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Development of an Information System for Monitoring, Data Collection and Reporting of Turtle Conservation in the Essential Ecosystem Area (KEE) of Kili Kili Beach, Trenggalek Regency, Based on the Website

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ABSTRACT

The decline in sea turtle populations necessitates effective conservation management, which is often hindered by inefficient manual data-recording systems. This study addresses the operational challenges faced by the Community Monitoring Group (Pokmaswas) at the Kili-Kili Beach Essential Ecosystem Area (KEE) in Trenggalek, Indonesia, where conventional notebook-based logging is prone to damage, loss, and inaccuracies. To overcome these issues, this research aimed to design, develop, and evaluate a website-based information system for integrated turtle conservation monitoring, data collection, and reporting. Employing the structured Waterfall development method, the system was built using the Next.js framework with an atomic design approach and utilizes a PostgreSQL database for reliable data management. Key features include digital logging of nesting activities, incubation monitoring, hatchling care records, release tracking, spawning zone mapping, and automated report generation. System testing yielded a 100% success rate in both Black Box (17 test points) and White Box (16 test points) testing. User Acceptance Testing (UAT) involving Pokmaswas members showed a 97.6% acceptance rate for functionality and 91.7% for non-functional aspects, confirming the system's usability and effectiveness. The study concludes that the developed web-based system significantly enhances data accuracy, operational efficiency, and reporting transparency, offering a viable digital solution to support community-based turtle conservation efforts in resource-limited settings.

Keywords: Waterfall, Sea Turtle Conservation, Website, Logging, Reporting, Monitoring

INTRODUCTION

Indonesia is an archipelagic country that is geographically classified as a maritime country, which is a country with a larger sea area than land area. With a sea area of 3.25 million km² and an Exclusive Economic Zone (EEZ) of 2.55 million km², compared to a land area of only 2.01 million km², this strategic position gives Indonesia great potential to become the world's maritime center. This geographical advantage makes the marine sector one of the main bases of national development, both in the global and regional contexts. In the regional scope, the government is expected to be able to establish maritime economic centers to strengthen Indonesia's position in international economic dynamics and marine commodity-based trade (Manurung, 2018).

One of the main assets of Indonesia's marine life is the diversity of marine life, especially sea turtles, which play an important role in maintaining the balance of aquatic ecosystems (Karraker et al., 2020; Laksmidewi, 2022; Wijaya et al., 2020). Six species of turtles found in Indonesian waters, such as green turtles (*penyu hijau*), leatherback turtles (*penyu belimbing*), and hawksbill turtles (*penyu sisik*), depend on habitats such as coral reefs and seagrass beds that also benefit ecologically from the existence of sea turtles. A decline in turtle populations can disrupt ecosystem chains and coastal productivity (Cáceres-Farias et al., 2022; Chevallier et al., 2023; Lin et al., 2023). As a form of preservation, turtle conservation at *Pantai*

Taman Kili-Kili, Trenggalek, is managed by the local community (*Pokmaswas*) through a semi-natural egg rescue method. However, the conventional data collection system makes it difficult to report turtle populations, even though the data is crucial to support government policies in realizing sustainable development (SDGs) (Allen et al., 2021; Bachmann et al., 2022; Ballerini & Bergh, 2021; Borghys et al., 2024).

Data recording activities on semi-natural nests by managers still use manual recording and are less efficient because, in terms of human resources, they are more than 48 years old, and the conservationists also have other jobs or activities (Gameiro et al., 2020; Santangeli et al., 2015; Williams, 2015). Not only that, from the results of field observations by the author, it was found that document damage (manual recording) was caused by nature, such as being damaged by seawater vapor, and sometimes forgetting to record the history of a turtle (Daniel et al., 2023; Wallace, 2021; Wallace et al., 2020). Finally, from looking at the above problems, the author initiated a study on how to create an information system for data collection, supervision, and reporting of turtles at *KEE Pantai Taman Kili-Kili* and whether the information system can be accepted by conservationists.

In solving turtle conservation problems at the *KEE Pantai Kili-Kili*, the author uses the Waterfall software development method, which is systematic and gradual. The first stage is needs analysis, which is carried out through direct observation and interviews with the *Pokmaswas* to identify the conservation process and recording problems that occur in the field. Based on the results of the analysis, the author proceeds to the system design stage using the Unified Modeling Language (UML) approach, which includes designing use cases, activity diagrams, sequence diagrams, data structures, and user interfaces. The next stage is the implementation of the program code, where the author builds a prototype of a web-based system according to the design that has been prepared. Once the system is successfully built, a testing stage is carried out, both functionally and non-functionally, to ensure that all features run according to conservation needs. The last stage is the practical application of the system in a conservation environment as a solution to manual problems, with the hope that this system can speed up recording, maintain data security, and improve reporting efficiency.

