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Managing University Accreditation Documents with an Online-Based Data Collection System

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Abstract *– By implementing digitalization, organizations and companies can increase and maintain competitive advantage, because it can increase productivity, innovation and reduce costs. One of the activities carried out by organizations is data management, including organizations operating in the education sector, such as universities. In managing a university, there are various kinds of data that must be managed. Data on the number of students, number of research studies, number of services, etc. need to be managed well. The data is usually stored in several separate places. If managers need information, they have to collect the data from several sources and process it manually using software such as Microsoft Word or Microsoft Excel. This causes the process of searching for information to take a long time, because there are several stages that must be carried out before getting the information in question. In this study, we developed web-based data management information system in universities using Waterfall Software Development Lifecycle (SDLC) method. The information system that was developed passed the Black Box method test with 100% of the possible points. According to this outcome, every feature created is in line with the executed design.*

Keywords: *information system; waterfall; accreditation documents*
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INTRODUCTION

Over the past fifty years, technological advancements have influenced society and guided the adoption of digitalization (Bach et al., 2022). The digitalization process has been applied in various aspects of life with the aim of optimizing processes, business models and user engagement (Julia et al., 2022). As digitalization increases, organizations and companies face the challenge of providing new alternatives by utilizing and developing existing resources in new ways (Brady and Davies, 2004). They need to immediately make changes and adapt to overcome these challenges. Digitalization can be an important factor for them to adapt (Kääriäinen et al., 2021). By implementing digitalization, organizations and companies can increase and maintain competitive advantage, because it can increase productivity, innovation and reduce costs (Moreira et al., 2018).

Information systems are very important for organizations operating in all fields (Varajão and Carvalho, 2018). In today's uncertain, complex and ambiguous world, it is necessary to strengthen and update features in the information systems they manage. This makes the organization have a competitive advantage (Ngereja and Hussein, 2021; Patnayakuni and Ruppel, 2010).

One of the activities carried out by organizations is data management, including organizations operating in the education sector, such as universities. In managing a university, there are various kinds of data that must be managed. Data on the number of students, number of research studies,

number of services, etc. need to be managed well. The data is usually stored in several separate places. If managers need information, they have to collect the data from several sources and process it manually using software such as Microsoft Word or Microsoft Excel. This causes the process of searching for information to take a long time, because there are several stages that must be carried out before getting the information in question.

With the development of technology, organizations can store important data in a centralized database (Harrington, 2009). The data stored in the database will then be processed by the information system. This process produces information that is useful and easy for managers to access when needed. The process of searching for information becomes easier, because managers can access one system that provides various information. The process is also faster, because the data is processed automatically by the system.

This research discusses the development of a web-based data management information system in universities. The information system was developed using the Codeigniter framework by taking a case study at Diponegoro University Vocational (Applied) School. The developed information system can make it easier for university managers to manage data.

RESEARCH METHOD

The Waterfall Software Development Lifecycle (SDLC) method was chosen as a model for developing information systems. The Waterfall method consists of several stages, beginning with system requirements analysis and progressing to system design, implementation, testing, and system operation. In this research, system development activities were only carried out until the system testing stage.

The system requirements analysis stage, which is the first step in the Waterfall method, is completed by observation and interviews. The purpose of this step is to discover the needs and issues that users are facing. The system design step comes next. Currently, a number of diagrams are created to interpret the needs analysis results so that programmers may understand them. The stage of implementation is the third. The information system will now be constructed with a particular database and programming language. The testing phase comes last. Currently, particular methods are applied to guarantee that the information system can function in accordance with requirements. Figure 1 depicts a schematic diagram of system development process using the Waterfall method.

