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RaphaVets Pet Clinic: A Web-Based Management and Pet Care System Utilizing Multiple Linear Regression

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CHAPTER 1

THE PROBLEM AND ITS BACKGROUND

This chapter introduces the study by presenting the introduction, background, statement of the problem, objectives, scope and limitations, and significance of the research. It begins with a discussion of the current situation of RaphaVet Pets Clinic and the challenges it faces in managing its daily operations. The chapter also outlines the goals of developing a web-based system designed to improve the clinic's efficiency and client experience. Through sections that explain the problem, purpose, coverage, and relevance of the study, this chapter provides a clear foundation and overview of the study.

Introduction

Humans use animals for a variety of purposes, from warfare and agriculture to emotional support and companionship. As a response to a plague that affected the cattle in 1761, since the horses and cattle are used for warfare, Claude Bourgelat established the first veterinary school (Mark & Hornblower, 2020). Another role of pets for humans is providing emotional support to their owners; studies show that pets can reduce stress, anxiety, and depression while increasing levels of serotonin and dopamine, hormones associated with happiness and relaxation (Robinson & Segal, Ph.D., 2024). Just like human beings, these animals need suitable healthcare, preventative care, and instant medical care when their well-being is compromised, hence the role of veterinary clinics for pet owners who want to provide health, safety, and quality of life to animals.

From conducting routine check-ups, grooming, surgery, and prescription of medication, these are just a few of the services the veterinary clinics offer that are necessary to keep a pet healthy. Additionally, veterinary clinics benefit not just animal well-being but also public health and emotional well-being, as healthy pets create healthier, happier, and more humane human communities.

However, despite the importance of veterinary clinics, many veterinary clinics still rely on manual and traditional methods. Processes such as record management, relying on phone calls or walk-ins for consultations, verbally relaying information to clients, and phone calls for vaccination and appointment reminders. Even though these methods have been around for quite a while now, they often fail in the fast-paced and technologically advanced world of today. Studies indicate that a number of clinics still use a physical filling system and record keeping which is time consuming and are prone to errors (LFU, 2023).

According to Pet Parent Research Report by PetDesk(2025), the majority of pet owners prefer digital ways of communication to manage their busy lives, and expect the same convenience and accessibility from their veterinary providers. These include features such as online appointment scheduling, automated reminder notifications and access to pet health records. This created a wider change in our current society that puts an importance on efficiency, accessibility, and ease. Similar to how human healthcare has advanced, veterinary medicine is starting to see the benefits of utilizing digital technologies.

In accordance with inefficiency, inconvenience, and manual processes, the research recommends a creation of a browsable website for RaphaVets Pet Clinic that incorporates digital components to maximize its operations. Through the provision of vital services like booking appointments online, information on services, and client inquiries, the website will also delve into incorporating a chatbot that utilizes multiple regression. The chatbot function will serve as a virtual aide able to provide general pet care advice, and guide clients through the clinic's services. This application is intended to immediately respond to frequent issues, and be an accessible point of contact even outside normal clinic timings.

RaphaVet Pets Clinic can create an enhanced approach to service that is not only at the cutting edge of technological advancements but also adaptable to the evolving needs of pet owners by fusing the flexibility of artificial intelligence with the effective features of web-based solutions such as online appointment bookings, automated reminders, and electronic medical records. Studies show that implementing online booking appointments can reduce phone call intakes by up to 30% and increase work efficiency (Peters, 2025). Similarly, the implementation of electronic medical records (EMRs) had shown the reduction in errors, sped up data retrieval, and smoothen the workflow in veterinary practices (Ahmed et al, 2023). Also, studies show that most veterinary clinics using online scheduling and automation software report enhanced client satisfaction and minimize delays (Vetstoria, 2024). Through the implementation of these innovations in technology, RaphaVet Pets Clinic can enhance operations, improve

accuracy when handling records, and deliver responsive, dependable, and client-focused pet care services.

Background of the Study

There has been a growing interest in companion animals such as dogs and cats, with 62% of adults in the United States (U.S.) reported to be pet owners, according to a survey of 5,073 respondents (Brown, 2023). This is further supported by data from the American Pet Product Association, as reported by Martyn (2025), indicating that 86.9 million households, or 66% of the population, had a pet in 2023-2024. By 2025, 71% of U.S. households own at least one pet, with approximately 68 million homes owning dogs and 49 million owning cats. This trend in pet ownership is reflected in massive consumer spending: U.S. citizens spent $152 billion on their pets in 2024, with projections reaching $157 billion in 2025 (Martyn, 2025). Similarly, in the Philippines, data from Social Weather Stations indicate that 64% of Filipino households owned a pet in 2023 (Dela Peña, 2023). Dela Peña further finds that some of the primary reasons for adopting pets include companionship, emotional connection, and the desire to help.

Veterinary clinics play a crucial role in maintaining the health and safety of our pets. In fact, Lloyd (2023) warns, citing his earlier report, that the shortage of veterinary professionals may lead to increased morbidity and mortality rate in animals, as well as the risk of zoonotic diseases; highlighting the importance of veterinary services. Using radio frequency identification (RFID) or photo identification, a South African study found that rabies vaccination administered by veterinary professionals significantly

reduced the risk of death from all causes of the tracked dogs after observing over a period of 4 years. Specifically, the vaccinated dogs' all-cause mortality was reduced by 56% for those aged 0-3 months, by 44% for those aged 4-11 months, and by 16% for those aged 12 months and older (Knobel et al., 2017). Likewise, a study conducted by Yoder et al. (2019) found a relationship between dog vaccination and human rabies death, where they found that an increase of 10% in dogs vaccinated reflects an approximated 12.4% decrease in human death caused by rabies.

It can be noted that veterinary services, aligned with healthcare, require efficiency and accuracy (Ramaswamy, 2023); an endeavor that can be supported by digital solutions. Recent developments align with this, veterinary clinics have been adapting to modern standards and demand, encouraging consultations over the phone and implementing online scheduling platforms (Kogan et al., 2016; Rosmani & Mokhtar, 2023). However, veterinary services extend beyond basic medical care, an essential aspect of a veterinarian's role is to guide pet owners in making informed decisions regarding their pets' treatment, ensuring both the animal's well-being and the owner's confidence in the care provided (Janke et al., 2021). Similar to this point, a recent study shows that pet owners prefer to be well-informed about their pets' health concerns, diagnostic findings, and the potential costs of treatment (Groves et al., 2025).

To support these communication needs, developers have introduced various digital solutions. Currently, veterinary clinics are adopting online appointment systems like the system developed by Rosmani and Mokhtar(2023), remote consultations such as

Joii Pet Care (n,d.) and Pawp (n,d.), and general symptom checkers such as BuddyDoc (n,d.). Despite these technological advancements, few have studied the integration of these approaches into a singular framework, and are more often implemented on their own. This can lead to redundant data entry on the user's part, which may not only contain inaccuracy, but also cause communication inefficiencies (Khashu, 2025). For instance, Liu (2022) demonstrated the capability of a symptom checker combined with a self-scheduling system where the overall patient experience was improved. Meanwhile, a systematic review by Laranjo et al. (2018) proved that conversational agents may benefit various domains of healthcare in different ways, but cautions that there is limited evidence in safety and efficacy. Furthermore, Khashu (2025) emphasized the importance of optimizing patient check-in procedures, where technology is being leveraged towards a better patient experience. Some technology mentioned includes patient portals, automated notifications, and real-time support that may be supplemented by AI chatbots. Khashu (2025) also discusses the challenges faced by technological integration such as reluctance to adopt, data privacy concerns, and scalability issues. Without this integration, the efficient flow of information between pet owners and veterinarians remains limited. Existing symptom checkers provide preliminary insights and suggestions of the next steps. However when such information is made accessible to veterinarians, it has the potential to facilitate clearer guidance and more collaborative decision-making.

While these problems are promptly addressed by larger businesses, the same may not necessarily apply to small and medium businesses. Particularly, for the context of this special project, the researcher partnered with RaphaVets Pet Clinic, a small-scale

veterinarian-owned veterinary clinic situated at Pembo, Taguig City. Specializing in feline and canine care, it provides basic consultations, vaccinations, laboratory tests, confinements, and certifications. Their clinic currently houses one veterinarian and two veterinary assistants, but they do employ veterinarians who show up once a week to allow the main veterinarian some rest. However, the amount of clients visiting the clinic each day tends to be sporadic, making it difficult to determine the exact daily average; instead they provide that they receive up to ten clients on a busy day. RaphaVets Pet Clinic's mission is to administer economic, empathetic, and excellent veterinary care to ensure the health and safety of both companion animals and their owners. In the foreseeable future, the clinic aspires to empower a community that compassionately cares for their companion pets with the same dedication and empathy they provide their service.

From the initial interactions, we gathered that the clinic lacks a dedicated web application, which may attract potential customers. Upon further questioning, we discovered that most of their clients afford their services via walk-in, sometimes after inquiring the clinic's availability . However, such an arrangement can be time consuming for the customers, and requires the constant availability of clinic staff members to calls and inquiries.

Accordingly, this project seeks to address this gap through the design of a web-based appointment system with recordkeeping features for previous appointments and critical information such as pet allergies. The appointment system will implement

optimization strategies suggested by Khashu(2025), which also points out the challenges and limitations of such a system. The system is expected to enhance information flow and help veterinarians conserve valuable time, and lighten the workload of the clinic's staff members. Specifically for RaphaVet Pets Clinic whose main veterinary tends to be more hands-on when receiving clients for consultation over the phone or through text messaging.

