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The development of a web-based internship information system at DLHK-DIY using the waterfall method

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Abstract: The Department of Environment and Forestry of the Special Region of Yogyakarta (DLHK-DIY) encounters a significant challenge related to the insufficient integration of information services for the admission of internship and research programs. This has resulted in difficulties for applicants who seek up-to-date information from the offices or departments within DLHK-DIY, as well as challenges in the inefficient management of data by the institution. This research aims to resolve these challenges through the development of a web-based platform designed to optimize the processes of information and data management. As a result, the deployment of this platform will allow applicants to access information with greater ease and efficiency, while simultaneously improving the institution's ability to manage applicant data. The development methodology for this platform employs the Waterfall approach, encompassing phases such as Needs Analysis, System Design, Implementation, and Testing. The results of this study are projected to enhance the efficiency and effectiveness of the internship and research program implementation at DLHK-DIY. The progress of information technology in the realm of public services, as exemplified by this initiative, is expected to significantly influence service enhancement and data management within the institution.

Keywords: Internship, DLHK-DIY, Platform, Waterfall, Web-Based

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Introduction

The Department of Environment and Forestry of the Special Region of Yogyakarta (DLHK-DIY) bears the responsibility for preserving and protecting the sustainability of the environment and natural resources, particularly in the forestry sector. A crucial effort to achieve these goals is by supporting research, internships, and field practices for students and researchers. However, challenges persist in providing fast, accurate, and integrated information regarding the available research or internship services at DLHK-DIY. This can hinder the interest of students and researchers in conducting research or internships at DLHK-DIY. A survey conducted by DLHK DIY staff showed that there was a high demand for a centralized and easily accessible platform to obtain information on internship and research opportunities. Respondents highlighted difficulties in finding up-to-date information, which led to missed opportunities and decreased engagement with DLHK-DIY programs.

The ongoing industrial revolution in information technology, especially the internet, presents significant opportunities to enhance public access to information and provide more efficient services. Therefore, the development of a web-based information service program becomes a suitable solution to address these challenges. This aligns with the regulations of Law Number 14 of 2008 concerning public information transparency (UU KIP). The law emphasizes that to achieve efficient, accurate, and straightforward services, every public entity is required to appoint an official responsible for information and documentation management. They are also tasked with designing and developing a system that delivers information quickly, conveniently, and simply, following the technical standards applicable to public information services nationwide [1].

The development of a web-based information service program can provide simple, comprehensive, and transparent information access for students, researchers, and the general public interested in conducting research, internships, or field practices at DLHK-DIY. Through the utilization of innovative web technology, this service will offer unprecedented convenience for prospective researchers or interns in accessing information related to requirements, quotas, offers, and procedures applicable at DLHK-DIY. Additionally, the platform introduces innovation in facilitating more efficient communication between internal departments or offices.

Based on the literature review, several previous studies have explored the development of web-based information services for research or internships. The research conducted by Nur Aini et al., titled "Development of Internship Information Service Information System at Malang State Polytechnic," has the advantage that the waterfall method has clear and structured steps, facilitating researchers in developing complex information systems. However, having structured stages may make it difficult for researchers to make changes to the information system after certain stages have been completed [2].

Furthermore, studies conducted by [3], [4], [5], [6], [7] offer the advantage of presenting comprehensive and integrated information, thereby enhancing efficiency. However, these studies are limited by the lack of integration with related information systems, and their focus tends to be on isolated functionalities rather than a holistic system that serves all stakeholders effectively. The primary gap identified in previous studies is the lack of a fully integrated system that not only offers comprehensive and detailed information but also seamlessly connects with other related systems, thereby improving usability for all stakeholders. While previous research has successfully developed systems with specific functionalities, they often fall short in providing a unified platform that integrates all necessary features, including administrative modules, user management, and data handling, which are essential for a more streamlined and efficient user experience.

This study aims to address these gaps by designing a comprehensive, integrated, and efficient web-based information service system for research and internships at DLHK-DIY. This study goes beyond the scope of previous research by ensuring that all necessary functionalities are not only included but also fully integrated, enabling fast, accurate, and seamless access to information for students, researchers, and the general public.

Methodology

In this context, the waterfall methodology will be employed to develop the Internship Information System at DLHK-DIY. The waterfall methodology is a systematic approach to software development, distinguished by its sequential progression through distinct phases: requirement analysis, system design, implementation, testing, and maintenance. Each phase must be fully completed before moving to the next one, which helps in understanding both system and user requirements thoroughly, thus facilitating the systematic development of the system [8].

For the Internship Information System, the waterfall methodology will guide the process from initial requirements gathering with DLHK-DIY to the final deployment. This process begins with requirement analysis, where detailed needs are collected from stakeholders and users to define the system's features and functionalities. In the system design phase, design documents and prototypes are developed based on the gathered requirements. After this, the implementation phase involves building the system in accordance with the design specifications. The process culminates in the testing phase, where the system undergoes thorough testing to verify that it meets the specified requirements and functions as intended.