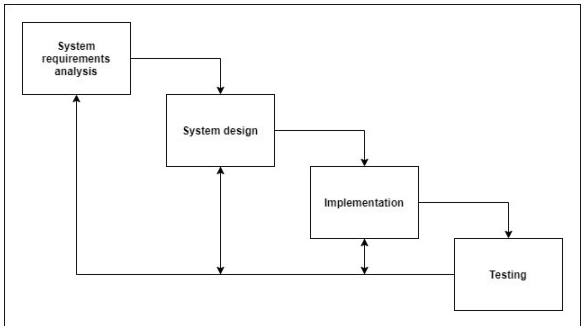

Figure 1. The Waterfall method is used in the system development process (Conrad, 2011)

System Requirements Analysis

The purpose of system requirements analysis is to understand the structure and operation of the information system that is going to be developed. Understanding the business processes that exist in the organization and determining the actors involved is how analysis is carried out. System requirement specifications are obatined by collecting data on system users' stakeholders. We gathered information through interviews and observatoins with faculty managers, study program managers, and any other user involved in data collection process.

Based on the system requirements analysis, it has been found that this organization requires an information system that can manage accreditation documents. The faculty managers and study program managers will be helped by this information system in gathering accreditation documents. Additionally, faculty managers can view all study program data under them. The overall amount of research, services, industrial cooperation, and other information are included in this data.

Knowing who will be involved in system operations is crucial for information system developers as they create new systems. A use case diagram was used to conduct user mapping in order to determine this. Finding the roles that require development and the people who play them is the goal of the diagram (Rosa and Shalahuddin, 2016). Table 1 describes Figure 1, which is a use case diagram.

Information System Use Case Diagram

Knowing who will be involved in system operations is crucial for information system developers as they create new systems. A use case diagram was used to conduct user mapping in order to determine this. Finding the roles that require development and the people who play them is the goal of the diagram (Rosa and Shalahuddin, 2016). Table 1 describes Figure 2, which is a use case diagram.

There are four actors that will be involved in this information system, according to the planned use case diagram. The Quality Assurance Team, Managers, the Auditor, and the Head of Study Program are those four actors. Head of Study Program can input self-assesment, upload evidence, input action plan, and view the audit's final score. The Quality Assurance Team has the ability to assign an auditor to audit a study program, check the study program rank, and start the process of calculating the final score. The study program may be evaluated by the Auditor, who can also see the action plan. The manager has the ability to oversee the entire audit process.

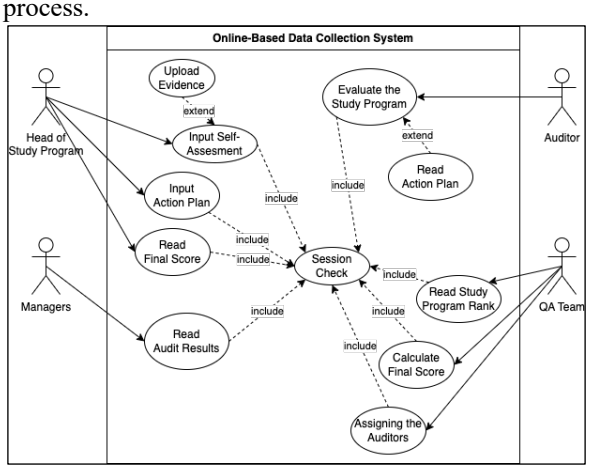

Figure 2 Use Case diagram

Table 1 Use case diagram explanation

Use Case	Explanation
Input Self-Assesment	Explain the conditions according to the criteria being assessed
Upload Evidence	Evidence of the explanation
Input Action Plan	Action plan based on input from the Auditor
Read Final Score	Final audit score
Read Audit Results	Read audit results from all study programs
Evaluate the Study Program	Provide input according to the criteria being assessed
Read Action Plan	Read action plan from all study programs
Read Study Program Rank	Read Study Program Rank
Calculate Final Score	Initiate the process of calculating the final score.
Assigning the Auditors	Assign an auditor to a study programme for auditing

Database Design

The use case diagram that has been explained allows one to see the database structure as well as potential relationships between database entities(Rosa and Shalahuddin, 2016). An entity relationship diagram (ERD) is used to show how different entities in the database relate to one another. The ERD is displayed in the study's information system in Figure 3.