Previous studies have explored the use of information technology in environmental conservation. For example, research by Widiyatmoko et al. (2020) developed a web-based monitoring system for school operational funds, demonstrating the effectiveness of digital solutions in data management. Similarly, Kurniawan et al. (2023) created a web-based activity management system for early childhood education, highlighting the importance of user-friendly interfaces. In the context of conservation, Heithaus et al. (2014) emphasized the ecological importance of sea turtles and the need for integrated management approaches. However, a significant gap remains in the development of dedicated, accessible, and field-adapted digital systems for community-based turtle conservation, particularly in regions with limited resources and connectivity.

This study aims to address this gap by developing a website-based information system specifically designed for monitoring, data collection, and reporting of turtle conservation activities at *KEE Pantai Kili-Kili*. The novelty of this research lies in its user-centered design approach tailored to the *Pokmaswas*'s operational workflow, the implementation of an atomic design system for interface consistency, and the use of the Next.js framework combined with a robust PostgreSQL database via CockroachDB to ensure reliability and data security in a resource-constrained setting. This study has benefits for both the author and the conservationists. For the author, this activity is a means of direct learning in applying the research approach and development of information systems, thereby expanding experience and improving system analysis competence. In addition, this research also supports improved technical capabilities in designing digital solutions that are applicable and relevant to the field of research. This enhances the researchers' insight in integrating technological approaches with environmental and conservation issues.

Meanwhile, on the conservation side, namely *Pokmaswas Wonocoyo Village* as the manager of the *KEE Pantai Kili-Kili*, it is hoped that the development of this system can help support the process of reporting turtle data that can be taken from various places by connecting to the internet. With this system, the process of reporting conservation data to stakeholders can be done faster. However, this study has several limitations, namely the non-development of a decision-making feature (dashboard) even though proposed by the user, and the non-inclusion of user interface development on the scale of this study.

RESEARCH METHOD

This research used the Waterfall model software development method, which was chosen for its systematic, sequential, and appropriate characteristics for projects with clearly defined needs from the outset. The model consists of five main stages: (1) Needs Analysis, (2) System Design, (3) Implementation, (4) Testing, and (5) Maintenance (Sommerville, 2011). This approach is considered appropriate given the specific and stable functional scope of the system, and allows for structured documentation at each stage.

In developing an information system for data collection, supervision, and reporting in turtle conservation in the Essential Ecosystem Area (KEE) of Kili Kili Beach, Trenggalek Regency, the author uses the Waterfall method as the main approach in the system development process. This method was chosen based on its structured and sequential characteristics, as explained by (Fitria (2020) that Waterfall is a linear sequential model that demands the completion of each stage before proceeding to the next stage. Ramadhan & Angelia (2023) also affirm that Waterfall is a classic approach that does not allow change before the previous stage is completed completely. In line with that, Sommerville (2011, p. 31) stated that Waterfall consists of five main stages, namely requirements definition, system and software design, implementation and unit testing, integration and system testing, and operation and maintenance, and is very suitable for use in projects with clear and stable needs. To ensure the application of the right method, the authors first conduct a literature review to identify relevant previous research. Furthermore, the author collected data through semi-structured interviews to obtain functional and non-functional needs directly from the Pokmaswas so that the system built could be in harmony with the conservation operational process in the field.

RESULTS AND DISCUSSION

Analysis of Conservation Field Activities

The turtle conservation cycle in the Essential Ecosystem Area (KEE) of Kili-Kili Beach began with night patrol activities carried out by Pokmaswas at around 19.00 to 03.00 WIB. This patrol aims to monitor whether any turtles have gone up to the mainland to lay eggs. If a turtle is found laying eggs, then in the morning the eggs are immediately taken and transferred to a semi-natural incubation site to avoid the risk of predators or environmental damage. During this process, officers record information such as the number of turtles that have climbed, the status of laying eggs or not, and the number of eggs rescued. After being transferred to incubation, the supervisor provides an estimate of the hatching time based on biological experience, which is about 40 days of incubation.

