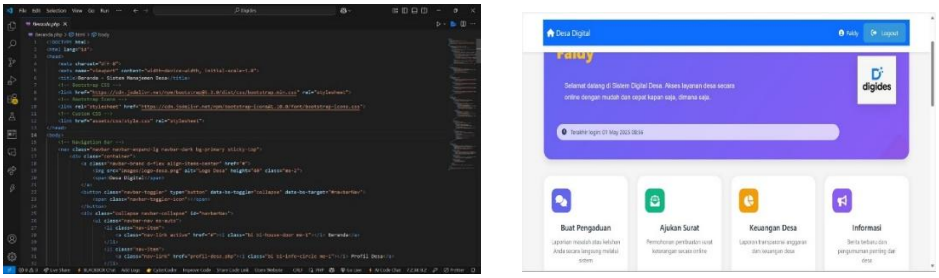

Figure 9. Home Page Code and UI View

Complaint

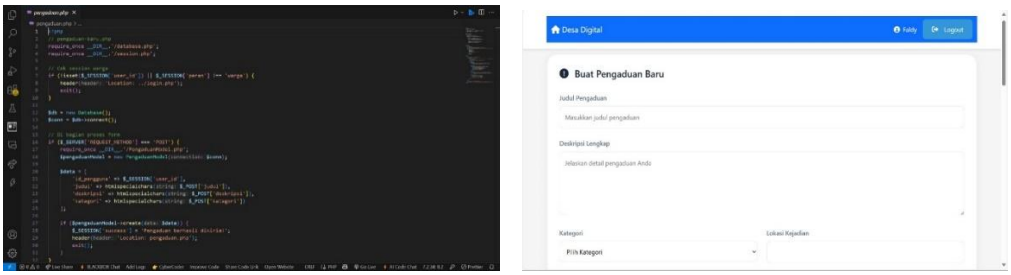

Figure 10. Complaint Page Code and UI Display

Mail Service

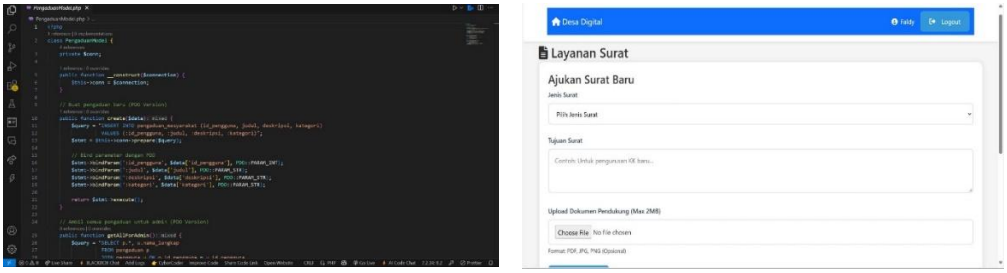

Figure 11. Mail Service Page Code and UI View

Village Finance

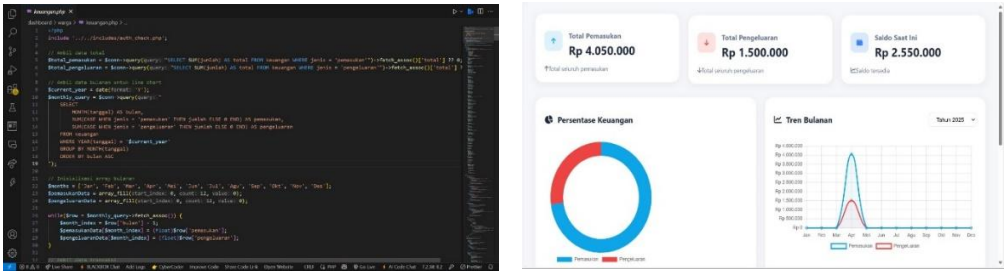

Figure 12. Village Finance Page Code and UI Display

Information

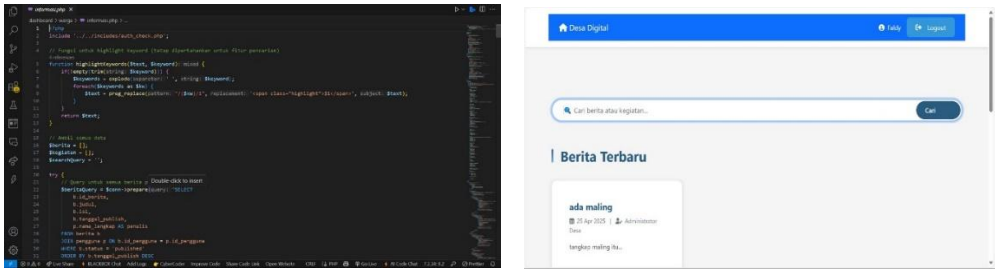

Figure 13. Display of Code and UI Information Pages

b. Test Results

Table 4. Black box test results

Black box testing				
Test Code	**Test Case**	**Expected Results**	**Results Obtained**	**Status**
UB-1	Log in with a blank username and password	The error message "Username and password must not be blank" is displayed	The error message "Username and password must not be blank" appears	Succeed
UB-2	Log in with the wrong username and password	Error message "Email or Password incorrect" displayed	" Email or Password incorrect" error message appears	Succeed
UB-3	Log in with the correct username and password	Successfully log in and redirect to the dashboard	Successfully log in and redirect to the dashboard	Succeed
UB-4	Register with complete data	"Successful registration" message and redirect to dashboard	"Successful registration" message and redirect to dashboard	Succeed
UB-5	Register without filling in any of the indicators	Error message "Indicator must be filled" displayed	The error message "Indicator must be filled" appears	Succeed
UB-6	Enter a registered email for password reset	Password reset instructions sent to email	Password reset instructions are successfully sent and received in the email	Succeed
UB-7	Filling out a complaint without filling in one of the indicators	Error message "Indicator must be filled" displayed	Error message "Indicator must be filled" displayed	Succeed
UB-8	Fill out a complaint completely	"Complaint successfully filed" message	"Complaint successfully filed" message	Succeed