Figure 3 indicates that for the information system to function, at least seven entities are required. **Department, study_program, audit, auditor, evidence, indicator,** and **elements** are some of these entities. The **audit** entity will handle the majority of the data management. Three foreign keys are present in this entity to illustrate the relationships between entities. **Study_program_id, element_id,** and **auditor_id** are the foreign keys in the **audit** entity. The relationships between the study program data being audited are shown by **study_program_id**, the relationships between the element data being measured are shown by **element_id**, and the auditor responsible for the evaluation is tracked and shown by **auditor_id**.

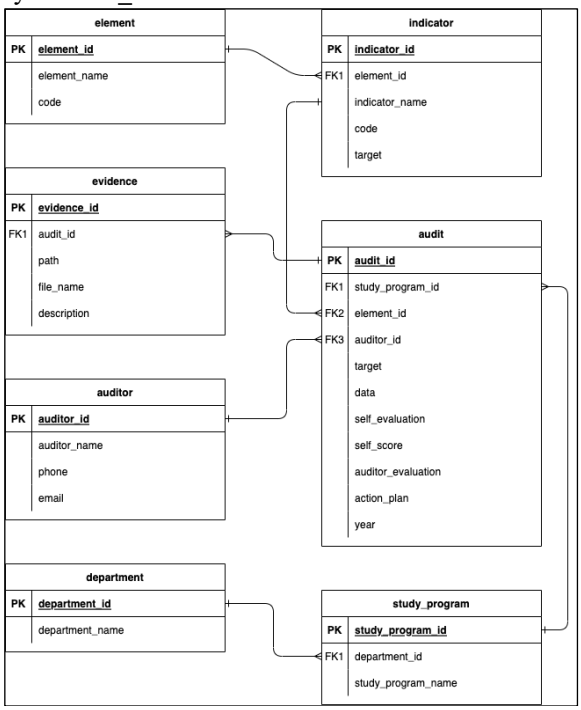

Figure 3 Entity Relationship Diagram

User Interface Design

The system design phase includes user interface design. In order to guarantee that the system being developed has a clear menu structure and does not confuse users, the user interface must be designed. The way a system that consists of input and output displays is designed is called its interface. Users enter data into the input display, which is a form, and view the results of their input, which are pulled from the database, on the output display. The menu structure of the system to be created is created

before the interface is designed. The user level determines how the menu structure is constructed.

The user page where the head of study program level is logged in has a menu that is part of the program's menu structure. There are three primary menus that the user can access after successfully logging in with the head of study program level: Final Score, Study Program Rank, and Self-Assessment. Inside the Self-Assessment page, there are two submenu called Action Plan and Upload Evidence. Figure 4 displays the head of study program's menu structure.

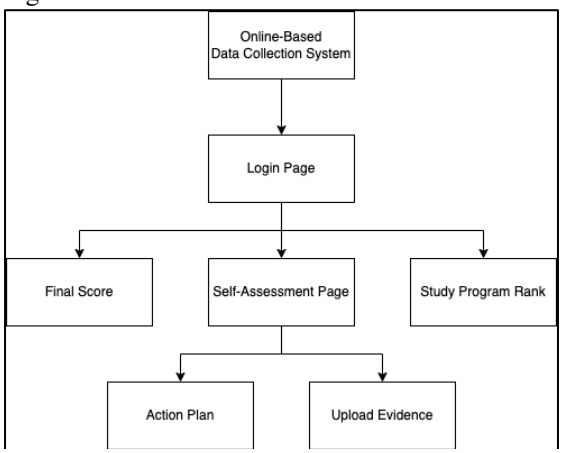

Figure 4 Menu structure for head of study program

The user page where the auditor level is logged in has a menu that is part of the program's menu structure. There are one primary menu that the user can access after successfully logging in with the auditor level called Audit. Inside the Audit page, there are Action Plan submenu. Figure 5 displays the auditor's menu structure.