While the waterfall method provides a clear, structured approach, it has limitations in accommodating changes once the project progresses beyond the design phase. This rigidity can be challenging if user requirements evolve or if issues are discovered late in the development process [9]. To mitigate this, continuous stakeholder engagement and comprehensive testing are essential to identify and resolve issues early in the development cycle.

The Research Stage

The solution design flowchart in this study employs the Waterfall methodology, which follows a sequential progression in the software development life cycle [10], This process initiates with analysis, followed by design, coding, testing, and concluding with the support phase [11].

Implementing a computerized system will improve efficiency and precision while enhancing security. Furthermore, data retrieval will become more streamlined [12]. The stages of the Waterfall methodology utilized in this research are illustrated in Figure 1.

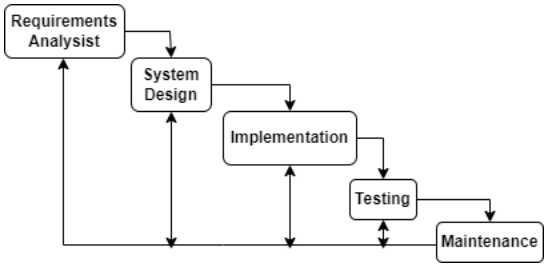

Figure 1. Waterfall diagram

This stage begins with the analysis of requirements, followed by system design. Subsequently, the solution is implemented, and testing is conducted using Black Box Testing. Black Box Testing, also known as behavioral testing, is a method of evaluating software where the tester does not have access to or knowledge of the internal structure and logic of the system being tested. Testers refer to the requirements specification and do not require an analysis of the code. In this Black Box Testing, the approach is conducted from the perspective of end users [13].

Requirements Analysis

In the Waterfall method, the initial stage involves requirement analysis, where information is gathered through interviews and field observations to discover necessary information for system development [14]. This phase identifies needs, including software and hardware requirements, for the website's creation. The results of the problem excavation are then analyzed and converted into a business process as depicted in Figure 2.

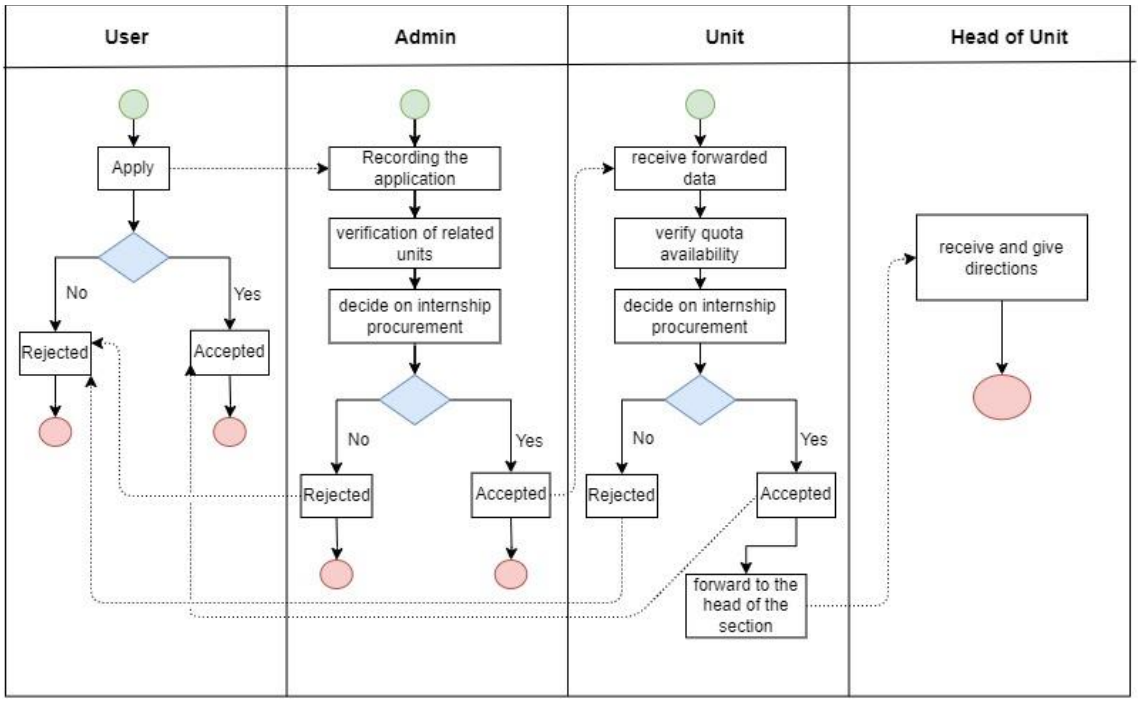

Figure 2. Business process

In the past, internship applications were submitted manually. In this updated business process, the system can now facilitate the submission of internship application letters. The system's users include Interns, Units, and Unit Heads. Available features in the system include submitting internship applications, viewing internship-related information, and managing registration, login, and logout activities. These features are detailed in the functional requirements: the system

should allow the submission of internship applications with registration documents and be capable of storing data related to registration, login, and logout.