Once the eggs hatch, the resulting hatchlings are transferred to a treatment site for observation and additional nutrition for one to three days. The goal is to ensure the physical condition of the hatchlings before they are released back into the sea. While at the treatment site, the officer records data on the number of hatchlings treated and if there is a death, the data on dead hatchlings is also documented and buried. This process ends with the release of hatchlings into nature, where data on the number of hatchlings released is also recorded. Based on these observations, it can be concluded that recording is carried out in layers according to the development phase of turtles, starting from the turtles climbing to the hatchlings being released. This flow of activities shows that turtle conservation recording systems are cyclical and interconnected, making the integration of data digitization an urgent need to support more systematic efficiency, accuracy, and reporting.

Problem Analysis

The main problem faced by the Kili-Kili Beach KEE Pokmaswas lies in the manual recording system that is still used in all turtle conservation activities. The use of notebooks as the main medium of recording raises various physical and functional problems, such as damage due to extreme coastal environments, vulnerability to data loss due to fading ink or pest attacks, and difficulties in maintaining the order of archives that continue to accumulate. This condition is further exacerbated by the absence of adequate digital backups, so it is prone to permanent data loss. These errors show the urgency of digitization in the recording system to ensure the continuity and integrity of conservation information.

On the other hand, the supervision system that adopts manual methods has proven to be less efficient and not adaptive to operational needs in the field. The process of searching for data for sudden needs requires extra effort because it has to open physical archives one by one. Time constraints, lack of lighting during night patrols, and age factors of most Pokmaswas members also aggravate the workload in supervision. In addition, the unavailability of a monitoring system for turtles to go ashore is also an obstacle in the conservation process. This shows the need to develop a system that supports fast, accurate, and responsive supervision to real conditions in the field.

Not only in recording and supervision, the reporting aspect is also significantly affected. The reporting process for the needs of external parties such as government agencies or academics is still carried out by manually calculating from book archives, which opens up opportunities for errors and inconsistencies. The absence of a digital reporting system makes this process slow and non-transparent. In addition, the security aspect is also a problem because there is no access authorization in the manual recording system. Anyone can change or delete data without a clear trace. Therefore, a digital system that supports login, access rights management, and personal account management is absolutely necessary to ensure security, integrity, and efficiency throughout the conservation process.

User Identification

From the results of the business process analysis, users who will use the information system are obtained, as follows:

Table 1. User Identification

No	User Code	Username	User Description
1.	P-01	Pokmaswas	Key actors in recording, monitoring, and reporting turtle cycles
2.	P-02	User	Parties who want to enter (pokmaswas parties who have not yet entered the system) and those who want to report

Source: Results of user identification analysis (2025)

Identify User Needs

From the identified business process results, the author of the necessary needs, here are the results:

Table 2. Identify User Needs

No	User Needs (KP) Code	Description
1	K01	Digital recording system for turtle cycles from laying eggs to hatching release
2	K02	Entering data based on the development phase of the turtle
3	K03	Secure and physically damage-resistant cloud-based or on-premises data storage
4	K04	Filter and data search features by turtle phase
5	K05	Recording data such as the number of turtles rising, the number of eggs, the number of eggs, the number of hatchlings
6	K06	Recording of hatchling deaths during treatment
7	K07	Hatchery release data input complete with number and date
8	K08	Mapping of the turtle zone going ashore
9	K09	Incubation monitoring and hatch date estimation features
10	K10	Automated digital reporting system that can be accessed by external parties
11	K11	Access data at any time without having to go to a physical post
12	K12	Hatchery Treatment Facility Asset Data Management System
13	K13	The system can be used free of charge as there is no fixed income from conservation
15	K14	The system separates the access rights of Pokmaswas and external parties (internal vs external users)
16	K15	Pokmaswas can add and manage members according to its authority
17	K16	Users can log in and out of the system

Source: Results of user needs analysis (2025)

Feature Identification

The main features developed in this system focus on the turtle conservation process based on user needs and the results of identifying problems in the field. The first feature is Manage Egg Data, which is used to record information about turtles that go ashore, the status of laying eggs or not, and the number of eggs that have been successfully rescued. This feature answers the need for early recording at an important phase in the turtle reproductive cycle. Next is Manage Incubation Data, which functions to record data on semi-naturally incubated eggs and estimated hatching time. This feature is designed to manage the transition process from eggs to hatchlings.