Objectives of the study

The general objective of this study is to design and develop a web-based system with AI and predictive analytics integration using multiple regression for RaphaVets Pet Clinic to improve client experience and enhance service efficiency.

1. To gather the demographic information of the respondents, including their age, gender, types of pets owned, number of years of pet ownership, frequency of clinic visit per year, history of pet illnesses and vaccinations, level of digital literacy and comfort in using online platforms, and preferred communication channel (SMS, email, app, or calls).
2. To design and develop a web-based application with the following core features:
    a) Facilitates user account creation, editing, and deletion;
    b) Enables online appointment booking with automated SMS and email reminders
    c) Provides a dedicated page for pet care tips
    d) Integrated an AI chatbot for general pet care guidance.

e) Includes a cat and dog breed detector for pet identification;

f) Features a missing pet finder page for reporting and locating lost pets;

g) Allows staff to monitor reports and manage system content;

h) Implements data collection and analysis tools.

i) Utilizes multiple regression analysis to generate possible diagnoses and predictive insights.

3. To design and develop a web based application using Python, ReactJS, NodeJS, Javascript, MySQL, HTML, CSS, and Tailwind CSS that will provide an efficient, responsive, and user-friendly platform for managing veterinary clinic operations. The systems interface will be designed and prototyped using Figma to ensure an intuitive user experience before implementation.
4. To evaluate the effectiveness and usability of the system through client feedback and technical testing to determine whether it improves the workflow efficiency, reduces miscommunication, and increases client satisfaction.
5. To evaluate and measure the performance of the system's diagnosis model using the following evaluation metrics:

    A. Evaluation Metrics

        I. Accuracy

        II. Precision

        III. Recall

IV. F1 Score

V. Confusion Matrix

6. To assess RaphaVet using the ISO/IEC 25010 standards of functionality, reliability, usability, efficiency, and maintainability.
7. To document the system following the APA 7th edition format.

Scope and Limitations

The scope and limitations of this study explain what the system can do and the boundaries of its functions. It focuses on the features designed for both the clinic staff and the clients, showing how the system will help in daily operations and services. At the same time, it points out the restrictions and challenges that may affect its performance. This section makes clear what the system covers and what it cannot fully achieve.

The scope of this study focuses on the design and development of a web-based management system for RaphaVets Pet Clinic. The main features of the system are the online appointment booking and the multiple regression analysis for possible diagnosis. The appointment booking feature allows clients to schedule consultations directly through the website, removing the need for traditional reservations or phone calls. It automatically sends SMS and email reminders to notify clients about their upcoming visits, which helps reduce missed appointments and improve time management. This feature also allows staff to manage the clinic's schedule efficiently by viewing and organizing bookings through the staff panel.

The multiple regression feature serves as an intelligent analytical tool that assists veterinarians during consultations. It works by analyzing the symptoms entered by veterinarians and using statistical modeling to suggest possible diagnoses. This feature supports the veterinarian by offering data-driven insights that can guide the initial assessment of a pet's condition. Although it does not replace professional judgement, it enhances decision-making and helps make consultations faster and more accurate. This integration of predictive analysis demonstrates how data science can improve veterinary healthcare.

The system also facilitates user account creation, editing, and deletion. However, only the staff can register or create customer accounts to ensure accuracy and proper verification. Once registered, customers can log in, update their personal details, and manage their profiles easily. This helps keep client information organized and up to date. A dedicated page for pet care tips is included to educate pet owners about proper nutrition, hygiene, and preventive healthcare. The cat and dog breed detector enables users to upload pet photos to identify their breeds, giving owners an easy and interactive way to learn more about their pets. Another key feature is the lost pets board, which allows users to report and locate lost pets by posting photos, descriptions, and contact details. Other users can view and share these posts to help find missing pets. It is also publicly accessible, meaning anyone, even guests without an account, can view posts of missing pets. This promotes community cooperation and strengthens engagement among pet owners.

For the clinic's staff, the system provides tools to monitor reports, manage user posts, and update content, ensuring that all information remains accurate, organized, and appropriate. It also includes data collection and analysis tools that summarize useful information such as appointment trends, frequent services, and common pet concerns. These insights help the clinic improve its operations and make informed decisions.

However, the system also has limitations. Since the system is web-based, it requires a stable internet connection to work properly; slow or unstable connections may affect its speed and performance. The AI Chatbot included in the system is programmed only to provide general pet care information. It does not have the ability to give medical diagnoses or make professional veterinary decisions. Its responses are based on pre-defined data and cannot adapt to complex or emergency cases. Therefore, it should be used only as an initial guide or support tool. Actual veterinary assessment is still necessary to confirm any diagnosis or treatment plan.

The cat and dog breed detector also has some restrictions. Its accuracy depends largely on the quality, lightning, and clarity of the uploaded photo. Blurry, dark, or partially visible images may lead to incorrect or uncertain results. Additionally, mixed-breed pets or those with uncommon appearances might not be recognized accurately by the system’s detection model. The detector serves as an educational and entertainment feature rather than professional identification tool. The lost pets board features success depends on how active users are in posting and checking updates. If pet owners or community members are not consistently engaged, the effectiveness of the

feature will decrease. The system can only display and organize posts, it cannot track or locate pets automatically. Its usefulness therefore relies on public participation and timely updates from both the owners and the clinic. For appointment reminders, the accuracy of notifications depends on the validity of contact details such as phone numbers and email addresses provided by users. Incorrect or outdated information may result in clients not receiving alerts. The reminder function also depends on the reliability of the SMS and email servers used by the system. Any technical or network issues could delay or prevent notifications from being sent.

On the staff side, staff members are responsible for updating content, verifying reports, and managing posts. Since these actions are performed manually, the system requires regular checking to ensure that all information is accurate and current. Without consistent monitoring, outdated or incorrect data may remain visible to users. This also means that additional staff time and effort are needed to maintain the system's smooth operation.

The current version of the system does not include financial tracking or advanced data analytics beyond simple report generation. While it allows basic data collection, it does not yet provide complex insights such as revenue trends, cost analysis, or financial summaries. In addition, the system does not include inventory or supply management, payment processing, or staff scheduling features, as these are outside the scope of this study. Implementing these functions would require integration with additional databases and modules. Lastly, the study assumes that both clinic staff and clients have basic

knowledge of computers and the internet. The system interface is designed to be user-friendly, but it still requires users to understand how to navigate websites, upload photos, and fill out forms correctly. No extensive technical training or support program is included in this study's implementation. Users who are unfamiliar with technology may need guidance during initial use.

Significance of the Study

Many pet owners today seek convenience and easy access to information. This study proposes a straightforward and practical system where clients can book appointments, access pet care information, view available services, and find contact details in one place. The findings of this study will support RaphaVet Pets Clinic in adapting to modern veterinary practices by using technology that enhances client satisfaction and streamlines workflows.

As Ramaswamy (2023) emphasized, efficiency and accuracy are important in veterinary services, and integrating digital systems directly supports these goals. The findings therefore provide new evidence that digital solutions, when properly designed, can strengthen trust between pet owners and their chosen clinics.

The beneficiaries of this study extend beyond RaphaVet Pets Clinic itself:

A) **Pet owners**, the system offers greater ease and efficiency. Pet owners will no longer need to make repeated calls or visit the clinic just to obtain basic information. With online forms, a list of FAQs, emergency contact details,

and practical pet care tips, the clinic enables them to make informed decisions while staying connected.

B) **Clinic Staff**, the system can really lighten the workload. Appointment scheduling becomes less stressful, there's less paperwork, and keeping track of client and pet records becomes more accurate. Also, tools like the pet/patient portal and real-time schedule updates makes it easier for staff to coordinate and deliver faster, more organized service.

C) **Veterinarians,** the system's organized record-keeping and data accessibility. By having a centralized database of pets' medical histories, appointments, and symptoms, veterinarians can provide more accurate diagnoses and treatment plans. The system also reduces manual record errors and helps them manage their time more effectively.

D) **Students,** particularly those studying veterinary medicine, information technology, or related fields, may gain insights from this project as an example of how digital systems can enhance veterinary services. It can serve as a reference for academic purposes, system development, and future research on integrating technology with animal care.

E) **Small Veterinary Clinics**, they can use this study as a guide for implementing cost-effective technological solutions in their own

operations. By adopting similar systems, these clinics can modernize their processes, improve client satisfaction, and remain competitive in a digitally evolving industry.

F) **Future researchers**, this study may serve as a useful reference in developing similar systems or improving existing ones.

Operational Definition of Terms

To better understand the conducted study, the following terms were operationally defined**:**

Algorithm – An algorithm is a finite sequence of logical steps designed to solve a problem or perform a specific task.

Appointment – An appointment is a scheduled arrangement between two or more parties set for a particular time and place.

Breed Detector – A breed detector is a tool that identifies the breed of an animal based on physical characteristics or images.

Chatbot – A chatbot is an artificial intelligence program that communicates with users through text or voice to simulate human conversation.

Context Diagram – A context diagram is a visual representation that shows the system's boundaries and how it interacts with external entities.

Data Flow Diagram (DFD) – A Data Flow Diagram is a graphical model that represents how data moves through a process or system.

