

## Improving Veterinary Clinic Efficiency: Web-Based Appointment Scheduling Application for Veterinary Clinics

Ida Farida<sup>1\*</sup>, Arya Suprobo<sup>2</sup>, Faisal Maulana Abdilah<sup>3</sup>, Abid Pradipta Wiguna<sup>4</sup>

<sup>1,2,3,4</sup> Informatics Engineering, Faculty of Computer Science, Universitas Mercu Buana, Indonesia

\*Corresponden Author: [dae.farida@mercubuana.ac.id](mailto:dae.farida@mercubuana.ac.id)

**Abstract** - This article presents the development of a website-based application aimed at improving appointment scheduling and service efficiency in a veterinary clinic, specifically addressing the challenges posed by a manual scheduling system that results in long wait times and customer dissatisfaction. The increasing demand for veterinary services, coupled with the shortage of veterinarians in Indonesia, requires innovative solutions to improve operational efficiency. To address these issues, the waterfall methodology was applied for application development, which includes five stages: requirements analysis, design, implementation, testing, and maintenance. The application features a user-friendly interface and efficient backend management, utilizing Next.js for frontend development and Firebase for backend data management. Key functionalities include user login and registration, a responsive homepage, a detailed list of services, an appointment booking system, and a contact page with Google Maps integration. The results show that the application successfully modernizes appointment management, improves communication between pet owners and veterinary staff, and increases overall access to clinic information. The conclusion highlights the effectiveness of the platform in streamlining veterinary services while suggesting future enhancements such as online payment integration, an admin dashboard, enhanced data security, and more extensive user testing to further optimize user experience and operational efficiency. This innovative approach not only addresses current challenges, but also lays the foundation for future advances in veterinary care.

### Keywords:

*Veterinary Clinics;*  
*Appointment Scheduling;*  
*Web Application;*  
*Waterfall Method;*

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## 1. INTRODUCTION

Pets are animals that are cared for or kept by someone or can be called their owners. There are many examples of animals that can be kept. These include dogs, cats, rabbits, turtles, or perhaps more "ferocious" animals such as snakes, lizards, eagles, spiders and other animals. Pets have played an important role in human life since time immemorial. Over time, the relationship between humans and animals has changed. Initially, the role of pets was only to guard the house from criminals, hunt something, or other violent actions, but nowadays most pets have functioned as friends of their owners or are called social functions [1]. Pets can play an important role in the physical and mental health of their owners. Therefore, pet owners must continue to pay close attention to their pets' health because it may affect the health of their owners as well. From this, the existence of a Veterinary Clinic is a solution to maintain the health of pets.

The existence of a veterinary clinic provides a solution for pet owners to carry out routine health checks, vaccinations, animal care for diseases, and other positive things. Although present as a solution, of course veterinary clinics also have their own problems. According to [2], the main problem for veterinary clinics in Indonesia is that

there are still not enough veterinarians in Indonesia. This certainly has an impact on the distribution or distribution of veterinary clinics, animal hospitals, and other animal health facilities in Indonesia. Then another problem, there are still many veterinary clinics that still use a manual system to manage appointments, which often causes long waiting times, scheduling errors, and customer dissatisfaction. This is certainly an impact of the main problem, namely the lack of veterinarians in Indonesia so that patients (animals) accumulate in one place. In order to overcome or reduce the impact of this problem, especially focusing on the problem of the manual scheduling system, technology can be applied to the veterinary clinic or animal health facility.

As previously mentioned, advances in information technology have provided opportunities to improve service efficiency in various fields, including animal health. One solution is to create a website-based application that can offer practical solutions in managing veterinary clinic appointments. Through this system, customers can easily book appointments, check schedule availability, and get important information without having to come directly to the clinic. This not only increases customer convenience, but also helps veterinary clinics manage schedules more effectively and in an organized manner. By implementing

an appointment website application, veterinary clinics can provide more modern and professional services. This system allows for reduced queues at the clinic, as well as improving communication between pet owners and medical personnel. Therefore, the development of this appointment application is not only beneficial for veterinary clinics, but also contributes to improving the quality of animal health services as a whole.