Then, the Manage Hatchery Data feature was developed to record the number of eggs that hatched successfully and that failed to hatch, as part of the evaluation of the success of the incubation process. The Manage Care Data feature includes recording of treated hatchlings, including feeding and health conditions of hatchlings, as well as data management of dead hatchlings. The next stage is the Manage Release Data feature, which is used to record the number of hatchlings released into the sea as well as the date of their implementation, as the final part of the conservation process.

To support the identification of spawning locations, the Spawning Zone Mapping feature allows the system to record and save the zones that turtles often use to spawn. In order to compile systematic reporting, the Automatic Reports feature was developed to generate reports on conservation activities based on monthly and annual time parameters. To support the physical conservation facility, the Manage Maintenance Assets feature is provided to record hatchling breeding grounds and monitor their use digitally.

In terms of user management, the system provides the Manage Member Account feature to add and manage Pokmaswas member accounts, as well as the Access Rights Settings feature to distinguish access between internal users (Pokmaswas) and external users. For easy monitoring of activity results, the View Detailed Report feature provides the function of viewing and downloading filtered reports. System login and exit access are managed through the Pokmaswas Login and Pokmaswas Logout features, which ensure that user sessions run securely. Finally, the system also provides a Manage Dead Hatchery Data feature, which allows for accurate recording of hatchling deaths including the date and location of the incident, to support better documentation and evaluation.

Functional and Non-Functional Identification

Functional identification is the process of determining the main features needed for the system to work according to the needs of the user. These features are described in detail as in :

Table 3. Functional Identification

(P-01) Pokmaswas			
No	**Function Code**	**Name of Need**	**Functional Description**
1.	F-PKM-01	Logout Pokmaswas	Pokmaswas can exit the system after completing the work
2.	F-PKM-02	Manage Turtle Data Ascending	Pokmaswas can add, change, and delete data on turtles climbing and laying eggs
3.	F-PKM-03	Manage Incubation Data	Pokmaswas can manage incubation data and estimated hatching dates
4.	F-PKM-04	Manage Hatching Data	Pokmaswas can manage data on the number of eggs hatched and failed to hatch
5.	F-PKM-05	Manage Care Data	Pokmaswas can manage data on hatchlings that are treated or die during treatment
6.	F-PKM-06	Manage Release Data	Pokmaswas can manage the number of hatchlings released and their release date
7.	F-PKM-07	Filter Data by Stage	Pokmaswas can filter data based on the development phase of turtles

8.	F-PKM-08	Spawning Zone Mapping	Pokmaswas can mark the zone where the turtle goes ashore
9.	F-PKM-09	Automated Reports	The system generates automated reports based on the data that has been entered
10.	F-PKM-10	Manage Maintenance Assets	Pokmaswas can manage asset data where hatchlings are cared for
11.	F-PKM-11	Manage Member Accounts	Pokmaswas can add and manage member accounts as authorized
12.	F-PKM-12	Access Rights Settings	The system distinguishes access between Pokmaswas and outside parties
13.	F-PKM-13	Manage Dead Hatchlings	The system must allow the Pokmaswas to record dead hatchlings during the treatment process.
14.	F-PKM-14	Manage Personal Accounts	Pokmaswas can change personal data and password independently through the account page
(P-02) User			
15.	F-EXT-01	Access and Download the Report	Outsiders can view and download available conservation reports
16.	F-EXT-02	User Login	The system provides a login page for all users, so that Pokmaswas can enter the system

Source: Results of functional requirements analysis (2025)

Non-functional identification aims to determine the quality criteria of the system that must be met beyond its main functions, such as security, speed, and ease of use. These needs are clearly summarized as in Table 4.

Table 4. Functional Identification

No	Kode NF	Name of Need	Description of Non-Functional Needs
1	NF-01	Free Access	The system must be usable at no cost because conservation has no fixed source of income
2	NF-02	Access Anytime	The system must be available and accessible at any time by the user without having to come to a physical location
3	NF-03	Secure Storage	Data must be stored in digital media that is safe and resistant to physical or environmental damage
4	NF-04	Separation of Access Rights	The system must be able to distinguish between Pokmaswas users and external users in their access rights
5	NF-05	Data Security	The system must maintain the integrity and confidentiality of data so that it cannot be manipulated by unauthorized parties
6	NF-06	Ease of Use	The user interface of the system should be simple and easy to use by all ages, including those over 40 years old
7	NF-07	Responsive and Fast Access	The system must be able to load pages and data quickly even if accessed over a slow internet network

Source: Results of non-functional requirements analysis (2025)

Use case diagram

This use case diagram in the turtle conservation system illustrates the relationship between the main actor, namely Pokmaswas and external users, with various system functions such as turtle data input, supervision, reporting, and account management. These diagrams are critical to identifying system limitations as well as user interaction with each feature, from recording turtle activity to viewing and downloading conservation reports. With this visualization, developers can understand the functional needs from the user side and design a more appropriate system according to the analysis of the predetermined problem.