Database – A database is an organized collection of structured data stored electronically for easy access and management.

Data Dictionary – A data dictionary is a structured collection of information that defines, describes, and catalogs the data elements within a database or system.

Entity Relationship Diagram (ERD) – An Entity Relationship Diagram is a visual model that shows the relationships between entities in a database.

Evaluation – Evaluation is the process of assessing or measuring the quality, performance, or effectiveness of something.

Feedback – Feedback refers to information or opinions given as a response to a process, service, or performance.

Flowchart – A flowchart is a diagram that uses symbols and arrows to represent the sequence of steps in a process or system.

Forum – A forum is a virtual space where users can share opinions, ask questions, and engage in public discussions.

Interface – An interface is the point of interaction between a user and a computer system or device.

Login – Login is the process of entering a username and password to gain access to a secure system.

Lost and Found – Lost and Found is a service that helps report, store, and recover misplaced or lost items.

Module – A module is a self-contained component or unit of a software program that performs a particular function.

Multiple Regression – Multiple regression is a statistical technique used to examine the relationship between one dependent variable and two or more independent variables.

Pet Owner – A pet owner is a person who keeps, cares for, and is responsible for a domesticated animal.

Prototype – A prototype is an early model or sample created to test a concept or function of a product.

Record – A record is a documented piece of information kept as evidence or reference of an event or transaction.

Regression – Regression is a statistical method used to analyze the relationship between a dependent variable and one or more independent variables.

Report – A report is a structured presentation of information or findings based on investigation or analysis.

System – A system is a combination of interrelated components working together to perform a specific function.

Testing – Testing is the act of examining a product, process, or system to ensure it meets required standards.

User Account – A user account is a digital identity that grants an individual personalized access to a computer or online system.

User Story – A user story is a short description of a software feature written from the perspective of the end user.

Veterinarian – A veterinarian is a licensed medical professional who diagnoses and treats diseases and injuries in animals.

Web Application – A web application is a software program that runs on a web server and is accessed through a web browser.

CHAPTER 2

CONCEPTUAL FRAMEWORK

In this chapter, the researchers gathered different readings, articles, and studies that are connected to the system. It focuses on the tools and technologies that will be used that will also include ideas from past projects that related to the topic. The purpose of this chapter is to understand how other studies were done and to use them as a guide in developing the proposed system.

Review of Related Literature and Studies

The review of related literature and studies helps the researchers understand how technology is being used in veterinary clinics and pet care services. It gives ideas from past projects and research that can guide the development of the proposed system. The following parts discuss how veterinary healthcare has improved over time and how these studies relate to the system being created for RaphaVet Pets Clinic.

Evolution of Veterinary Healthcare

Veterinary practices have been around for quite a long amount of time now that it has become essential to pet owners who are concerned about their domesticated animals. Early veterinary care was developed in ancient India, China, Mesopotamia, and Egypt, but the formal veterinary profession was later on found by the veterinary surgeon Claude Bourgelat (Mark & Hornblower, 2020). According to (Michigan State University College of Veterinary Medicine, 2019), Bourgelat established the first veterinary school in Lyon, France in 1761 as a response to the massive deaths of cattle due to a plague.

Initially, the interest in veterinary care is focused on horses and cattle as they are essential in warfare and agriculture (Mark & Hornblower, 2020). Clinics during this period primarily offered medical care, such as disease prevention, and treatment primarily for farm animals. However, with societal industrialization and urbanization, the role of veterinary medicine expanded. The 19th and 20th centuries saw a growing trend in animals being treated as an important companion, diversifying the veterinary service (Brown, 2023).

Today, veterinary clinics have adopted digital technologies such as telemedicine, mobile health apps, and artificial intelligence (AI) diagnostic tools (Celeritas, 2024; Jokar et. al 2024). Not only do these digital technologies enhance healthcare services but also client communication and operational effectiveness. The implementation of electronic medical records changed patient information management, enhancing clinical decision-making and practice workflow (Krone et. al 2014). Veterinary clinics in the modern day act as sophisticated medical centers that manage advanced medical treatment, client interactions, and business processes, which are characteristic of changing requirements of both pet animals and their owners.

Veterinary Healthcare Interventions

A) User account management

According to Koller (2025), account management ensures that only authorized users can access the system, which helps maintain data security and privacy. Account creation allows new users to register their basic information, such as name, email, and password, which gives them a personalized experience and secure access to the system (Green et al., 2022). The ability to create an account also improves user engagement and retention, as it allows users to store their preferences and access system features that require authentication (Pohn & Hommel, 2023). Furthermore, maintaining an organized user registration database allows administrators to monitor activity and provide technical or medical assistance when needed (Solis, 2025).

Account editing, on the other hand, allows users to modify their personal information when changes occur, such as contact details or passwords. Pohn and Hommel (2023) emphasized that continuous data help reduce errors and keep system records accurate. In this way, features like email or SMS notifications can reach the correct users, improving the reliability of clinic operations (DataReportal, 2025).

Lastly, account deletion ensures that outdated or inactive user data are removed from the system, promoting both privacy and efficient database management. According to Jurzik and Steuwer (2025), removing old accounts limits unauthorized access and enhances system

performance. Green et al. (2022) also pointed out that having a deletion process is crucial to prevent pre-hijacking attacks, a type of cyber threat that targets dormant or incomplete user accounts. Additionally, the right to delete one's account aligns with the ethical data management and global privacy standards, such as General Data Protection Regulation (GDPR) (Solis, 2025).

B) Appointment system

Appointment systems are tools that help clients and service providers schedule a meeting ahead of time. Studies show that these systems reduce client waiting time, a common concern in healthcare facilities (Almomani & AlSarsheed, 2016; Cao et al., 2011). While previously, these appointment systems were done through walk-in and telecommunication, the internet allowed the development of various web-based appointment systems(Cao et al., 2011). A systematic review by Zhao et al. (2017) highlighted that web-based appointment systems reduces burden on staff, decreases client's no-show rates, and uplifts client satisfaction.

An earlier study in Australia by Zhang et al. (2014) showed that the major limiting factor of these systems is the patients' lack of digital access and literacy. However, a more recent study conducted in Guangzhou, China finds that even old people who struggle with learning

emerging technologies are able to access mobile health technologies with the help of younger family or community members (Tu et al., 2021). Furthermore, Lopez (2025) reported that there is a surge in internet usage in the Philippines. While not everyone has access to the internet, the trend points toward increased usage of the internet (Kemp, 2024).

Regardless, much can still be done to improve the accessibility of such systems. For example, a system developed by Chaudhry et al. (2021) incorporated text-to-speech functionality, which significantly enhanced usability for the semiliterate users. In the veterinary field, a web-based appointment system was developed by Rosmani and Mokhtar (2023), which focused on the functionality and usability of their system. They suggested implementing a payment system to reduce the need for bringing cash to the clinic.

Meanwhile, Tamayo (2018) from Pangasinan State University developed an appointment system that allows outpatients to book appointments using SMS with the use of keyword commands enabled by Twilio. This platform was designed to be more accessible to Baby Boomers who are better adjusted to SMS, while also providing an alternative in the absence of internet access. In another example, students from Mapua University Makati developed VetConnect, a platform that combined e-commerce and veterinarian services. The platform provided

information of the veterinary clinics, doctors, products and services, while facilitating online appointments (De Guzman et al., 2021).

While web-based appointment systems are well-established technologies, various integration approaches have demonstrated benefits depending on the specific use case. Although most of the literature reviewed focuses on human healthcare, the principles remain applicable to veterinary clinics as they address similar healthcare service challenges.

C) SMS and Email Reminders

Short Message Service (SMS) and Electronic Mail (Email) are modern modes of communication that have been widely adopted by healthcare professionals (Dash et al., 2016; Kogan et al., 2016). In the Philippines, Republic Act No. 10639 provides free mobile text alerts during disasters and emergencies; this shows the importance of SMS as a reliable communication channel.

A review of systematic reviews and meta-analyses, as well as a meta-analysis, found positive effects of calls, text messages, and email on adherence to medical appointments (Aguilera et al., 2018; Boksmati et al., 2016). Moreover, with communication as an essential part of veterinary medicine, pet owners prefer to have timely updates, and clear confirmation of appointments via SMS or email (Kogan et al., 2019).

In recent developments, a Nigerian designed application incorporates SMS and email services in their medical record management system, giving timely notifications while using the same media as modes of communication for both doctors and patients (Edeh et al., 2024). Similarly, in Malaysia, Rosmani and Mokhtar (2023) from Universiti Teknologi MARA developed a veterinary appointment system that provides email notification for appointment confirmation.

In the Philippines, local developments include Tamayo's (2018) outpatient appointment system that uses an automated SMS system for booking appointments as an alternative to his web based system, allowing patients to book appointments even in the absence of the internet.

D) Chatbot system

Veterinary care is changing at a fast pace as clinics aim to provide more convenient and efficient services. One significant development is the implementation of AI-driven chatbase systems, which are also known as chatbots. They aid clinics in handling client communication twenty-four hours a day. Chatbots enable pet owners to book appointments, obtain answers to frequently asked questions, be reminded of vaccinations and

visits, and receive personalized care advice for their pets. Empirical evidence indicates that such features enhance client satisfaction through making information more comprehensive and interactions simpler, which are key determinants in adoption in respect to accepted frameworks of technology adoption (Huang et al., 2021). More recent innovations include chatbots contributing to telemedicine, enabling veterinarians to perform initial remote consultations and help in prioritizing patients better (Santos, 2024). For example, one study explored the use of ChatGPT in supporting diagnostic decisions, noting its potential to assist veterinarians with complex cases while emphasizing that it should not replace professional clinical judgment (Jokar et al., 2024).