## 2. LITERATURE REVIEW

In conducting research, experiments, manufacturing, and other scientific matters, a literature review is needed. A literature review is important for understanding current research, identifying knowledge gaps, building theoretical frameworks, understanding research methods, providing justification, avoiding duplication, and increasing research credibility [3]. In the context of this article, references to previously created applications that have a similar context are certainly needed. Therefore, the following are references to previous research or experiments that have been conducted which are used as reference materials.

The first is about the selection of application development methods. For the application that we will create, from the references that we found, most of them use the waterfall method. This is because this method is quite easy to apply and the flow is sequential. To be more precise, there are several website application creations that use this method such as [4], who applied the waterfall method in developing the Yonif 509 Clinic website in Jember which aims to improve health promotion and information dissemination. The results of the study show that the structured approach of the waterfall method facilitates the overall development process, resulting in a functional website that increases access to clinic information and reduces staff workload, thereby improving overall clinic performance and accreditation scores. In line with other research[5], this research which has successfully implemented a veterinary clinic information system using the waterfall model which facilitates a structured approach in system development. The results of the study showed that this new system significantly improved the operational efficiency of the clinic, allowing faster data input and retrieval compared to previous manual methods, which ultimately improved overall clinic management. Another study that provides an example of the advantages of the waterfall method is [6] study, which discusses the application of the waterfall method as a structured approach in software development. This study emphasizes that the waterfall model requires sequential development through different phases, including requirements analysis, design, implementation, verification, and maintenance. Each phase must be completed before moving on to the next phase, ensuring that all requirements are thoroughly understood and documented during the analysis stage. This systematic approach is highlighted as a useful approach to managing complex software projects effectively.

Next is about creating a design with certain principles. This can be found in [7] scientific article, which discusses the design and evaluation of a pet disease consultation application using a human-centered design approach.

Usability testing conducted with five pet owners yielded impressive results, achieving a score of 100% in the effectiveness and efficiency tests. Furthermore, the user experience questionnaire showed positive user perceptions, with "good" ratings in attractiveness and clarity, and "very good" ratings in efficiency, accuracy, stimulation, and novelty. Overall, the design solution demonstrated a good user experience, as all test scores exceeded the average benchmark, indicating that the application effectively meets the needs and expectations of pet owners.

Then other reference sources, discuss the form of the application. If previously discussed the design principles, this session discusses the application. There are several application designs that we use as sources of inspiration or references, including [8] which discusses the development of the Animal Clinic Management System, emphasizing the importance of front-end design in improving user experience. The main programming language used for front-end system development is PHP which is equipped with CSS to design the interface and layout of various modules in the system. Although the programming language we use later will be different, the design can still be used as a reference, especially in the patient data information section. Next is the creation of another application that has a similar context, namely the results of [9] who also discusses the creation of a veterinary clinic website. The research article discusses the front-end design of the Pet Health Management System for GeBuu Veterinary Clinic, highlighting the programming languages used in its development. The main code structure is built using HTML, which serves as the foundation of the user interface. While JavaScript is integrated to ensure the functionality of the various buttons in the system. In addition, CSS is used for the design aspects of the system interface, which enhances the overall user experience and aesthetic appeal. Here we will also take references for the home page such as the main page, login page and other pages that will later be created with a combination of JavaScript as well, but the framework is different.

Lastly, talking about the front-end, it would not be complete without talking about the back-end. One of these is the creation of an application, the [10] application, which uses Firebase as its database. According to the article, Firebase was chosen as a database solution to minimize errors and improve data management capabilities in the application.

## 3. METHODOLOGY

In developing or creating an application, a development method is needed. As previously mentioned, we will use the waterfall method to develop this veterinary clinic website. The waterfall method is a sequential software development method consisting of five main stages: requirement, design, implementation, testing, and maintenance. This method was chosen because of its structured and organized nature, so it can minimize the risk of changing requirements during the development process. This approach ensures that each stage is completed thoroughly before proceeding to the next stage [11].