Figure 1. Use case diagram

Source: Author's design (2025)

Use case scenario

From the results of the use case diagram, a ske-nario in running the application was obtained, the following is one of the scenarios in the information system for data collection and supervision of KEE Kili Kili Beach:

Tabel 5. User scenario login

Use case Scenario Login	
Actor	**Users (who are members of Pokmaswas)**
Description	Users who are members of Pokmaswas log in to the system using an account that has been registered. The system will verify identity and assign access rights as Pokmaswas.
Precondynia	Users already have an account registered as a member of Pokmaswas.
Postcondition	The user successfully entered as a Pokmaswas and was directed to the conservation system.
Main Plot	1. The user opens the system login page. 2. User enters username and password. 3. The system verifies credentials. 4. The system recognizes the user as a member of Pokmaswas. 5. Users are directed to the main page to access the features.
Alternate Flow	If the username or password is incorrect, the system displays an error message.
Exception	• The system cannot connect to the server. • The login process failed because the connection was unstable.
End of the flow	Actors successfully enter the system

Source: Results of use case scenario analysis (2025)

PLANNING

After analyzing, the author designs the application. To design the author's application using UML, activity dia-grams. Sequence diagrams, package diagrams, folder diagrams, ERDs, and interface designers.

Activity diagrams

Activity diagrams serve to model the system's workflow in a structured manner, while visualizing the logic of the processes carried out by the user and the system. This diagram is an important element in the design stage because it is able to represent dynamic processes such as decision-making, branching, and certain conditions. In this study, the activity diagram is designed by considering the results of needs and non-functional analysis, and adopts an atomic design approach so that repetitive processes can be arranged in a modular, efficient, and consistent manner. This helps in defining how users (Pokmaswas) interact with features such as data collection, reporting, and supervision, as well as being a visual basis in the development of user interfaces and further system development.

One example of this can be seen in the login process activity diagram. This process begins when the user enters a username and password into the system. The system will immediately check the data through middleware to ensure the validity of the information. If it is valid, then the user will be given a session token and redirected to the main page. However, if it is invalid, the system will display an error message and prompt the user to try again. This diagram reflects the principles of security and efficiency, in accordance with the needs of the field that requires a fast, easily accessible, and able to distinguish access rights between users.

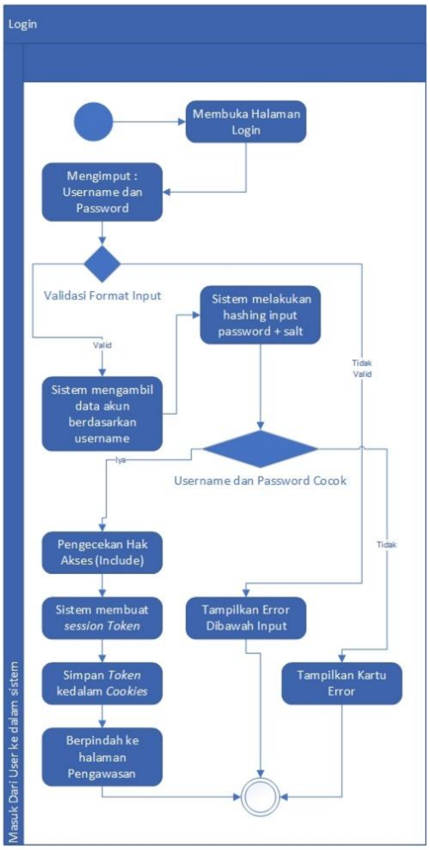

Figure 2. Activity Diagram Login

Source: Author's design (2025)

The process of input data on turtle eggs is carried out after observations in the field show that a turtle has laid eggs. In the system, Pokmaswas will fill out a form that includes the number of turtles on board, the number of eggs found, the status of whether or not they lay eggs, and additional information. If the egg laying status is enabled, then there will be additional options such as whether or not the eggs are directly incubated. This process reflects the need for real-time data logging that was previously done manually, as well as responding to the efficiency and accuracy of logging issues identified in the needs analysis. The activity diagrams in this section help visualize the decision-making flow and system logic that speeds up the input process without losing data validity.