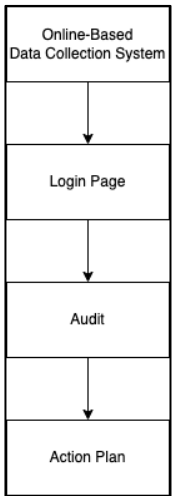

Figure 5 Menu structure for auditor

The user page where the quality assurance team is logged in has a menu that is part of the program's menu structure. There are three primary menus that the user can access after successfully logging in with the quality assurance level: Calculate Final Score, Assign Auditor, and Study Program Rank. Figure 6 displays the quality assurance team's menu structure.

The user page where the manager level is logged in has a menu that is part of the program's menu structure. There are two primary menus that the user can access after successfully logging in with the manager level: Audit Results and Study Program Rank. Figure 7 displays the manager's menu structure.

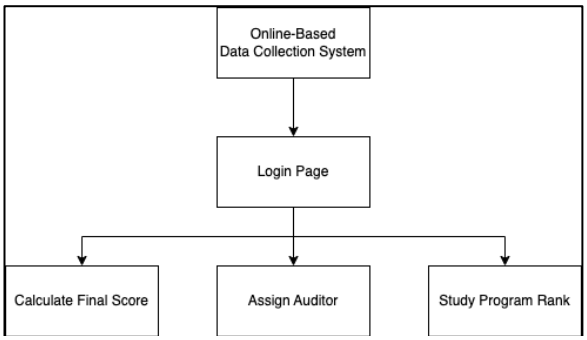

Figure 6 Menu structure for quality assurance team

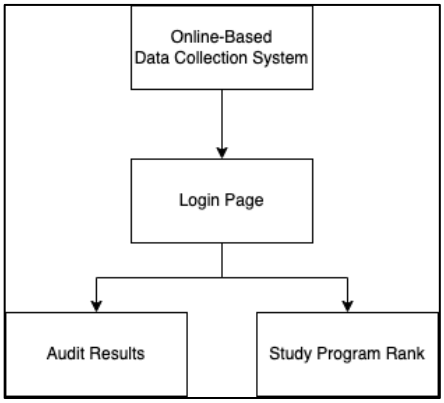

Figure 7 Menu structure for manager

RESULTS AND DISCUSSION

The goal of this study is to provide solutions for the data management issues faced by university administrators. In managing a university, there are various kinds of data that must be managed such as number of students, number of research studies, number of services, etc. The SDLC Waterfall Method was utilised in the development of this information system from the system requirements analysis stage through the testing stage.

The system requirements analysis stage, which is the first step in the Waterfall method, is completed by observation and interviews. The purpose of this step is to discover the needs and issues that users are facing. The system design step comes next. Currently, a number of diagrams are

created to interpret the needs analysis results so that programmers may understand them. The stage of implementation is the third. The information system will now be constructed with a particular database and programming language. The testing phase comes last. Currently, particular methods are applied to guarantee that the information system can function in accordance with requirements

The system requirements analysis stage, which is the first step in the Waterfall method, is completed by observation and interviews. Problems with data collection at the university were discovered as a result of the analysis that was conducted. In order to manage the university, a number of data must be kept track of, including the number of students, research projects, community services, etc. In order to solve these issues, an information system is suggested that can both gather all the data required by university administrators and facilitate their data searches.

The system design step comes next. Currently, a number of diagrams are created to interpret the needs analysis results so that programmers may understand them. Use case and entity relationship diagrams are the diagrams that are used. Use case diagrams are a useful tool for visualising the roles and functions of the different actors in a system. The relationships between the entities in the database are mapped using entity relationship diagrams.

The stage of implementation is the third. The information system will now be constructed with a particular database and programming language. Using the Codeigniter framework and the PHP programming language, the information system was created. MySQL is the database that is utilised in this information system. The programmer uses PHPMyAdmin as a Database Management System (DBMS) and PHPStorm as a code editor to support in the development process.

1. Home Page

When utilising the information system, users land on the home page first. The home page is shown in Figure 8. Numerous data summaries, including those on research, community service, publications, and employees, are available for broad viewing on this page.