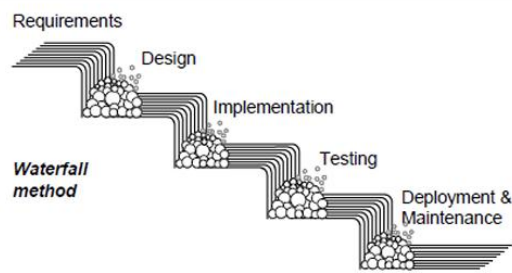


Figure 1. Waterfall method [11]

### 3.1 REQUIREMENT STAGE

At this stage, we must analyze user needs, in this context, namely from the perspective of people in the clinic (doctors, nurses, and workers who will later be assigned) and from the customer perspective. However, because this is only a general application design or creation experiment, what is done is to analyze or observe existing applications or research, such as that which has been done in the literature review section. From there, it can be seen that the veterinary clinic website is certainly designed to meet the needs of clinic owners and customers. Clinic owners need tools to manage service information, appointments, and communication with customers. They also need a simple administration interface to access relevant data such as appointment forms. In addition, they need a system that can help clinic operations run more efficiently.

From the customer perspective, the main need is quick and easy access to information about the clinic, including the services offered, doctors on duty, and operational procedures. Customers also need features to make appointments online without having to come directly to the clinic. Ease of submitting questions or complaints via the contact form is also a priority.

The results of this needs analysis provide a basis for designing key features such as service pages, appointment forms, and contact forms. All these features should be designed to be easily accessible, intuitive, and support a variety of devices such as desktops, tablets, and mobile phones, to provide an optimal user experience.

### 3.2 DESIGN STAGE

The design stage focuses on creating an intuitive and professional layout and user interface (UI) in accordance with the principles of human-centered design. To ensure that users can easily find the information they need, the interface is designed with simplicity and accessibility in mind. During the design phase, the Figma application is used to create a prototype to guide the implementation phase.

Responsiveness of the design is a top priority so that the website can be accessed well on various devices. Color schemes, such as blue and gray, are used to create a calm and professional atmosphere that matches the character of the veterinary clinic. Elements such as navigation, forms, and information pages are designed to look neat and easy to use by various types of users.

The result of this design phase is a functional prototype that is ready to be used for development. This prototype includes all the main features, such as appointment forms,

contact forms, and service pages, ensuring that functional needs have been accommodated in the design.

### 3.3 IMPLEMENTATION STAGE

Once the design is done, it's time to execute the design at this stage. As mentioned earlier, website development is done using modern technologies to ensure performance, scalability, and efficiency. Next.js is chosen for frontend development because it supports server-side rendering (SSR), which improves performance and SEO. Tailwind CSS is used to speed up the process of creating a responsive and consistent interface. The backend uses Firebase to store form data and support future authentication.

Each part of the website is developed modularly. Components such as the header, footer, and appointment form are created separately so that they are easy to manage and update. Input validation on the form is done on the client and server side to ensure that the data submitted is valid and secure. This development also includes an automatic notification feature to remind customers about their appointments.

In the implementation process, as an application creator or developer, you must ensure that each feature works according to specifications. Then, there is another thing that may still be considered trivial by some people, namely documentation. Even though good documentation is created during this process to facilitate maintenance and system updates in the future.

### 3.4 TESTING STAGE

After the application is ready or completed, the next stage is Testing. A creation certainly needs to go through a testing stage, this stage is carried out to ensure that all website features run as needed. In this case, the black-box testing method is used to check functionality without looking at the source code. There are several things that are tested such as the Appointment form is tested to ensure that data can be sent and received correctly. Input validation is tested to prevent errors, such as empty columns or incorrect email formats.

Then the website response is also tested on various devices, from desktops to mobile phones, to ensure that the display remains optimal on all screen sizes. In addition, user testing is also needed by involving clinic owners and customers to evaluate the ease of use and comfort of the interface. However, because this application is made for a general context, it does not need to be specific to certain health facilities or customers. After testing is complete, the results are analyzed to identify bugs or areas that need to be improved. The iteration process is carried out until all features run smoothly and meet the desired quality standards.

### 3.5 MAINTENANCE STAGE

Finally, the stage at the end or below the waterfall method is Maintenance. Maintenance must be carried out routinely after the website is launched to ensure the system remains relevant and functions properly. Bug fixes are prioritized based on user reports or system monitoring results. In addition, feature updates are made to adapt to evolving business needs, such as adding new features or

improving performance.