Chatbase systems have various pragmatic benefits, such as automating appointments, providing immediate feedback to customer inquiries, and monitoring pet health through veterinary clinical records. They also offer assistance outside regular clinic hours, allowing customers to get advice in case of emergencies and offering clinics useful continuous feedback to enhance service (Celeritas, 2023; Crowdy.ai, 2025). Through AI technology, such chatbots are capable of identifying early slight changes in health, encouraging preventive treatment, and facilitating fewer unnecessary visits to the clinic—all beneficial to save time and money and enhance outcomes for animals (Santos, 2024; Jokar et al., 2024).

Aside from chatbots, most veterinary clinics utilize integrated management systems which merge electronic medical records with inventory management, billing, and AI-powered diagnostic support. These systems enable veterinary staff to work more efficiently by creating structure around information gathered from consultations and tests, which aids in establishing improved treatment plans and tracking patients over time (Larkin & Lefebvre, 2023; Karolina, 2023).

E) Telehealth

In today's digital world, information and communication technologies (ICT) are becoming increasingly available to the public. The American Veterinary Medical Association (AVMA) defines telehealth as the use of ICT in providing health information, education, or care (AVMA, n.d.). Telehealth includes components such as telemedicine, the sharing of medical details through ICT in order to provide care; teleconsultation, asking medical professionals and consultants for advice through similar means; and teletriage, which is the proper and safe assessment of the urgency of the pet's condition electronically .

Despite the accessibility of these practices, a recent study finds that it was more widely adopted during and after the Corona Virus Disease (COVID-19), and gained positive feedback from both patients and medical

professionals (Shaver, 2022). In this context, telehealth solutions such as consultation via video conferencing have been adopted, allowing pet owners and veterinarians to coordinate remote consultations effectively (Abu-Seida et al., 2024; Bishop et al., 2024). While Shaver (2022) finds that telehealth services can be equivalent to in-person care, veterinarians and pet owners agree that online consultations are inferior to in-person consultations mainly due to the lack of proper observation leading to diagnosis inaccuracy(Sigesmund, 2022).

During the COVID-19 pandemic, The Children's Hospital of Fudan University in Shanghai, China utilized the internet and a social application called WeChat to provide pediatric telemedical care and online consultation services. A cross-sectional study by Zhai et al. (2021) revealed that while it was very effective in combatting illness as a remote option, there were limitations in the accessibility of lab results and physical observations. In 2024, Nigerian developers provided a web-based medical consultation platform where medical professionals from various fields of study can sell their services on the internet (Onwe & Ognehekaro, 2024). However, there were no details on the effectiveness of their platform, only concluding that they successfully provided a micro job website for medical professionals.

In 2019, before the COVID-19 breakout, students from Mapua University, Makati developed InTelect, an interactive telemedicine communication technology (Samonte et al., 2019). The mobile application included features such as appointment system, video conferencing platform, locating functions, and report generation; although they emphasized on remote functions, the program still considers traditional health options.

Some not peer-reviewed developments in the field include Joii Pet care (n.d.) that allows continuous access to veterinarians through affiliated insurance companies. On the other hand, Buddydoc (n.d.) developed a module to assess symptoms via veterinarian-approved series of survey questionnaires. While their development process and effectiveness are not revealed to the public, these programs demonstrate how telehealth is being adopted to the web in practice.

In light of these findings, it is evident that ICT, and the convenience of digital integration, is increasingly accepted by the healthcare field. However, there is still resistance to adopt modern technology, likely due to limited technological literacy among both practitioners and patients.

F) Lost and Found Forum

The increasing rate of lost animals has prompted the emergence of several lost and found mechanisms that pool community support, organized shelter procedures, and technological solutions to enhance rates of pet recovery. As per Human Animal Support Services (July, 2023), a successful procedural framework termed "48 Hour Program" in which those finding healthy stray animals are asked to keep them until they have some guidance and resources from shelters. This method keeps the pets closer to home and drastically enhances return-to-home rates, with various shelters involved reporting almost threefold reunification after adopting the system (Human Animal Support Services, 2023). In addition, the PawBoost platform illustrates the power of online lost and found systems, with over two million pets being reunited through online posting and neighborhood notices. Statistics show that about 48% of the cases have a successful reunion, with 80% of them being achieved within only three days—highlighting quick information dissemination and online presence (PawBoost, 2024). Evidence also confirms the effectiveness of systematic lost and found systems. According to Huang et al. (2018), a third of lost cats were recovered in a week, with the majority being found within 500 meters of home, highlighting the benefits of local search systems. On a similar note, Weiss et al. (2012) reported that dogs are commonly recovered through active searching, whereas cats return by themselves, noting the requirements of differentiated approaches in lost and found systems. Combined, these results show that systems integrating digital

participation, community collaboration, and systematic search protocols significantly enhance pet rescue rates and identify technology and systematic control as critical determinants of contemporary animal welfare.

G) Monitoring and Content management

In recent years, small to medium sized businesses have been adapting to the immense growth of the internet by utilizing Web Content Management Systems (WCMS) such as Joomla!, WordPress, and Drupal to publish their content with limited programming knowledge (Martinez-Caro et al., 2018). However, in this special project, we are focusing on the admin-side content management system (ACMS) that is custom built for similar reasons. The ACMS would allow administrators to manipulate the content displayed on their website without necessarily learning programming, or having to contact technical support.

Ferraiolo, Barkley, and Kuhn (1999) introduced a role-based access control model which uses roles to decide the privileges of a user, which simplifies administrative management. However, it paradoxically creates blind spots as privileges may apply to multiple users which demonstrates the necessity for proper monitoring and auditing of user actions, especially for processes that are sensitive.

In the Philippines, industry professionals and students from Lyceum of the Philippines University - Cavite campus joined in a collaborative effort to develop a cross platform educational application which features dynamic content management (Tacda et al., 2025). In this mobile application, the CMS was accessible through an administrative user role which can export, edit, add, and delete user or portal information.

Meanwhile, students from Isabella State University, Philippines implemented RBAC along with information classification and cryptography to provide high-level security protection against data breaches for an intranet document management system (Bumalod & Velasco, 2024). The role of RBAC in this system was to simplify access control administration, and screening the user's access to resources. The system further improves security by applying log trails wherever necessary such as log in, password management, and document requests.

This special project may benefit in the proper and consistent assignment of user roles as entry point for the ACMS, which enables fresh content that may increase user engagement. Furthermore, log trails and auditing may increase staff accountability and content security.

H) Data Collection and Analysis Tools

With the rise of efficient data handling technologies, the value of data further elevates as a key decision-making input. McCloud et al (2023) emphasizes the importance of systematic data collection and using the responsive feedback approach to continuously improve by monitoring real time data. Furthermore, data analytics proves to be an indispensable tool in the business sector, now capable of predictive analytics through artificial intelligence (AI) and machine learning (ML). This not only analyzes past trends, but also analyzes the future through pattern recognition to mitigate risks (Tiwari, 2024). Toure and Chukwuba (2022) meanwhile caution against misleading data, and suggest the need to verify the quality of data, so that it does not lead to incorrect conclusions.

In 2016, Sylim and Santos-Acuin from the Philippines successfully provided a low-cost data collection device for a health facility survey which covers several regions of the archipelago by leveraging existing technologies, particularly AppSheet by Google. They decided to use AppSheets because it did not require a lot of training for the staff to use, as they did not have the luxury of time. However, due to technical limitations of the application such as limited data validations, and conditional branching, they had to fix it through the database, which then experienced bloating. Additionally, the application was not accessible without the internet, which caused some lack in functionality.

I) Multiple Regression for Predictive Diagnosis

A statistical method called multiple linear regression (MLR), or just multiple regression, makes use of a number of explanatory variables in order to forecast the value of a response variable (Hayes, 2025). In the global healthcare field, this method has become an essential tool for predicting disease outcomes, patient recovery times, and treatment responses. Kibria and Banik (2020) noted that regression analysis helps researchers and practitioners understand how multiple factors such as age, lifestyle, and medical history, jointly influence health conditions. In many hospitals and research institutions around the world, regression models, especially multiple regression, are used to predict health-care outcomes and support clinical decision-making (Trunfino et al., 2022). For instance, Li et al. (2005) demonstrated how regression models could analyze the relationship between hypertension and quality of life, helping clinicians provide more personalized care.

In the Philippines, government agencies have begun promoting greater use of data analytics and digital health systems to support improved care and decision-making. For example, the Department of Information and Communication Technology (DICT) states that “data and ICT statistics serve as our guide in ensuring that the government is steering national ICT development initiatives on the right course… Data gathered can help government agencies monitor programs and develop

evidence-based projects and policies" (DICT, 2020). At the same time, the Philippine Health Insurance Corporation (PhilHealth)and the Department of Health (DOH) introduced the National Health Data Repository Framework (NHDR) which emphasizes unified data architecture, analytics and reporting in health-care service delivery (National Health Data Repository Framework, 2022). These initiatives show that local research and health-care operations are moving toward predictive modeling and statistical tools such as regression analysis, paving the way for systems like yours to apply these methods to veterinary settings.