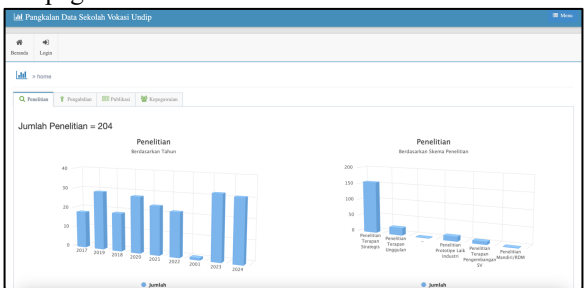

Figure 8 Home page

2. Login Page

Verifying a user's access rights to particular pages is done through the login page. Figure 9 displays the page for login. Upon logging in successfully, the user can access various features based on their level. Since some sensitive data is also stored in this information system, the login feature is required to protect data confidentiality.

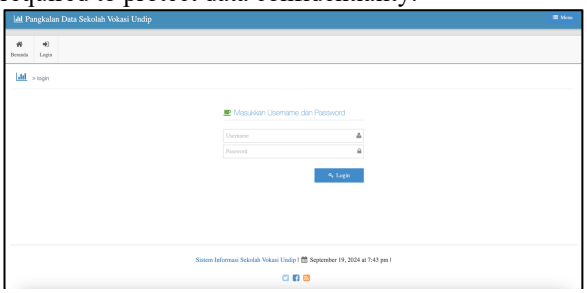

Figure 9 Login page

3. Self-Assessment Page

The head of the study program administers self-evaluation using the self-assessment page. The head of the study program must complete the assessment forms on this page. The evaluation consists of scores, descriptions, supporting documentation, and action plans. The self-assessment page can be seen in Figure 10.

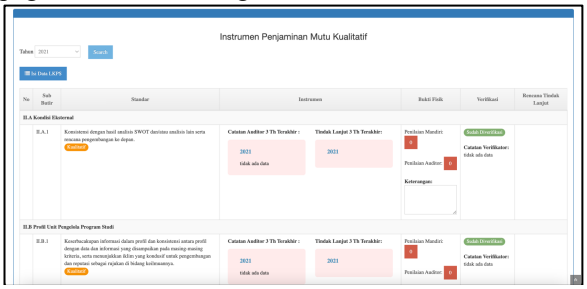

Figure 10 Self-assessment page

4. Final Score Page

The audit score results are displayed on the Final Score page for the study program head to view. The auditor's evaluation is the basis for calculating the score. The final score page is displayed in Figure 11.

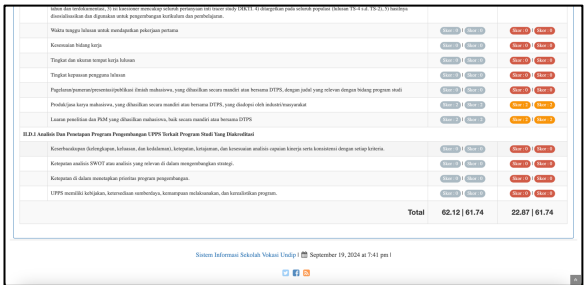

Figure 11 Final score page

5. Assign Auditor Page

Selecting and assigning auditors is a necessary step in the audit process. Certain study programs are audited by auditors assigned by the quality assurance team. The assign auditor page depicted in Figure 12 can be utilised by the quality assurance team to carry out this process.

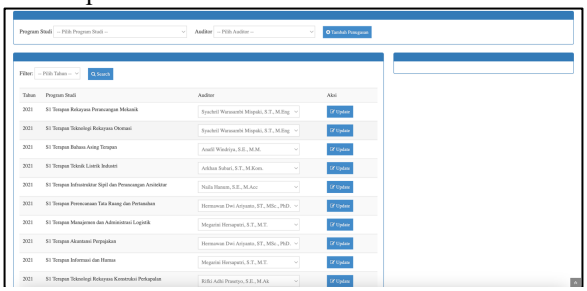

Figure 12 Assign auditor page

6. Study Program Rank Page

Following the audit process, a final score is assigned to each study program. To rank the program, the score is compared to those of other study programs. Study programs with high scores are recognised and awarded based on their score ranking. The study program ranking page is displayed in Figure 13. The managers, the quality assurance team, and the head of the study program can all access this page.