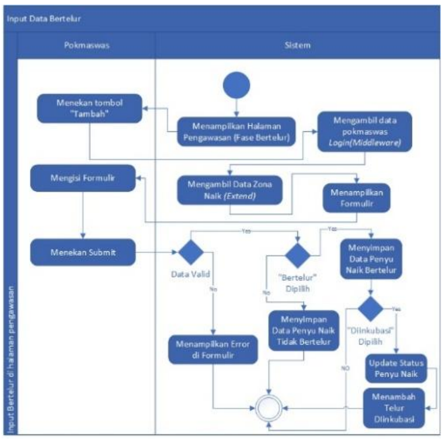

Figure 3. Activity Diagram Login

Source: Author's design (2025)

Folder structure diagrams

The structure diagram folder in this system is designed to support organized and efficient file management, according to non-functional needs related to ease of access, speed, and long-term maintenance. Based on the results of the analysis, the folder structure is arranged hierarchically with the principles of simplicity and consistency, making it easier for the development team and conservation parties to understand the relationship between components. The diagram also reflects an atomic design approach that divides components based on scale and function, from the smallest elements to the overall structure of the page. With this design, the system becomes more modular, easy to set up, and can be quickly adapted and updated as needed without causing excessive technical complexity.

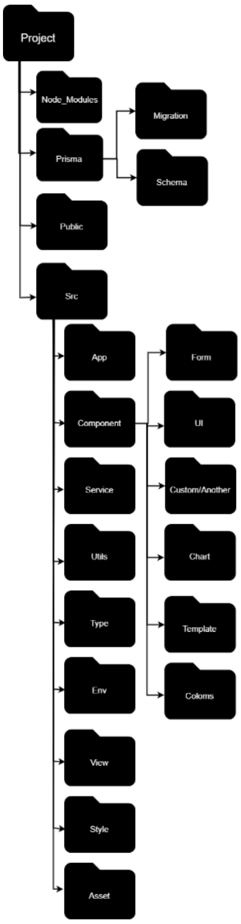

Figure 4. Folder structure diagrams

Source: Author's design (2025)

Sequence diagrams

From the results of the analysis obtained by the author, a sequence diagram design was made. The resulting sequence diagram also follows the atomic design model. Here is an example of a sequence diagram login.

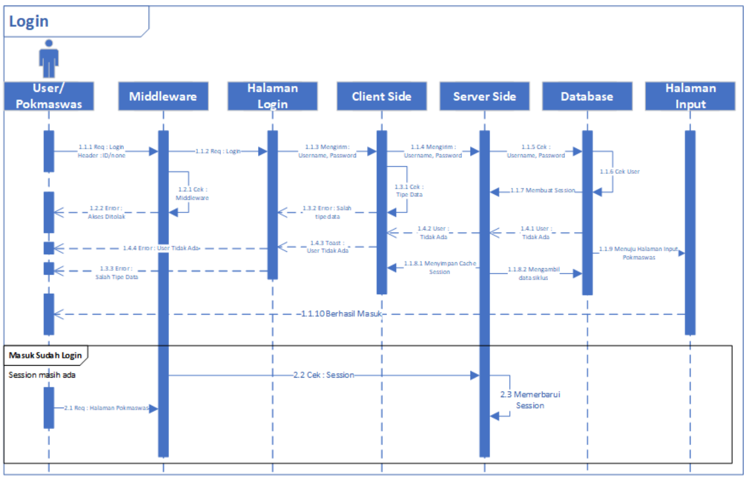

Figure 5. Login sequence diagrams

Source: Author's design (2025)

The sequence diagram for the input process of turtles on the beach in Figure 6 illustrates the flow of interaction between Pokmaswas and the system in recording data on turtles that go up to the beach. The process starts when the user presses the plus button on the turtle cycle page, which then displays an input pop-up. After the user fills in the data and presses the submit button, the system will check access through the middleware and validate the input. If it passes validation, the data will be sent to the server for processing and stored in the database. The system then provides feedback in the form of a notification of success or error, according to the results of the process. This diagram supports efficiency and accuracy in recording field data as per user needs.