Maintenance also includes monitoring website performance, such as page load times and service availability. Techniques such as caching and image optimization are used to improve performance. User feedback is integrated periodically to improve the design and user experience. Through ongoing maintenance, the website can remain modern, secure, and support optimal veterinary clinic operations. This also ensures that customers continue to get the best experience when using the services provided by the website.

#### 4. RESULTS AND DISCUSSION

From the existing process or stages, a veterinary clinic website is produced which is a form of a modern and responsive digital platform, designed to meet the needs of users, both clinic owners and customers. The website consists of several main pages with certain features and functions to provide an optimal user experience. The following are details of the development results.

##### 4.1 LOGIN PAGE

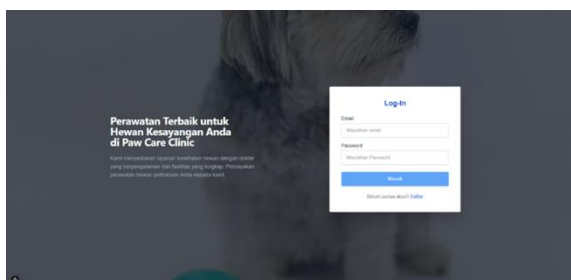


Figure 2. Login page

On the login page, of course, it is a means to access personal features for users who have an account. The login form consists of fields for email and password, with a "Login" button that is connected to the backend system to verify user credentials securely. Input validation is applied to check the email format and ensure that no fields are empty before continuing the process. If an error occurs such as an incorrect email or password, an error message will appear to provide direction to the user.

This page also has a "Forgot Password" feature integrated with Firebase. Users who forget their password can request a recovery link that will be sent to their email, making it easy to reset their password safely. This page also has the word "register" for those who do not have an account will be directed to the register page

##### 4.2 REGISTER PAGE

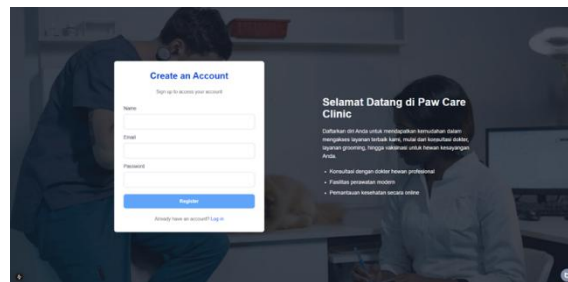


Figure 3. Register page

On this page, as mentioned earlier for people who do not have an account. The registration page allows new users to create an account to access the clinic's services. The registration form includes fields such as full name, email, phone number, and password. The "Register" button connects the user's data to the backend for secure storage.

This page also implements Input validation to ensure that the email format is correct, and the password meets security standards, such as a minimum length of 8 characters and a combination of upper- and lower-case letters, numbers, and symbols. All fields must be filled in before the registration process can continue. The data of successfully registered users is stored in Firebase Authentication. This system ensures secure authentication and manages email verification, where users receive a confirmation link before their account is fully activated. Finally, there is a "login" button for users who just remembered they have an account, so they can log in directly on the login page.