System Design

The system design for the Internship Information System includes a detailed diagram of the business processes. This diagram visualizes the specific workflows involved in managing internship applications, from login for Admin and User to view tracking status. The system architecture within this informational framework employs the Unified Modeling Language (UML), a widely recognized and suitable tool for graphically illustrating the relationships between software components [15] or a standard language for specifying, visualizing, and constructing software [16]. Unified Modeling Language (UML) is also employed to facilitate system development by illustrating and documenting the outcomes of the preceding phase, specifically the requirements analysis stage, and subsequently providing a visual representation of these results [17].

The Use Case Diagram serves to depict the activities that users can execute within the operational system. This diagram illustrates various activities or interactions that occur between the system and actors [18]. It is useful for identifying each function in the system and determining who has access to or uses these functions [19]. Information about the admin use case can be found in the diagram presented in Figure 3.

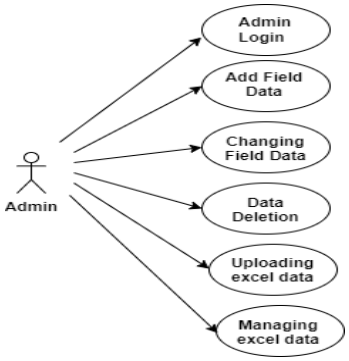

Figure 3. UCD for admin

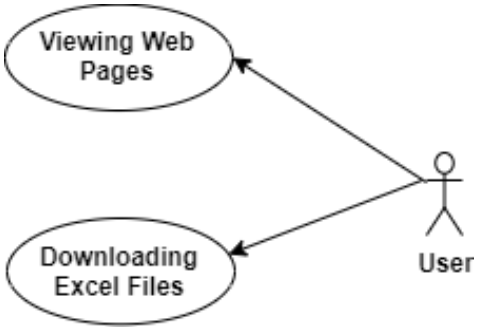

Figure 4. UCD for user

Furthermore, the Use Case Diagram (UCD) delineates the access privileges and functionalities available to users, elucidating the dynamic interplay between users and the envisaged system. The delineation of user-centric use cases also embodies the envisioned user-system interaction in accordance with anticipated requirements and functionalities. The Use Case Diagram for users can be found in the diagram presented in Figure 4.

An Activity Diagram is a type of diagram that visualizes the workflow and activities involved in the operation of a website when accessed by a user, such as an admin.The activity diagram is used to detail the expected functions that operate within the system. These activities are described using specific characters or symbols that represent activities in the system [20]. This diagram displays the sequence of activities sequentially and is used to illustrate the activities that occur in the website's operation. The following is Figure 5, the Activity Diagram for Login.

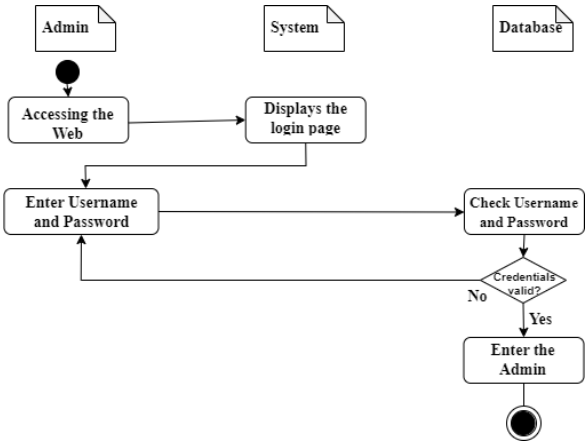

Figure 5. Activity diagram for login

For instance, the activity diagram for this website can commence with the activity "Accessing the Website," represented by a circular symbol as the starting point. Subsequently, there is an arrow leading to the activity "Admin Login" as the next step. Then, there is the activity "Enter Username and Password," followed by "Verification" as part of the login process. These activities continue until entering the Admin Dashboard page and conclude with an oval symbol as the endpoint. The Activity Diagram for viewing detailed information about a department or office is illustrated in Figure 6.