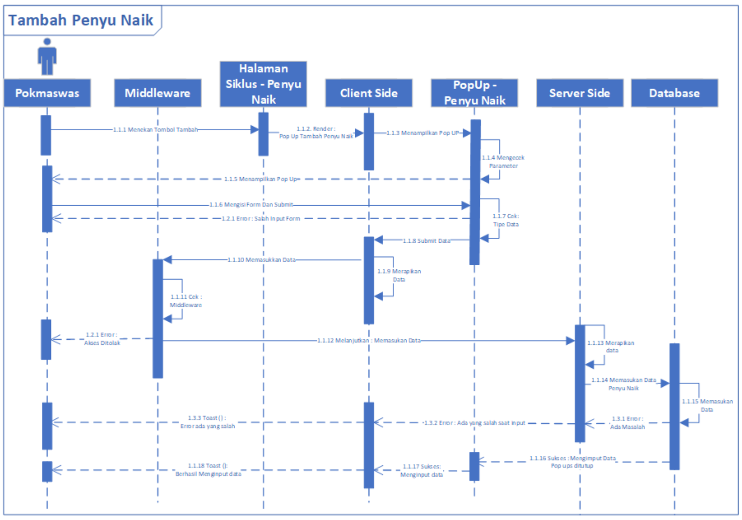

Figure 6. Login sequence diagrams

Source: Author's design (2025)

Package diagrams

Because the author uses an atomic design approach, it is necessary to divide functions according to the principles of atomic design. Here is a package diagram of the concept of atomic design.

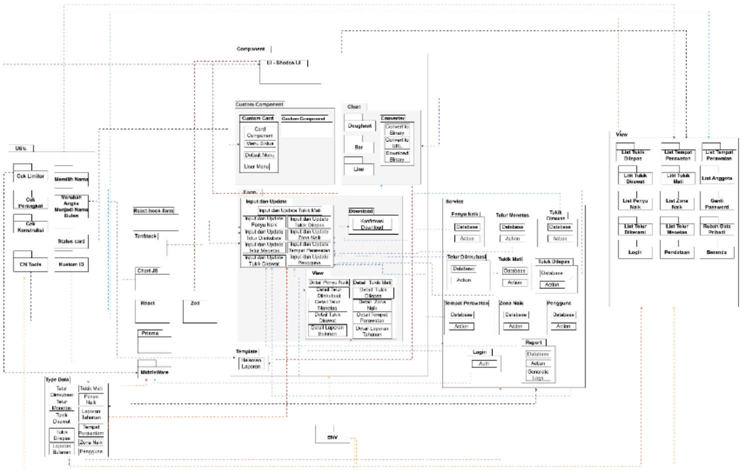

Figure 7. Package diagrams

Source: Author's design (2025)

Interface design

After designing the system, an interface is created so that users can interact with the system, here are some interface designs that the author made.

Login interface design

This page serves for users to log in as pokmaswas. By entering the username and password, the user will enter the data collection system.

Figure 8. Login interface design

Source: Author's design (2025)

Designing a folding interface

This page serves to record the turtle cycles that have occurred. This page has sub-pages i.e. turtles climb, eggs are incubated, eggs hatch, and are cared for. The sub-pages have the same look and only the rising turtles have the plus of the rising turtles. (Figure 8)

Figure 9. Design of the data collection interface

Source: Author's design (2025)

Member detail popup design

This pop-up provides complete data on the details taken from the data of pokmaswas members. These details can be accessed on the member list page.

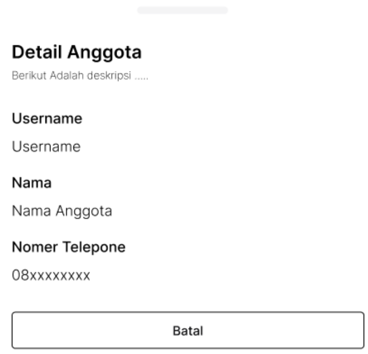

Figure 10. Design of member details popup interface

Source: Author's design (2025)

Implementation

From the design that has been made, the author implements it into the form of a website application using the Next JS framework and postgresql database. Here are the results of the implementation.

Login Implementation

To operate the system, the system must know who is accessing. The login page is the gateway to access the system. To enter pokmaswas, you need a username and password.

Figure 1. Login Implementation

Source: Author's implementation (2025)

Implementation of data collection and supervision

After the user logs in to become a Pokmaswas user, the data will be taken from the database and displayed in the depth of the data collection and supervision page. The following are the results of the implementation of administration and supervision.