##### 4.3 HOME PAGE

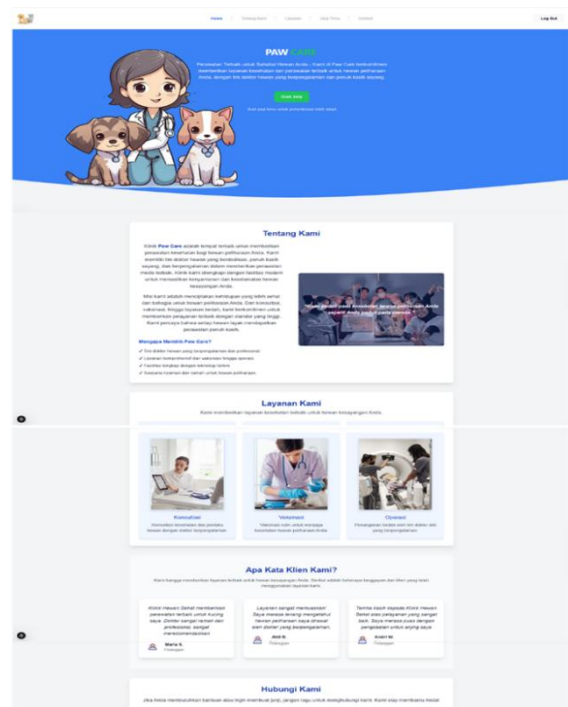


Figure 4. Home page

On this page, it is the page that will be directed after the user successfully logs in. The main page serves as a gateway to information that is attractively designed with a

simple yet informative layout. The interactive header is a key element, providing a navigation menu that makes it easy for users to move to pages such as "About Us", "Our Services", "Appointments", and "Contact". This header is sticky, meaning it remains visible even as the user scrolls the page, so accessibility is maintained at all times.

To improve the user experience across devices, this page uses a responsive layout. The design automatically adjusts the size of elements such as buttons and images based on the device screen, whether desktop, tablet, or mobile. This ensures that the display remains optimal without compromising on function or aesthetics.

This page also features a featured services section that is designed to be visually appealing. Some of the clinic's main services are highlighted with attractive icons and brief explanations so that users can quickly understand the information. In addition, Call-to-Action buttons such as "Make an Appointment Now" are strategically placed, directing users to the appointment page to increase service conversions.

#### 4.4 ABOUT US PAGE

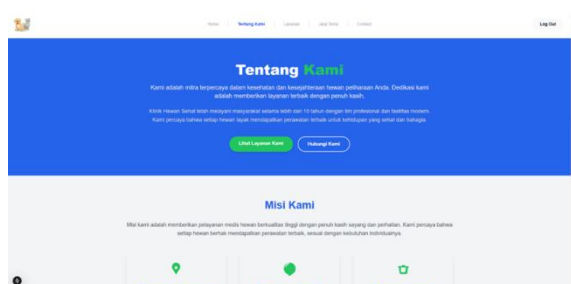


Figure 5. About us page

This page provides in-depth information about the clinic, including its history, vision, mission, and team of doctors. The clinic profile section provides a brief story about the clinic's founding, values, and main goals for animal health services. The purpose of this narrative is designed to build trust and increase emotional engagement with visitors.

Then, the team section displays the profiles of professional veterinarians, including official photos, names, and brief descriptions of their expertise and experience. This helps users get to know the doctors who will be serving them, while also demonstrating the clinic's competence in handling animal health. The visual design of this page combines text and images in a balanced way, ensuring that the information can be easily understood. Attractive images combined with a neat layout, provide a comfortable and professional user experience.

#### 4.5 OUR SERVICES PAGE

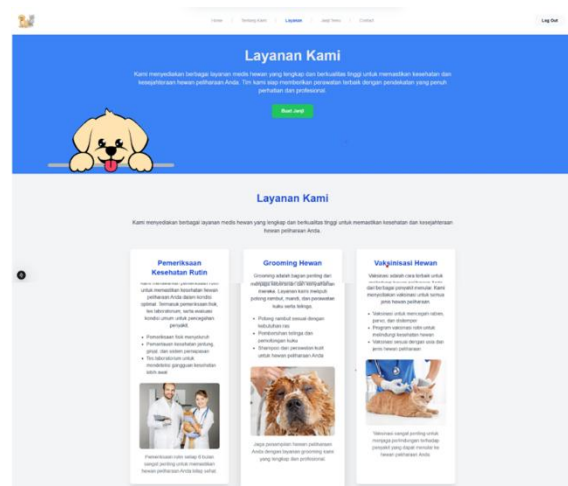


Figure 6. Our services page

On the next page, which is a page that explains what services the clinic provides, such as vaccinations, consultations, treatments, and routine health checks, as well as other services. These services are presented in an interactive grid design, where each service is given a special icon to make it look more organized and visually appealing. Each service is equipped with a short description to help users understand the benefits and scope of the service.