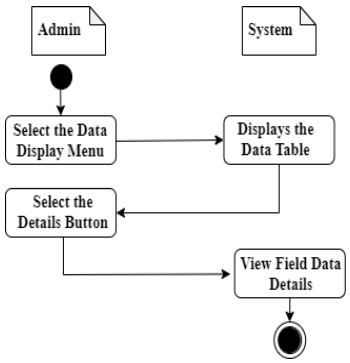

Figure 6. Activity diagram for view details

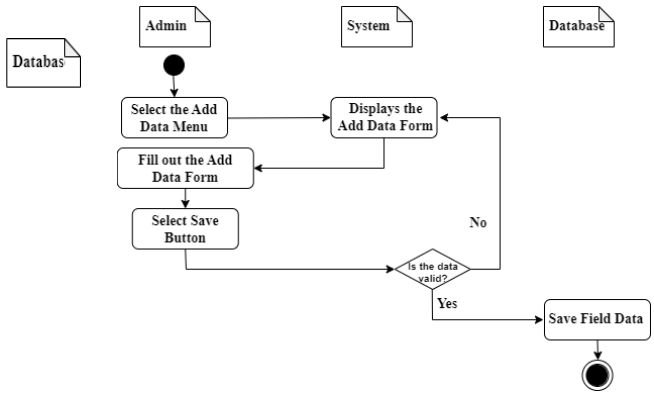

Figure 7. Activity diagram for adding hall data

This is an Activity Diagram illustrating the process of adding department or office data on the website's admin page in Figure 7. It starts with "Accessing the Admin Page" after user login. The next step is "Select Add Department or Hall Data," leading to "Fill in Department or Office Information," where users input necessary data. After successful input, the system verifies data in "Data Verification." If successful, it proceeds to "Save Data," signifying storage of the new data. This diagram visually guides users in efficiently and adding department or office data on the admin page.

In the activity diagram, each activity or process within the website is represented by geometric symbols. A black circle indicates the start or end of an activity, arrows connect the activities, and rectangular shapes represent the actions or processes occurring within the system. The Activity Diagrams for editing and deleting hall data are depicted in Figure 8 and Figure 9.

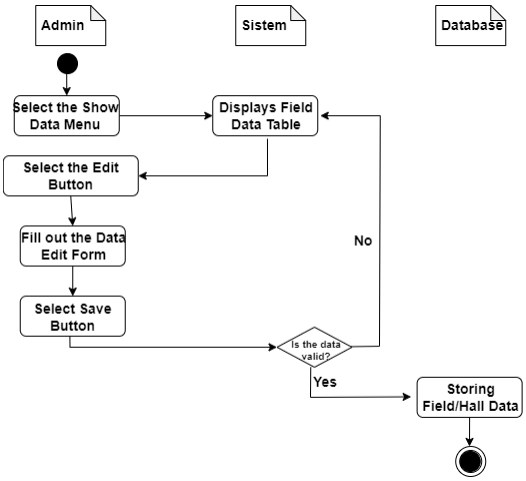

Figure 8. Activity diagram for editing data

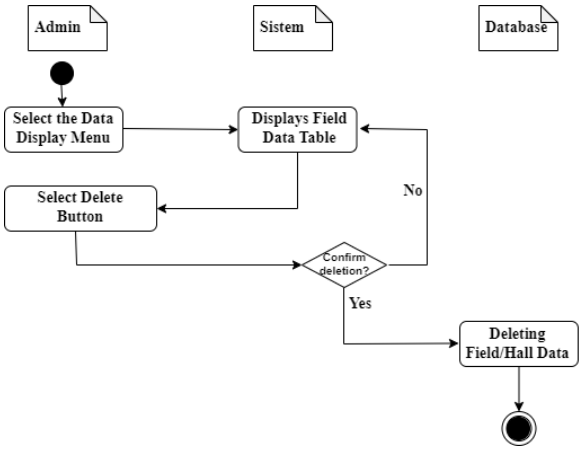

Figure 9. Activity diagram for deleting data

In this website, an activity diagram is employed to provide a more detailed overview of how users interact with the website and how the system responds to user actions in facilitating internship, research, and fieldwork information services at the Environmental and Forestry Agency of Yogyakarta Special Region. Figure 10 is the Activity Diagram for uploading an Excel file on the admin side.

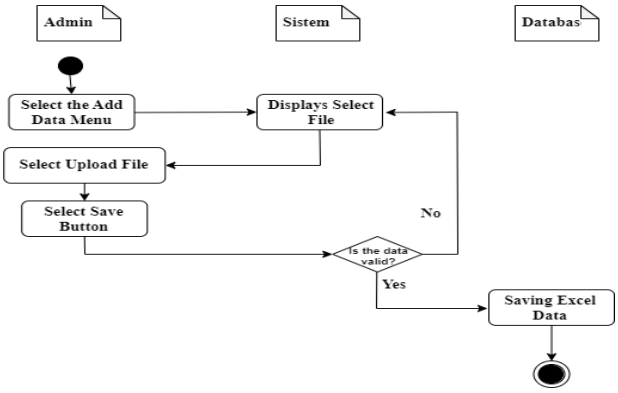

Figure 10. Activity diagram for upload excel data

By utilizing the activity diagram, users can clearly understand the flow and sequence of activities that occur within this website. This diagram aids in analyzing and designing the performance processes and user interactions with the website in a more detailed and efficient manner. Through detailed graphical representation, users can identify critical points in the user experience, facilitate better understanding, and support the overall development and enhancement of the website's functionality.

The Data Flow Diagram (DFD) serves as a structured analytical and design technique utilized as a graphical instrument for elucidating the logical framework and elucidating data alterations within a given system. DFD encompasses mechanisms for modeling data flow and supports decomposition to detail data flow and functions. While DFD may not present information about the sequence of operations, it is not a process or procedural modeling method. The DFD used in this research currently under construction can be outlined in Figure 11, Figure 12, and Figure 13.