RaphaVets Pet Clinic applies multiple regression analysis as part of its web-based management system to support veterinarians in making data-driven diagnostic assessments.

Challenges and Limitations

The user of digital health tools like telemedicine and online systems still faces some problems. One of the main issues is limited internet access and low digital skills. Zhang et al. (2014) explained that older people and those living in rural areas often struggle to use online platforms, making appointment systems less effective. Zhao et al. (2017) also pointed out that while online scheduling helps reduce waiting times, not everyone can access it. Another concern is that online consultations are sometimes seen as less accurate than face-to-face

checkups since doctors or veterinarians cannot do a proper physical examination (Sigesmund, 2022).

In the Philippines, internet use continues to grow, but stable connections are still a problem in many areas (Kemp, 2024). This affects the use of digital veterinary systems that depend on a strong internet. Younger people usually adapt faster to online platforms, but older adults may find them difficult to use without help (Tu et al., 2021). These challenges show that while web-based systems are useful, accessibility and readiness remain issues in the local setting.

For veterinary clinics, especially smaller ones, adopting new technologies can be difficult because of limited budget, equipment, and staff training. Rosmani and Mokhtar (2023) noted that appointment and management systems can make work easier, but they require proper resources and skilled staff. Some clinics also face financial problems or resistance to change, which slows down the adoption of new systems. This shows that having the technology is not enough, the clinic also needs to be ready and capable to use it well.

Software Requirements

HTML 5

HyperText Markup Language (HTML) is the core structure of all websites. HTML5 introduced new semantic tags, multimedia elements, and improved accessibility that help modernize web systems (W3C,

2017). HTML5 remains the standard language for web content creation and is supported by major browsers. Universities and developers in the Philippines, such as those in UP Diliman and Mapúa University, use HTML5 for web development courses and capstone projects (UP ITDC, 2023). For RaphaVet, HTML5 defines the structure of pages like appointment booking, client registration, and service listings.

CSS

Cascading Style Sheets (CSS) is used to control the appearance and layout of web pages. It allows developers to customize colors, fonts, margins, and spacing for a consistent design (MDN Web Docs, 2023). Globally, CSS is one of the core technologies of front-end web development. In the Philippines, it is widely taught in web design courses and used by freelance developers to create attractive websites (CHED, 2024). In RaphaVet, CSS ensures a clean and professional interface that reflects the clinic's brand.

Tailwind CSS

Tailwind CSS is a modern utility-first CSS framework that allows faster styling using predefined classes (Tailwind Labs, 2023). It helps developers maintain design consistency and responsiveness without

writing long CSS files. Internationally, companies use Tailwind for rapid development and prototyping, while locally, web developers in tech schools and start-ups adopt it for mobile-friendly designs (UXPH, 2023). RaphaVet uses Tailwind to create a responsive layout that works smoothly on both mobile and desktop devices.

Python

Python was chosen to handle data processing and implement the multiple regression model of the system. It is a powerful beginner-friendly programming language widely used for web applications, artificial intelligence, and predictive analytics (Python Software Foundation, 2024). Globally, python powers the data systems of Google, NASA, and IBM, supporting automation and research (IBM Developer, 2023). In the Philippines, the Department of Information and Communications Technology (DICT, 2023) encourages the use of Python in analytics training and software development programs. For RaphaVets, Python performs the statistical calculations for predicting possible pet diagnoses based on symptoms entered by clients, helping veterinarians make quicker, data-supported assessments.

JavaScript

JavaScript is a scripting language used to add interactivity to websites, such as handling form submissions, validating inputs, and updating content without refreshing the page (MDN Web Docs, 2023). It is one of the most widely used programming languages worldwide. In the Philippines, JavaScript is part of most IT and Computer Science curriculums, making it a common skill among web developers (CHED, 2024). In RaphaVet, JavaScript is responsible for features like dynamic content updates and appointment scheduling interactions.

React.js

React.js is a front-end JavaScript library developed by Meta for building reusable user interface components (Contentful, 2022). It improves speed, efficiency, and scalability by updating only the parts of a web page that change. Globally, major companies such as Netflix and Airbnb use React for large-scale applications. Locally, communities like ReactJS Philippines promote its use for interactive web projects (ReactJS PH, 2024). For RaphaVet, React.js is used to build modular components like dashboards, client profiles, and chatbot interfaces.

Node.js

Node.js is a runtime environment that allows JavaScript to run on the server side (Simform, 2021). It is efficient for building scalable applications and managing multiple user requests simultaneously. Globally, it is used by companies like LinkedIn and PayPal for backend systems (IBM, 2022). In the Philippines, developers use Node.js in booking and management systems for its real-time processing capabilities (DICT, 2023). RaphaVet uses Node.js for backend logic such as managing appointments, storing data, and handling client requests.

MySQL

MySQL is an open-source relational database management system used to store and organize structured data (Oracle, 2022). It is widely used by companies such as Facebook and YouTube for its reliability and speed (DigitalOcean, 2023). In the Philippines, MySQL is one of the most common databases taught in universities and used in academic projects (CHED, 2024). For RaphaVet, MySQL handles client records, pet information, and transaction data securely.

Figma

Figma is an online design and prototyping tool that enables designers and developers to collaborate in real-time (Figma, 2024). It

allows teams to visualize interfaces and test usability before development. Globally, it is used by companies like Google and Microsoft, and locally, it is popular among design students and developers for project mockups (UXPH, 2023). RaphaVet used Figma to create the system's layout and user interface before actual coding.

ISO/EIC 25010

ISO/IEC 25010 is an international standard for evaluating software quality based on characteristics such as functionality, usability, and reliability (ISO, 2020). It is widely used by developers and researchers to assess the performance and effectiveness of systems. In the Philippines, this model is commonly used as an evaluation framework in IT-related thesis projects (CHED, 2024). RaphaVet uses ISO/IEC 25010 to evaluate the quality of the system after development.

Socket.IO

Socket.IO is used to enable real-time, two-way communication between the client and server. It supports instant updates such as chatbot messages and live appointment notifications without refreshing the page. Socket.IO is widely used in modern applications that require interactive features, such as chat systems and dashboards (Socket.IO, 2023). Locally,

it is applied in online booking systems and messaging tools for better user engagement (DICT, 2023). In the RaphaVets system, Socket.IO ensures that clients and admin can communicate efficiently, making the platform more responsive and interactive.

Hardware Requirements

Computer hardware refers to the tangible components that allow a computer system to perform essential functions such as input, processing, output, and storage (IBM, n.d.). These components include the processor, memory, storage drives, and network interfaces, which collectively form the foundation of any information system. System performance depends not only on having sufficient hardware but also on how efficiently the hardware architecture aligns with the system's workload. Capra (2019) emphasized that processor design and memory configuration play an important role in distributed systems, especially those operating in IoT or edge computing environments where responsiveness and low latency are crucial. Likewise, Georgescu, Pappalardo, Cucu, and Blott (2021) found that computationally demanding applications require hardware with optimized CPU and memory balance to maintain accuracy and efficiency. Applying these findings to RaphaVet Pets Clinic, a dedicated server with a multi-core CPU, 8–16 GB of memory, and SSD storage will prevent performance bottlenecks during simultaneous user logins, appointment scheduling, or retrieval

of pet medical records. Network equipment such as routers and switches should also support at least Gigabit Ethernet to handle concurrent data transmission efficiently.

Finally, hardware scalability is crucial to accommodate future growth and feature integration. Flynn (1972) demonstrated that computer architectures capable of parallel processing improve system throughput by executing multiple operations simultaneously. Implementing this principle in RaphaVet's system means selecting server hardware that supports virtualization or cloud deployment, allowing for additional storage or compute resources as user demand increases. Ensuring that the system's hardware includes redundant storage (RAID 1 or 5 configuration), backup drives, and reliable power supply units will further enhance its durability and security. By integrating these hardware specifications and principles, the system can sustain high performance, reliability, and scalability—key requirements for a continuously operational web-based veterinary platform.

Synthesis

In conclusion, the literature and studies highlighted different areas that improved over the years, and areas that still need improvements. Due to a growing number of household pet owners, the demand for veterinarians and other services also grew over the years, and keeps growing until today. The study shows that the veterinary and pet industry is undergoing a critical digital transformation driven by client expectations that

have shifted toward fast, digital interactions while many clinics still run on slow, manual processes that waste time and raise clinical risk. The findings provides justifications that directly support the design and deployment of the RaphaVets system.

The study identifies a significant gap in veterinary practice and pet ownership management: the extensive use and reliance on manual and traditional methods, such as physical filing systems, walk-in consultations, and phone calls for reminders, and even in pet lost and found, which are evidently time-consuming and prone to administrative errors that are still in use in most cases. This not only affects businesses, but also pet owners and the pet industry. These shortfall runs contrary to the current societal demand for rapid, accessible digital services. The Review of Related Literature provides the necessary foundation, validating the adoption of Electronic Medical Records (EMRs) to improve record accuracy and the use of integrated digital solutions, including automated reminders, to enhance efficiency and client satisfaction. The primary purpose of the RaphaVets platform is to address these deficiencies by providing an accessible, organized, and integrated web-based system for pet owners and clinic staff, by that means realizing the general objective of enhancing client experience and service efficiency.