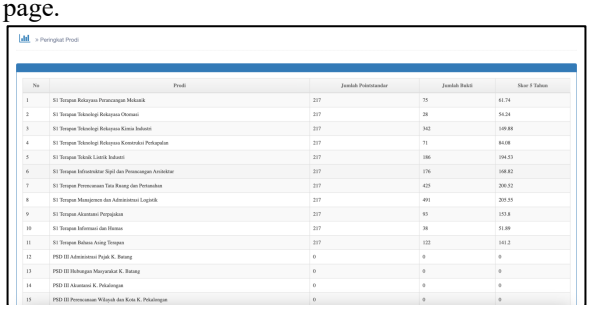

Figure 13 Study program rank

Testing

The testing phase comes last after the information system is developed. At this point, the Black Box method is used for testing. The goal of this method is to guarantee that the system that is created adheres to the system design that has been completed. Every feature that has been developed will be tested under particular scenarios. The output of the system will be monitored; if something is found to be inappropriate, the programmer needs to make changes.

There are various scenarios used for testing. To make sure that every feature has passed testing, the scenarios are employed. Expected outputs are also included in the test scenarios. The information system needs to be improved if the expected output does not match the system output. Depending on how many actor levels are available, testing is broken down into multiple phases. The test scenarios for all levels are displayed in Table 2. The test scenarios for actors with the head of study program level are displayed in Table 3, and those with the auditor level are displayed in Table 4. Table 5 displays the test scenarios for actors at the quality assurance team level, and Table 6 displays the test scenarios for actors at the manager level.

Table 2. Test scenario for all user level

Testing Name	Test Form	Test Result
Login page test	Fill in the correct username and password	Success, successfully logged in
	Fill in the wrong username and password	Success, the system shows an error message
Change Password Test	Fill in the correct old password, new password, and password confirmation	Success, the system can change the user password
	Fill in the wrong old password, new password, and password confirmation	Success, the system shows an error message

Table 3. Test scenario for head of study program user level

Testing Name	Test Form	Test Result
Self-Assessment Menu Test	Fill in the score in the range 1 – 4	Success, the system can save the score
	Fill the score with a value of more than 4	Success, the system shows a warning message
Action Plan Menu Test	Fill the action plan	Success, the system can save the action plan
Upload Evidence Menu Test	Upload the relevant files	Success, the system can save the evidence
	Upload the irrelevant files	Success, the system shows a warning message

Table 4. Test scenario for auditor user level

Testing Name	Test Form	Test Result
Audit Menu Test	Fill in the score in the range 1 – 4	Success, the system can save the score
	Fill the score with a value of more than 4	Success, the system shows a warning message

Table 5. Test scenario for quality assurance team user level

Testing Name	Test Form	Test Result
Assigning the Aduitors Menu	Assigning Auditors to study programs in need of an Auditor	Success, system can save the auditor
	Assigning Auditors to study programs with Auditor existence	Success, the system shows a warning message
Calculate Final Score Test	Finding the study program scores that have been audited	Success, the system can calculate the final score
	Finding the study program scores that haven't been audited yet	Success, the system shows a warning message

Table 6. Test scenario for manager user level

Testing Name	Test Form	Test Result
Audit Result Menu Test	View the audit results of all study programs	Success, system shows all audit results

The Black Box method, which is displayed in Tables 2 through 6, has been used for testing. Testing indicates that the system is capable of producing the desired results. This study's Black Box testing success rate was 100% since all output requirements were fulfilled.

CONCLUSION

It is possible to draw the conclusion that the information system has been successfully developed using the PHP programming language and the Codeigniter framework based on the testing and analysis results. The information system that was developed passed the Black Box method test with 100% of the possible points. According to this outcome, every feature created is in line with the executed design.

One potential avenue for improvement would be to facilitate user input of accreditation data by integrating the information system with the university's information system. This is necessary because the university's information system already has some of the data.

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