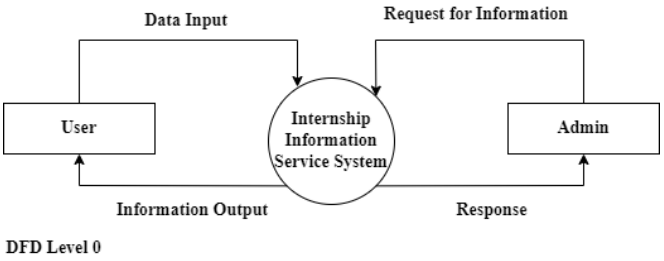

Figure 11. DFD level 0

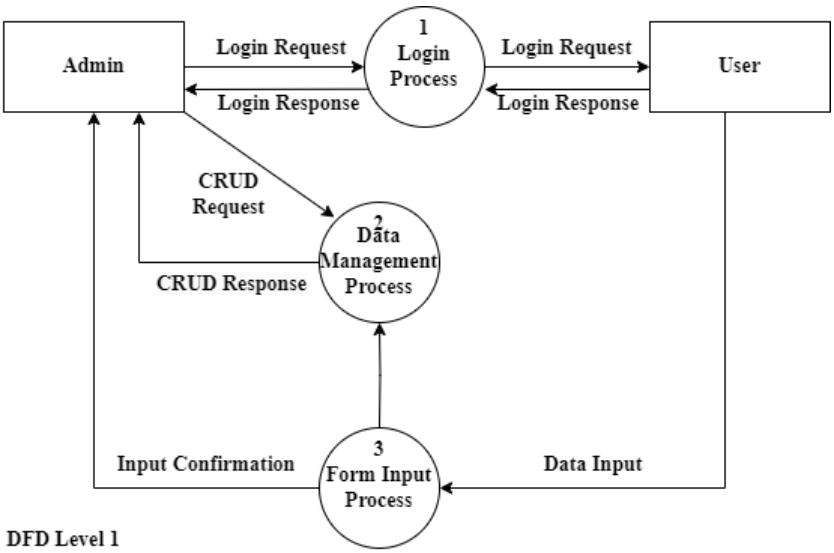

Figure 12. DFD level 1

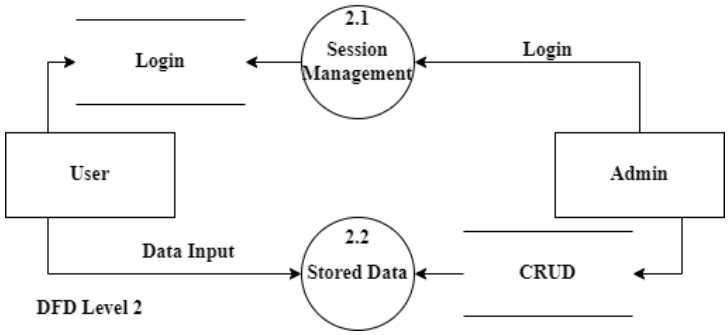

Figure 13. DFD level 2

Subsequently, the design must be translated into software programming code. This process results in the creation of a computer program that aligns with the design specifications established during the design phase.

Implementation

The third stage in the applied waterfall method is the implementation phase. Implementation involves combining physical resources with previously conceptualized ideas to create a cohesive system. This phase also entails specifying the hardware and software components to be utilized in building the website. The hardware specifications include an Intel® Core i5 10th gen 3.8 GHz processor and 12 GB DDR4 RAM. For software, the specified operating system is Microsoft Windows 11, the browser is Google Chrome, and the server is XAMPP, featuring an Apache web server, PHP, and MySQL. The code will be edited using Visual Studio Code (VSCode).

This comprehensive program is accessible through the GNU (General Public License) and serves as a user-friendly web server capable of displaying dynamic web pages [21]. In the implementation phase, these hardware and software specifications will guide the development and execution of the website according to the previously conceived design. The conceptualization of the design should be implemented through the translation into software program code, thereby yielding a computer program that conforms to the design plan established in the preceding design phase [22].

Testing

The fourth step is the testing phase. System testing is implemented using the Blackbox Testing approach, which focuses on the software's functionality [23]. Subsequently, testing will be conducted on various browsers such as Chrome, Microsoft Edge, and Mozilla Firefox. This aims to ensure that the website functions well and consistently across different browsers. If the test results meet expectations, the next phase involves testing with users and administrators. This testing aims to assess the comfort, security, and responsiveness of the website when used by regular users and administrators.

The principal objective of a website is delineated as an assemblage of pages presenting diverse forms of content encompassing text, images, static or animated graphics, audio, video, and their combinations, whether static or dynamic, interlinked within a structured framework, wherein each page is interconnected via hyperlinks, is to operate proficiently [24].

The importance of Blackbox testing is pivotal in assessing the quality of internship, research, and fieldwork information web services at DLHK-DIY. This method scrutinizes the execution outcomes by employing test data to ascertain the conformity of system functionality with pre-established specifications [25]. Identifying errors or weaknesses in the application early is crucial, allowing for quick action and the implementation of specific testing phases to evaluate the developed program. Any identified concerns encountered during the testing phase will be diligently rectified and optimized to augment both the quality and performance of the website before its official launch [26].