The information provided is designed to be short but concise, so that users can quickly find what they are looking for without feeling overwhelmed. Finally, a hover effect is applied to increase the interactivity of the page. When the user hovers over the service icon or description, additional information will appear, providing a dynamic visual experience that attracts the user's attention.

#### 4.6 APPOINTMENT PAGE

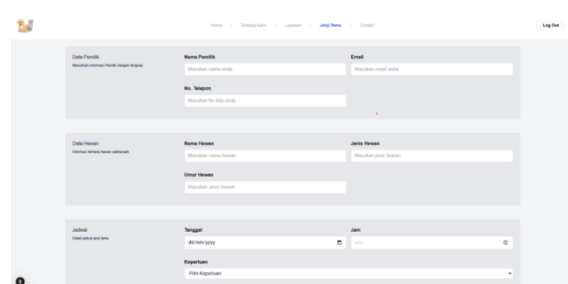


Figure 7. Appointment page

On this page are the main features offered in this website solution. The page is of course the Appointment page that allows users to book a consultation schedule with a veterinarian online. The booking form feature includes columns such as name, phone number, type of animal, desired service, and desired date and time. This form is intuitively designed to be easy to fill in by all users.

A validation feature is also implemented on this page. To ensure that the data entered is valid, a regex-based validation algorithm is applied. This validation checks the email and phone number formats and ensures that all mandatory fields are filled in before the form can be submitted. This minimizes the possibility of incomplete or incorrect data.

Appointment data is directly saved to Firebase in real-time, ensuring security and ease of access for clinic staff. After successfully filling out the form, users receive a confirmation notification, which provides assurance that their data has been received and processed. This will of course be a superior feature in this website application.

#### 4.7 CONTACT PAGE

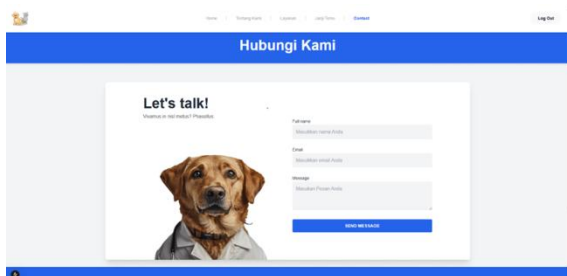


Figure 8. Contact page

This page contains information to contact the clinic. On this page, it is easy for users to contact the clinic via a contact form or direct contact information. The contact form has columns such as name, email, and message, with input validation to ensure users fill in all columns correctly before submitting.

Then, the contact information section includes the clinic's complete address, phone number, email, and operating hours. Google Maps integration is also added to make it easier for users to find the clinic's location, so they can plan their visits more easily, quickly and most importantly not get lost. Social media icons such as Instagram and Facebook are displayed to strengthen the clinic's digital presence. Direct links to the clinic's official accounts allow users to interact, get updates, and build better relationships with the clinic.

#### 5. CONCLUSION

Based on the development results, it can be concluded that the development of this website application for a veterinary clinic has succeeded in achieving its main objectives. This application is able to provide a modern solution in managing appointments and providing clinic information efficiently and practically. This system simplifies the process of making appointments through an online form integrated with Firebase, thereby reducing the potential for errors in managing schedules and minimizing customer waiting time.

This website also provides easy access to information for customers, such as pages about the clinic and the services offered, without having to come directly to the location. With a responsive design using Tailwind CSS, the website is able to provide an optimal user experience on various devices, thereby increasing user convenience. The use of modern technologies such as Next.js and Firebase produces high system performance with secure and scalable data management. This application not only makes it easier for customers, but also helps clinics provide more organized, professional, and modern services, which ultimately improves the quality of animal health services as

a whole.

For further development suggestions, this application can be improved by adding features such as online payment integration to facilitate customer transactions, as well as an automatic reminder system via email or SMS for appointment schedules. In addition, this application does not yet have an admin dashboard that can facilitate clinic owners in monitoring and managing data in a more structured manner. User data security also needs to be improved by implementing data encryption and two-factor authentication. Testing with a wider user scale also needs to be done to ensure that website performance remains stable under more complex operational conditions. With the hope that it can be developed further, this application is expected to provide a more comprehensive and beneficial solution for veterinary clinics and their customers.

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