UB-9	Filling out a letter submission without filling in one of the indicators	Error message "Indicator must be filled" displayed	Error message "Indicator must be filled" displayed	Succeed
UB-10	Fill out the letter submission completely	"Letter submission successfully submitted" message	"Letter submission successfully submitted" message	Succeed
UB-11	Fill in the news or activity you want to search for	Show available news or activities if they match your search	Show available news or activities if they match your search	Succeed

Table 5. White box-Login test results

Black box testing						
Test Code	**Function / Path Name**	**Test Case**	**Tested Conditions**	**Expected Results**	**Results Obtained**	**Status**
UW-1	login(username, password)	Blank username and password	if username == "" or password == ""	Return error: "Username and password cannot be blank"	Error: "Username and password cannot be blank"	Succeed
UW-2	login(username, password)	Wrong username, wrong password	if user not in database	Return error: "Email or Password is wrong"	Error: "Email or Password is incorrect"	Succeed
UW-3	login(username, password)	Username is correct, password is wrong	if user exists and password != user.password	Return error: "Email or Password is wrong"	Error: "Email or Password is incorrect"	Succeed
UW-4	login(username, password)	Username and password are correct	if user exists and password == user.password	Redirect ke dashboard	Redirect ke dashboard	Succeed

UW-5	login() internal flow	Check your password hash	if hash(password_input) == password_hash_db	Validation of success	Validation of success	Succeed
UW-6	login() internal flow	Session created after successful login	if login_success: create_session()	Active sessions and stored user data	Active session	Succeed
UW-7	login() path else	All conditions fail	else fallback	Return error generic	Return error "Email or Password is wrong"	Succeed

The image shows two tables of software test results, namely Black box testing (Table 4) and White box testing – Login (Table 5). In Table 4, the tests are carried out based on user input without regard to the internal structure of the program code. Each test case such as login with a different combination of inputs (blank, false, true), as well as registration and filling of complaints, is tested to ensure that the system responds as expected. All test results show a status of "Successful", which means that the system successfully displays an error message or resumes the process according to the scenario being tested.

Meanwhile, Table 5 shows the results of white box tests that focus on the internal logic path of the login() function in the system. Each path is tested against specific conditions, such as empty inputs, unregistered users, or a combination of correct or incorrect usernames and passwords. The test results show that all conditions are executed as expected, such as displaying error messages or pointing to the dashboard. However, the limitation of this research lies in the scale of the system trial which is still laboratory, which has not involved village users directly in the UAT stage of this research.

Discussion

The results of the development and implementation of DIGIDES show that this system is able to answer the needs of administration and public services at the village level in an efficient and integrated manner. To provide a broader perspective, here is a comparison between DIGIDES and some similar systems from previous research:

1. Panda System (Khairunnisa et al., 2024) – This system focuses on online population administration services. Compared to DIGIDES, Panda has a more limited range of features and does not include financial services and community discussion forums [5].
2. SIPODANG (Mursalim et al., 2024) – This Android-based information system is designed for citizen data collection. However, DIGIDES excels because it is web-based and brings together many features in a single platform, including village finance and mail services [6].

3. Muara Pangi Village System (Yandani et al., 2024) – Has web-based population data and correspondence management features. However, this system does not yet support village financial integration and is still limited to certain regions. DIGIDES is more flexible and scalable [7].
4. E-DISARPUS Mobile (Rahayu et al., 2024) – This system focuses on regional library digital services. Although not specific to the village, the waterfall used similarly, but DIGIDES is more complex in the implementation of public services holistically [2].
5. School Administration System of SMK Al-Habibata'in (Mukrodin, 2020) – Used waterfall and administrative scope, but limited to the education sector. DIGIDES has a bigger challenge because it involves the general public with varying digital literacy [17].
6. Laikanggu App (Aksa et al., 2025) – Focus on Figma-based UI/UX design with an approach user centered design. DIGIDES also adopts an intuitive UI design, but it has greater challenges due to the more complex system coverage and users from diverse technological backgrounds [1].
7. CV XYZ Personnel Information System (Purwanto, 2020) – Focus on company administration with limited features. DIGIDES excels in terms of multi-service integration and scalability in the context of village government [13].

In general, the main advantages of DIGIDES over similar systems are:

- Multi-service integration (population data, finance, mail services, complaints, information).
- A complete technical, economic, and organizational feasibility approach.
- Flexibility and scalability for different types of villages.

Support for inclusive digital transformation, including users with low technology literacy.

CONCLUSION

This study shows that the implementation of the village digital information system (DIGIDES) with the Waterfall method approach is able to produce a structured, stable, and in accordance with the administrative needs of the village government. Through the stages of needs analysis, design, implementation, testing, and maintenance, this system successfully integrates various main functions such as population data management, mail services, village finance, and citizen communication forums. The test results show that DIGIDES functions as expected and is feasible from a technical, economic, and organizational point of view. This research contributes to the development of science in the field of information technology in the village government by providing a model for the development of systems that can be replicated and further developed according to local needs.

As a suggestion, it is recommended that continuous training be carried out to village officials to improve digital literacy, as well as socialization to the community so that the use of the system can run optimally. In addition, the development of advanced features such as village data analytics and integration with national systems will further strengthen DIGIDES' role in supporting efficient, transparent, and participatory village governance.

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