The proposed system addresses this necessity by implementing a unified digital ecosystem that ensures seamless information flow. Therefore, the RaphaVets platform must be conceived not as a collection of individual features, but as a singular, unified digital ecosystem. The core objective of enhancing client experience and service efficiency can only be realized if the architecture ensures a continuous, efficient flow of

information. The system must strictly link every feature—from the Cat and Dog Breed Detector and the Missing Pet Finder Page, to the Appointment System and the AI Chatbot, so that all captured data feeds directly and seamlessly into a centralized Electronic Medical Record for access by authorized clinic staff.

This architectural approach ensures data integrity and continuity of care, establishing the necessary foundation for true digital modernization.. The platform features an AI-integrated chatbot to handle initial consultations and general inquiries, providing 24/7 accessibility. However, the system must adhere to strict, professional limitations, the chatbot must explicitly not replace professional veterinary consultation or give medical diagnoses, and the FAQs are limited to general pet care tips. This design ensures the platform functions strictly as an efficient preparation and communication aide, recognizing the inherent limitation that accurate diagnosis and treatment require proper, in-person physical observation by licensed veterinary staff.

Conceptual Model of the Study

The study uses the Input-Process-Output-Evaluation (IPOE) Model as its conceptual model. The IPO model is widely recognized in information systems research as a way of describing how resources and requirements are transformed through system functions into results (DeLone & McLean, 2003). In many IT and IS research projects, the traditional IPO framework is modified by including an Evaluation stage, which

results in the IPOE model. This added component highlights the need to check not only the outputs of the system but also its overall usability, effectiveness, and impact on the users (Adeosun & Shittu, 2017).

Using the IPOE model allows the study to present a clearer picture of how the proposed system functions while also recognizing the need for systematic evaluation. Unlike traditional frameworks that stop at outputs, the IPOE model provides a space to gather user feedback and measure system quality, aligning with best practices in system development and evaluation (ISO/IEC 25010, 2011; Davis, 1989). By using this model, the study ensures that the platform is not only technically functional but also effective and satisfactory for its intended users.

Figure 1.
Conceptual Model of the Study

The Input-Process-Output-Evaluation (IPOE) model shown in the figure illustrates how the RaphaVet Pet Clinic System works from start to finish. It serves as a

guide in understanding how the system's components interact with one another. Each part of the model represents a stage that contributes to the overall development, operation, and improvement of the system. This helps ensure that the project follows a clear and organized flow.

The input stage includes all the data, user profiles, and resources needed to make the system work. This stage also includes feedback and evaluation results gathered from users and testers, which are important for improving the system. These inputs provide the foundation for developing features that meet the needs of both the clinic staff and pet owners. By collecting reliable and relevant data, the researchers can make sure that the system is built based on actual user requirements.

The process stage represents the main features and functions of the system. These include appointment scheduling management, symptom data collection and regression analysis for possible diagnosis, chatbot assistance and consultation support, client and pet record management, breed detection and identification, lost and found forum, an administrative dashboard for reporting, and data collection and analysis tool. This stage shows how the collected input is processed into meaningful functions that users can interact with. It also highlights how different modules of the system work together to deliver efficient and convenient services for both clients and staff.

The output stage produces the final result, which is the RaphaVet Pet Clinic System itself. This is the developed web-based platform that allows users to book

appointments, access pet care information, and communicate with the clinic easily. However, development does not end at output. The system must be tested and assessed in the evaluation stage, where aspects like usability, efficiency, reliability, user satisfaction, and accuracy are examined. Results from the evaluation are then fed back into the process stage to serve as a basis for future improvements, making the process continuous and sustainable. This ensures that the system remains responsive to user needs and can be enhanced over time.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter presents the sequence of project development. It includes the discussion of methods and course of actions taken to develop the project, the collation of related information and development procedures, and the definition of a number of users on how the project was evaluated by the users and developers.

Research Design

The researchers used descriptive research methodology to evaluate the RaphaVets Pet Clinic: A Web-Based Management and Pet Care System Utilizing Multiple Regression. In order to assess the system's effectiveness and usability, this research design focuses on gathering data to measure its impact and overall effectiveness. This will provide us details of everyday interactions (registering, book, cancel, and use the chatbot and other features), capture the clinic's workflow changes (phone call volume, front-desk time spent on staff tasks), and measure basic technical performance (uptime, response time, errors) alongside simple accuracy checks for AI features such as the breed detector and regression predictions.

This approach is centered on describing the system's functions and analyzing user feedback to determine its performance as well as gathering information and data from other existing systems or studies . This descriptive methodology will be implemented for the researchers to evaluate the system through client feedback and technical testing,. This will provide statistical data and analysis on the effectiveness of the software by objective

measurement, which is essential for understanding user satisfaction and system quality. Analysis will emphasize clear, simple accuracy rates for AI features, and qualitative feedback findings. Ethical safeguards include informed consent for any interviews and surveys that will be conducted, secure storage of identifiable data, and a safety policy that frames all AI outputs as advisory only and requires clinician confirmation before any clinical action. This approach produces a human centered, realistic evaluation that caters directly to the clinic's needs and provides concrete recommendations for more improvement.

Sampling Methods

This study will use the judgement sampling or purposive sampling method. Participants were deliberately chosen to include the veterinarian, clinic assistants, and/or the staff who manage appointments and records, as they directly experience the clinic workflow. Judgment sampling will be used to select pet owners who could give the most useful feedback—regular clients, owners with recent visits to veterinarians, those who had reported lost pets, or those who had used the clinic's services once or regularly. Meanwhile, EBSCO (March 22, 2025) / Scribbr (Revised June 22, 2023) described purposive sampling as a non-probability sampling technique where researchers deliberately choose individuals, cases, or events based on predetermined criteria, specific characteristics, or their unique knowledge that aligns with the study's purpose. It is also known as judgmental, selective, or subjective sampling.

This method is essential for the study for testing to gather accurate data and firsthand experience. The researchers needed to ensure that the system was tested by the people whose opinions matter most. This strategic, targeted approach is important to guarantee that the feedback we collected is not only accurate but also truly reflective of real-world operational needs and actual user experiences, ensuring the final system is both functional and user-friendly

Project Development

The researchers used the Waterfall Software Development Life Cycle (SDLC) in developing the RaphaVets Pet Clinic system. The Waterfall Model follows a linear and structured process where each phase must be completed before moving on to the next (Atlassian, n.d.). This model was chosen because it provides a clear structure for planning, designing, building, and evaluating the system. Each phase ensured that the system was developed systematically and met the needs of the clinic and its clients.

Planning

In this phase, the researchers identified the main goals and features of the system. Meetings were conducted among the team members to discuss how the system could help the RaphaVets Pet Clinic improve its daily operations. The researchers also consulted the clinic staff to understand their problems with the current setup such as difficulty in organizing appointments and handling client records. From these, the team finalized the system's main features.

Requirements Analysis

After planning, the researchers gathered and analyzed all the information needed to define the system's requirements. This included identifying the types of users (staff, vets, and clients) and the functions each should be able to perform. The team studied how data would flow between features like account creation, appointment management, diagnostic tool, and report monitoring. The researchers

also reviewed existing studies about veterinary systems and appointment platforms to ensure that the functions they included were both realistic and beneficial. At the end of this phase, a clear list of system requirements and technical specifications was created, which served as the basis for design and development.

Design

During this phase, the researchers focused on how the system would look and function. Using Figma, the team created a prototype that showed the layout of each page, including the home page, appointment form, chatbot interface, and pet care tips section. The design was made to be clean and easy to navigate, using colors and icons that match the clinic's theme. The goal was to make the interface comfortable for both staff and clients, even those who are not highly familiar with online systems. The researcher also designed the database structure, including the tables for user accounts, appointments, pet records, reports, and multiple linear regression-related datasets. This ensured smooth handling of system information once the system was implemented.

Implementation

This phase involved the actual creation of the system based on the approved designs. The researchers used ReactJS for the frontend, NodeJS and Python for the backend, MySQL for the database, and Tailwind CSS for styling.

Each module was developed step-by-step, including account registration, appointment scheduling, chatbot, breed detector, and missing pet finder. The Multiple Linear Regression model was implemented during this phase using Python, where the algorithm was trained and integrated into the system for data analysis and prediction features.

Testing and Assurance

After implementation, the system was carefully tested to check its functionality and reliability. The researchers tested each feature, such as registering accounts, booking appointments, receiving SMS and email reminders, chatting with the AI assistant, trying the pet breed detector, and lost pets board. The multiple linear regression model was also tested for accuracy to ensure that its predictions were reliable. They also checked for errors, bugs, and interface issues. The testing was done repeatedly after every step, allowing early detection and correction problems. The clinic staff also tried using the system and gave feedback on its ease to use the design. This feedback was used to make adjustments and improvements to ensure the system met user expectations.

Deployment and Maintenance

Once the testing was complete, the system was deployed in a test environment to simulate actual use. The researchers observed how the clinic staff and clients interacted with the system. Minor bugs and performance issues found during this stage were fixed immediately. The team also evaluated the overall

performance of the system using the ISO/IEC 25010 quality model, focusing on functionality, reliability, usability, and efficiency. After evaluation, the system was finalized and prepared for real deployment at RaphaVets Pet Clinic. This phase ensured that the system was stable, user-friendly, and ready for use in the clinic's daily operations.