Figure 2. Implementation of Data Collection and Supervision

Source: Author's implementation (2025)

Implementation of member data details

On the member list page, pokmaswas can see details of one of the members. Here is the implementation of the member data details.

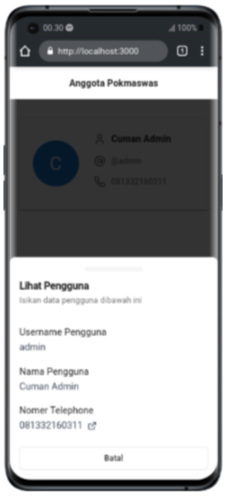

Figure 3. Implementation of Member Data Details

Source: Author's implementation (2025)

TESTING

To find out whether the system that has been created is effective in helping data collection, supervision, and reporting of the turtle cycle that occurs in the KEE Pantai Taman Kili Kili, testing is needed. To test the system, the author uses 3 test methods, namely black box test, white box test, and user acceptence test. The testing was carried out with 3 members from KEE Kili Beach. Here are the results of each test.

Black box testing

In this test, the author tested the functions that have been identified in the analysis above. For this test, there are 17 function points that are tested and the results are obtained below :

$$Percentage = \frac{48}{(3\ x\ 16)} \times 100\%$$

Where the result obtained is a 100% running function.

White box testing

In this test, the author tests from the logic of the functions that have been identified in the analysis above. For this test, there are 16 points of functional differentiation that are tested and the results are obtained below:

$$Percentage = \frac{120}{(3\ x\ 40)} \times 100\%$$

Where the result obtained is 100% branching of the running function.

User acceptance testing

In the test, there are two tests, namely testing whether the function has been accepted by the conservation party and testing the ease of using the application. For functional testing there are 14 points and for non-functional testing there are 4 points. In this test, the author used a scale of 1-5 where the value of one is "I Disagree" and the value of five is "I Agree". Here are the results of functional testing.

$$V = \frac{N}{(5 \times P \times Q)} \times 100\%$$

$$V = \frac{205}{(5 \times 3 \times 14)} \times 100\%$$

$$V = 97{,}6\%$$

From the results of the calculations obtained, in terms of system, the pokmaswas received the system by 95.4%. Next is non-functional testing and the results are obtained below.

$$V = \frac{55}{(5 \times 3 \times 4)} \times 100\%$$

$$V = 91{,}7\%$$

From the results above, it can be concluded that for the ease of running the application, a percentage of 93% was obtained.

Data Recovery Strategy and System Infrastructure

The data recovery strategy and system infrastructure are designed to address the needs of fields that are vulnerable to data loss due to manual logging. Based on the findings of observations and interviews with Pokmaswas at the Kili-Kili Beach KEE, the recording in the notebook faces various risks such as physical damage, insect attacks, and data loss due to extreme environments. Therefore, the system adopts a digital approach by utilizing *cloud hosting services* such as *Vercel* to store and serve applications, as well as *CockroachDB* as a distributed database system that has automatic *recovery* capabilities. This strategy aims to ensure real-time data availability, reduce the risk of loss, and facilitate the long-term management of conservation data.

The selection of *CockroachDB* was based on its ability to maintain data integrity through its high *consistency* and *fault tolerance* features, where data is copied to multiple nodes and automatically restored when a failure occurs. This corresponds to the non-functional needs of the system, i.e. guaranteeing the security, reliability, and availability of conservation data whenever needed. Meanwhile, *Vercel* as a system presentation platform is considered suitable because of its easy-to-access, free, and high-performance nature with a *serverless architecture*, answering Pokmaswas's financial limitations. This strategy is an appropriate solution that supports the sustainability goals of turtle conservation activities without burdening operational resources.

CONCLUSION

In research conducted at KEE Pantai Taman Kili-Kili, the author successfully designed and developed a website-based application for turtle conservation monitoring using the structured Waterfall method, built on the Next.js framework and powered by a PostgreSQL database via CockroachDB. Comprehensive testing—including black-box (100% success), white-box (100% success), functional user acceptance testing (UAT; 97.6%), and non-functional UAT (91.7%)—confirmed that the system fully meets both technical requirements and user needs of the Pokmaswas. For future research, integrating a decision-making dashboard with real-time analytics and mobile app compatibility could enhance data visualization, predictive modeling for turtle population trends, and accessibility in low-connectivity areas.

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