Results and Discussions

Results

This section is utilized by the administrator to manage the entire website. This management includes the ability to modify the content of data or information within the website, such as adding or reducing information about departments or offices, altering the registration flow, updating quotas and application statuses, and other actions. To obtain access permission, the administrator must have a combination of a username and password to log in to this page. The admin login interface is depicted in Figure 14.

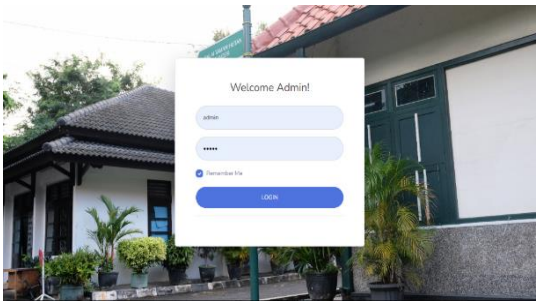

Figure 14. Login page

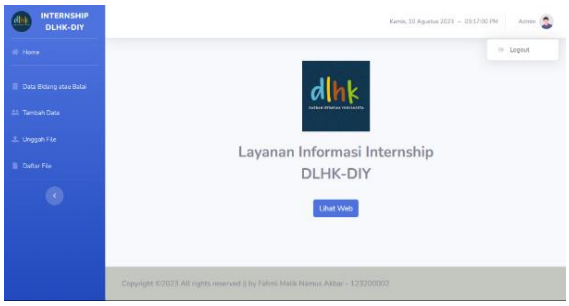

Figure 15. Home page

After successfully logging in, the admin will be directed to the main page. This page will display a list of various menus on the website using a sidebar. This page also functions as the administrative area where the admin can add, modify, or reduce information on the page and make adjustments if the information seems inconsistent with the website. Additionally, there is a footbar displaying copyright or author information, and a top bar showing the profile and real-

time clock. When the cursor is directed to the profile icon, a dropdown feature will appear, allowing the admin to log out of the admin page. An illustration of the main page view can be seen in Figure 15.

The next page is the Department or Hall Data Page. On this page, detailed information is available regarding the departments or offices associated with DLHK-DIY. Additionally, some features allow the administrator to edit or delete this data. The Department or Office Data Page view can be seen in Figure 16 attached below and on the Department or Office Data page, each department or office name that is highlighted in blue can be clicked to navigate to a detailed data page for that specific department or office, as exemplified in Figure 17.

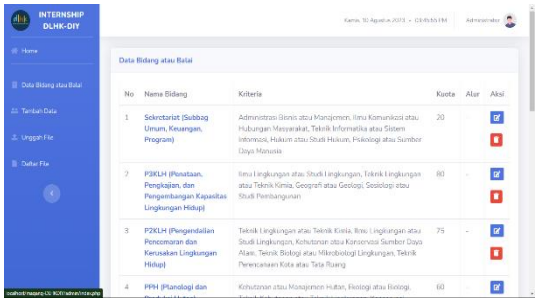

Figure 16. Department of hall data page

Figure 17. Details of department or hall data page

In the data management process, the administrator can edit the information contained in each department or office entry. If the admin desires specific changes or adjustments, the steps are straightforward. The admin simply needs to click on the blue edit data icon located on the far left in the "action" column. This action will redirect them to the edit data page specifically designed to facilitate information editing. The edit data page, as seen in Figure 18, provides space for the administrator to update and modify relevant information. Each department or office has its edit data page displaying editable details such as department name, location, and other information. This provides flexibility for the admin to ensure that the recorded data is always accurate and up-to-date in line with the latest developments. This process demonstrates the advantages of a data management system that gives full control to the administrator to maintain and synchronize information with current needs. On that page, the admin can edit data and save it by clicking the blue "save" button located at the bottom. Automatically, the data is updated in the database, and the updates can be seen on the web page. Furthermore, there is also a feature to add department or hall data, as shown in Figure 19.

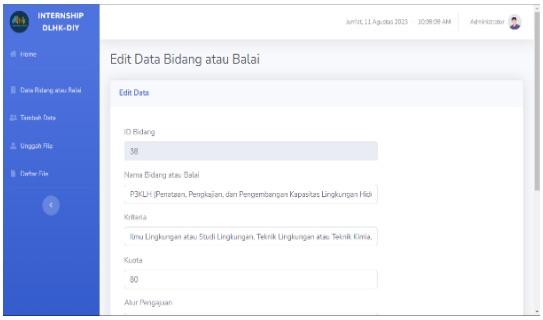

Figure 18. Editing department or hall data page

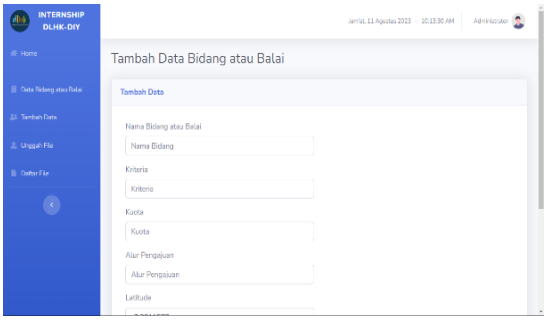

Figure 19. Adding department or hall data page

The next feature is the page for uploading an Excel file. Only Excel files can be uploaded as they are automatically filtered through coding. This Excel file contains the quotas of departments or offices and a list of application statuses, which will be displayed on the user's home page and allows users to download them qnd the last feature on the admin interface is the file list page. This page contains uploaded files, allowing the admin to delete them, and an Excel file that allows the admin to be directed to Google Drive as the editor. Figure 20 illustrates the upload file page and Figure 21 illustrates this page.