Project Design

In developing the project, the researchers will undergo different activities shown in Figure 3. It identifies the analysis, resources, and procedures in designing and creating the project. The activities involved will be illustrated below:

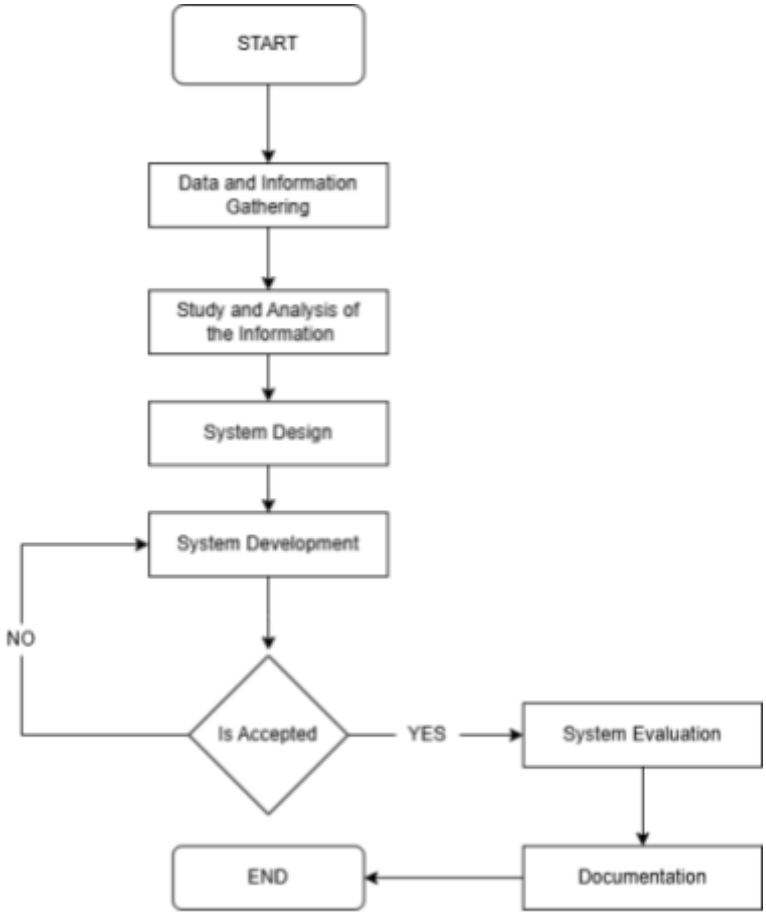

Figure 3.
Flowchart of the Project

Data Information Gathering

To make sure that the system being developed fits the needs of RaphaVets Pet Clinic, the researchers gathered information from both the staff and the clients of the clinic. The main goal of this process was to understand how the clinic currently operates, what problems they experience, and what improvements they want to see in their system.

The researchers first visited the clinic and talked to some of the staff and the doctor. Through simple interviews and observation, they found out that most of the clinic's records are done traditionally, and appointments are scheduled through walk-ins or phone calls. The staff also shared that it would be helpful if there was a system that could recognize appointments, send reminders, and help communicate easily with clients. Aside from interviews and observations, the researchers also used secondary sources such as articles, journals, and previous studies related to veterinary systems and online booking platforms. These sources helped the team learn about the features that other systems used and how they were designed.

The information gathered from all these sources as the basis for designing the RapahaVets Pet Clinic System. It guided the researchers in choosing features like online appointment booking, AI chatbot, pet care tips, breed detector, forum for missing pets, and staff monitoring tools. This process helped make sure that the system was not only useful but also practical and easy to use for both the clinic staff, doctor and the clients.

Study and Analysis of the Information

After gathering all the needed data from the clinic staff, and related studies, the researchers studied and analyzed the information to understand the main problems of RaphaVets Pet Clinic and how the proposed system could help solve them. The researchers carefully reviewed the notes from the interviews and observations to identify the most common issues and needs.

The findings showed that the clinic relied mostly on traditional methods of operation. Appointments and client information were done through Excel, and reminders were sent through phone calls or text messages. Because of this, the clinic sometimes experienced scheduling conflicts and miscommunication delays. These practices made the process time-consuming for both the staff and the clients.

Based on the analysis, the researchers concluded that the clinic needed a web-based system that could make their workflow faster, more organized, and easier to manage. The information gathered helped the researchers decide which features to include in the system. The online appointment booking was chosen as the main feature because it directly addresses the problem of scheduling and helps clients to book appointments anytime. The AI chatbot was added to assist users with basic pet concerns and common questions, reducing the staff's workload. The analysis also helped determine the most suitable tools and technologies for the system. Since the users were already familiar with basic online platforms, a web-based system using ReactJS, NodeJS, MySQL, and Tailwind CSS was found to be appropriate.

Through this study and analysis, the researchers were able to clearly define the system requirements, user roles, and features. This ensures that the proposed system would not only meet the needs of RaphaVets Pet Clinic but also be easy to use, reliable, and helpful for both staff and clients.

System Design

The system design phase serves as a blueprint for the development of the project. This stage translates the gathered requirements into a structured framework that defines how the system's components interact, process data, and deliver services to users. The design includes diagrams such as Context Diagram, Data Flow Diagrams (DFDs), Entity Relationship Diagrams (ERDs), Data Dictionary and User Story, which illustrate the system's flow of data and relationships between its users and internal processes. By creating these models, the researchers ensure that each component of the system functions coherently and aligns with the project objectives of improving veterinary service management, diagnostic accuracy, and client convenience.

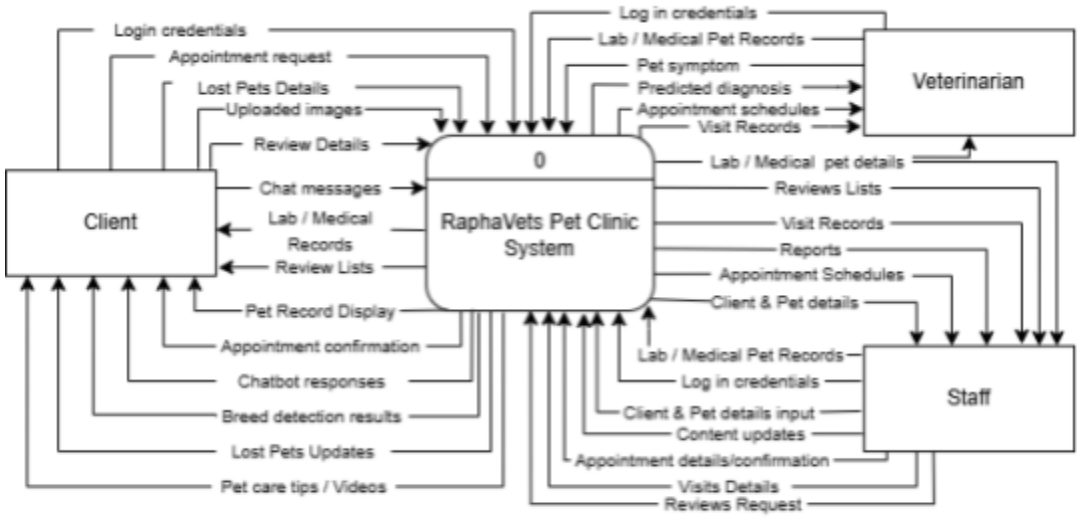

Figure 4.
Context Diagram

The figure above illustrates the overall data flow between the RaphaVets Pet Clinic System and its three main external entities: the Client, Veterinarian, and Admin. The system, represented by a single process at the center, acts as the core that receives, processes, and exchanges information between these entities. This context diagram provides a high-level overview of how data moves throughout the system and defines the boundaries between internal system processes and external interactions.

The client represents the pet owner who interacts with the system for various pet-related services. The client can log in using their credentials, request appointments, and upload images for lost or found pet posts. They can also access medical and laboratory records, view pet care information, and receive chatbot responses. In return, the system provides appointment confirmations, breed detection results, updates on lost or found pets, and relevant chat messages or notifications. The veterinarian is the clinic professional responsible for handling consultations and maintaining medical records. The veterinarian logs into the system to access client and pet details, appointment schedules, and laboratory or medical pet records. After each consultation, the veterinarian inputs diagnoses and updates medical data. The system also assists the veterinarian by processing pet symptoms and generating predicted diagnoses based on the diagnostic features available. The Admin oversees and manages the entire system's operations. The admin logs in to manage records, monitor appointment schedules, and handle client and veterinarian data. They are responsible for inputting and updating content, ensuring the accuracy and security of stored data, and generating reports. The system, in return,

provides the admin with appointment confirmations, compiled report data, and updates regarding clinic activities.