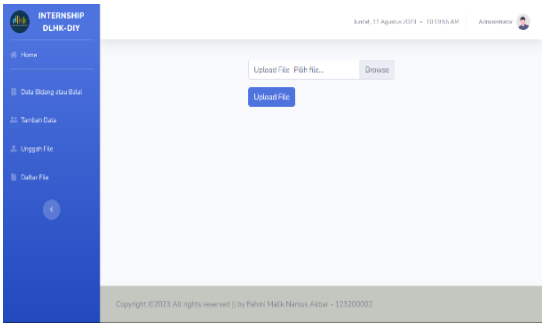

Figure 20. Uploading file page

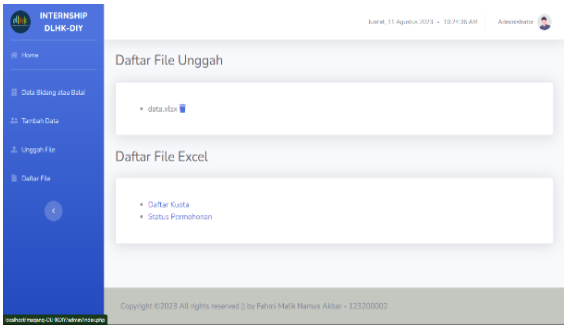

Figure 21. List file page

On the homepage, users can choose to register through the menu at the top of the screen, leading them to the internship, research, or fieldwork registration form via Google Form. The illustrated banner view on the user's homepage can be seen in Figure 22.

Figure 22. Banner of user page

Users can also explore detailed information about fields or offices by selecting the "Lihat Bidang/View Field" button in yellow on the homepage. This will take them to a page that displays detailed field information, as shown in Figure 23.

Figure 23. Details of hall data page

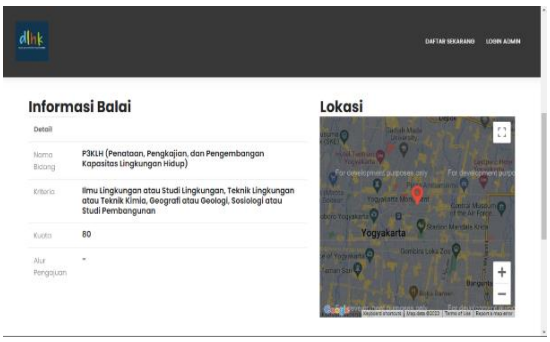

Figure 24. Details and locations page

On this page, users can obtain further information by choosing the "Details and Location" button in blue. This will open the "Informasi Balai" or Field Information page, as illustrated in Figure 24. This page provides users with in-depth information about the fields or offices in the DLHK-DIY environment. Additionally, there is an integrated map with Google Maps, allowing users to determine the location of internships, research, or fieldwork destinations. On the homepage, if users scroll down, they can see the general flow illustrated in Figure 25. It should be noted that each field or office may have a slightly different flow than the general flow displayed on this page.

Figure 25. General flow

Further information includes a list of quota availability for each field. This data is directly taken from the spreadsheet managed by the administrator and is updated in real time. This makes it easy for prospective applicants to know the available quota for each field or office in the DLHK-DIY environment. Additionally, this information is also available in the form of an Excel file that users can download, as illustrated in Figure 26.

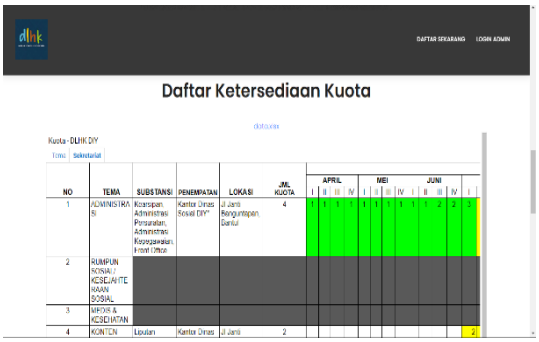

Figure 26. Quota availability

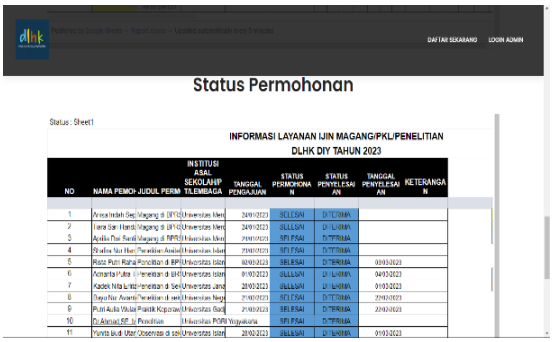

Figure 27. Applications status

The next section is a list of information about the status of incoming applications. Here, applicants can view the progress of their applications in detail. This list is managed by the administrator through a Google spreadsheet accessible via the admin page in the file list feature. The illustration of this page can be seen in Figure 27.

In the course of this research, the system underwent testing employing the black box method, aiming to verify its alignment with the intended operational specifications. The black box testing methodology is primarily utilized to evaluate the software's compatibility by analyzing the correlation between input parameters and resultant output, emphasizing the absence of internal structure knowledge. The outcomes derived from the black box testing are presented in the subsequent Table 1.

Table 1. Result testing

No	Scenario	Test Case	Expected Result	Result
1	Visiting the website page	The user visits the website page	The browser displays the desired outcome	Successful
2	Navigating through available menus	User clicks on available menus	Displays the selected menu page	Successful
3	Performing CRUD on the website	The user performs create, read, update, and delete actions on data linked to the database	The database is updated with these actions	Successful
4	Logging in and logging out	The user logs in and logs out	Displays the admin page and logs out of the admin page	Successful

5	Uploading an Excel file	The user uploads a file Excel	The file is uploaded to the website	Successful
6	Downloading an Excel file	The user downloads a file	The file can be downloaded from the website	Successful
7	Launching a link	The user clicks on a link on the website page	Displays the intended page according to the link address	Successful
8	Accessing location on maps	User views the location on maps	Displays the location on Google Maps on the website	Successful

Next, browser testing has been conducted to assess the overall output of the website creation process, including the layout, menus, and other features, to ensure that everything aligns with the plan. The following table provides a comparison before and after DLHK-DIY implemented the information service website for internships, research, and fieldwork in Table 2.

Table 2. Result testing

Before	After
Insufficient maximum dissemination of information regarding internship, research, and fieldwork services at DLHK-DIY.ser visits the website page	Information is more easily disseminated through a website that is easily accessible to the public.
The community faced difficulties obtaining detailed information and the location of departments.	The public can easily obtain detailed information and the location of available offices
The public had limited knowledge of the various departments or offices available at DLHK-DIY.	It is easy to know which departments or offices are present in DLHK-DIY.
Applicants and internal parties encountered challenges in accessing quota information and application statuses.	It is also easy to view real-time lists of quotas and application statuses on the website.

Discussions

Development of internship, research, and apprenticeship information services at DLHK-DIY's web-based platform, the activities follow the Waterfall methodology. This method outlines a phased approach to software development, beginning with needs analysis and progressing through the implementation and testing stages. The process initiates with an in-depth analysis of user requirements, followed by a design based on the analysis findings. Implementation proceeds once the design is deemed adequate, with testing conducted to ensure consistency with the established plans and specifications.

The design process in constructing this website involves the utilization of several visual tools such as UML, UCD, and Activity Diagrams. Through UML, diagrams like use cases and activities are employed to visualize interactions among system components, facilitating a better understanding of the overall system workflow. During the implementation phase, key features such as Admin Features, file uploads, Excel file management, and field or pavilion details are successfully developed to provide an optimal user experience and meet diverse user needs.

Following the implementation phase, the system is examined using the black box testing methodology to verify that its functionality aligns with the predefined specifications and designs.

By elucidating the acquired understanding, the author can correlate research findings with the theoretical knowledge framework previously discussed, enabling the integration of research outcomes with broader knowledge and fostering a deeper understanding of software development and development methodologies.

Conclusion

This research concludes that the developed website successfully presents comprehensive information about the departments and offices within DLHK-DIY, as well as detailed guidance on the procedures and requirements for submitting research, internships, and apprenticeships. The website provides easy access for users to explore the opportunities available at DLHK-DIY, facilitating research, internships, and apprenticeships.

Key functionalities of the website include an administrative module that enables login, logout, and CRUD operations, along with Excel file uploading and administration, thereby ensuring efficient data and information management. The development of this website adhered strictly to the Waterfall methodology, ensuring coherence and quality across all phases, including analysis, implementation, and testing. The use of UML, UCD, and Activity Diagram methodologies enriched the design process by offering a comprehensive system view and focusing on user needs.

Quantitative results from the testing phase support the effectiveness of the system. The black box testing methodology confirmed the system's adherence to initial designs, with a 100% success rate in test cases. Additionally, user feedback gathered from participants during the usability testing phase showed an overall satisfaction rate of 80%, with 90% of users finding the website easy to navigate.

In summary, this research has effectively achieved its objectives by developing a website that provides detailed information about the departments and offices within DLHK-DIY, offers comprehensive instructions for research and internship applications, and facilitates easy monitoring of ongoing progress. The system's quantitative performance metrics demonstrate its robustness, usability, and efficiency, further validating the quality of the implementation.

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