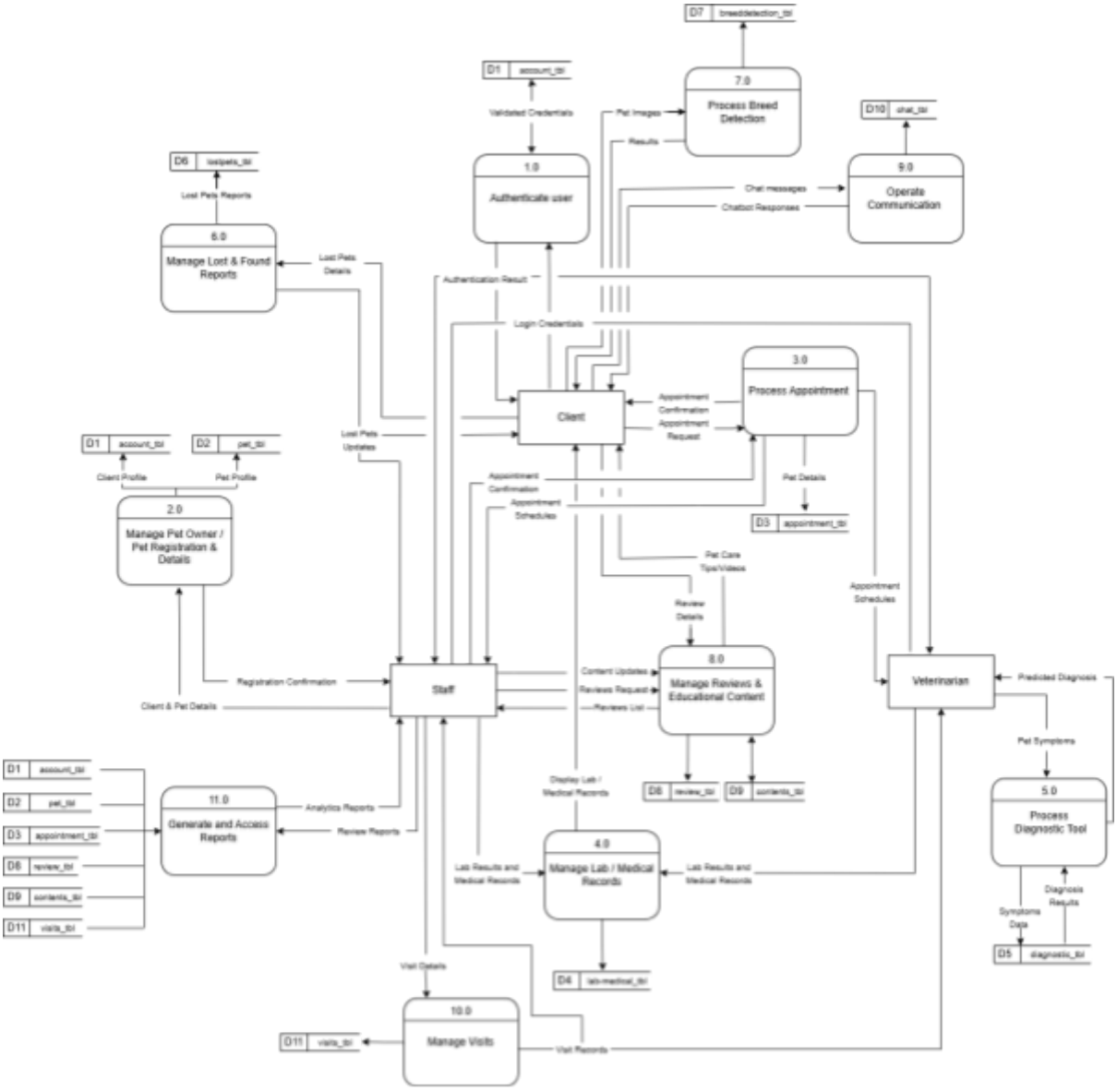

Figure 5.
Level 1 DFD

The figure above illustrates the Level 1 Data Flow Diagram (DFD) of the RaphaVets Pet Clinic System, which presents a more detailed breakdown of how data moves between users, system processes, and data stores. This diagram expands the main process into seven interconnected sub-processes, showing how the system manages user accounts, appointments, diagnostics, chatbot communication, breed detection, lost-and-found forums, and content management. It also depicts the interactions among three main external entities which are client, veterinarian, and admin, ensuring efficient and organized data flow throughout the system.

The Manage User Account and Pet Details (1.0) process handles user registration, login, and profile management. Clients, veterinarians, and admins provide their login credentials, which the system validates for accuracy and security. Once verified, the user and pet data are stored in User/Pet Data (D1). This process also returns appropriate success or error messages to users based on the outcome of their actions. The Appointment Request and Lab/Medical Records (2.0) process manages appointment scheduling and laboratory result handling. Clients can send appointment requests that are recorded and forwarded to the veterinarian or admin for review and confirmation. After approval, the system sends confirmation messages back to the client. All appointments and medical details are stored in Appointment & Lab/Medical Data (D2). The Handle Diagnostic Tool (3.0) process facilitates the diagnostic function of the system. Admins and veterinarians can input pet symptoms, which the diagnostic tool analyzes to generate possible diagnostic results. Veterinarians then review these results and store them in Pet Records (D3). The AI Chatbot (4.0) process enables automated chat interactions between

the client and the system. Clients can ask questions or seek initial guidance through the chatbot, which provides responses and assistance related to appointments, pet care, and system navigation. All message exchanges are stored in Messages Records (D4). The Breed Detection (5.0) process allows clients to upload images of their pets for automatic breed identification. The system processes the uploaded images, determines the likely breed, and stores the results in Breed Records (D5). The identified breed is then sent back to the client as a response. The Lost and Found Forum (6.0) process serves as a community-driven feature where clients can post and browse lost or found pet information. Each post is recorded in Forum Posts (D6), allowing other users or admins to review and interact with these entries to assist in pet recovery efforts. Finally, the Content, Feedback, and Report Management (7.0) process is primarily managed by the admin. This module handles report generation, user feedback, and content moderation. The admin can review data from other modules, manage updates, and ensure system data quality and accuracy. All related outputs are stored in Content, Feedback, and Report Data (D7).

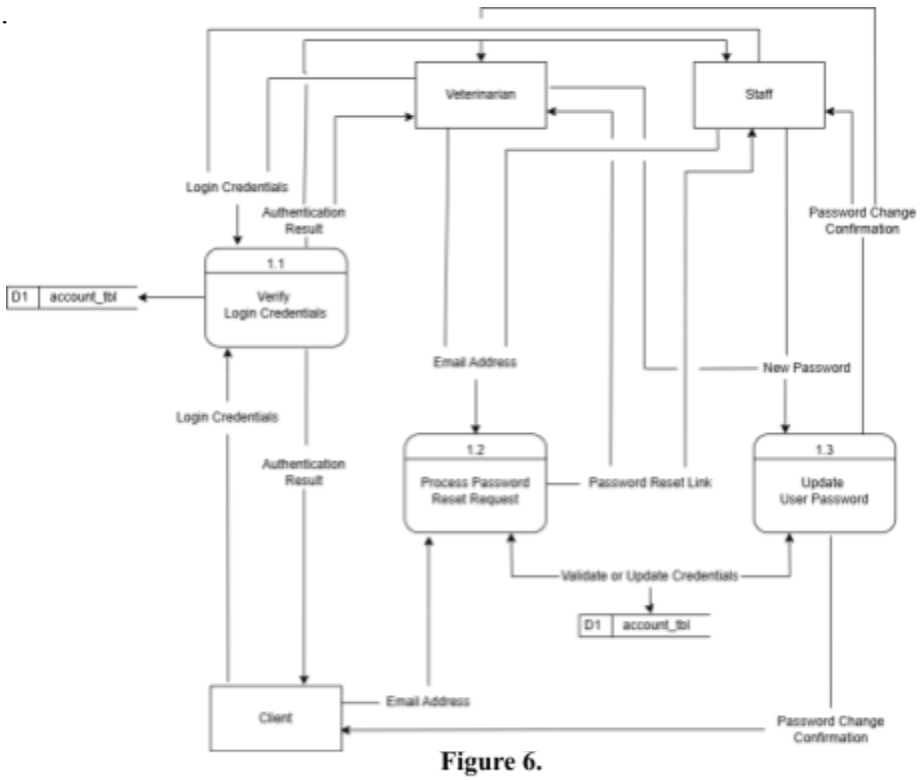

Figure 6.
Level 2 DFD: Process 1

The figure above illustrates the Level 2 Data Flow Diagram for Process 1: Manage User Accounts, which provides a detailed view of how user registration, login, account management, and pet information updates are processed within the system. This level of detail highlights how the system ensures secure and verified user access while maintaining accurate account and pet records. The main external entities involved are the Client, Veterinarian, and Admin, while the primary data store used is D1: User Data, which securely stores all user-related information.

The Login User (1.1) sub-process handles the authentication of users attempting to access the system. Clients, veterinarians, and admins provide their login credentials, which are verified by retrieving stored account information from User Data (D1). If the credentials are valid, users are granted access to their respective dashboards based on their role. Otherwise, the system sends an appropriate error message indicating incorrect login details or failed authentication. The Add, Update, Delete Account (1.2) sub-process manages the creation, modification, and removal of user accounts. The admin can add new user accounts (such as clients, other admins, and veterinarians), update existing user details, or delete inactive accounts. This process ensures that all changes made are reflected accurately in User Data (D1). Upon completion, the system provides a success

or error message, depending on the result of the operation. The Add, Update, Delete Pet Information (1.3) sub-process focuses on maintaining the accuracy of pet-related data. Both clients and admins can add or modify pet details, such as profile pictures, pet details, or ownership updates. The system processes these updates and stores the information in User Data (D1) to keep records consistent with the associated user account. The system then provides confirmation or error messages to indicate the status of the request.

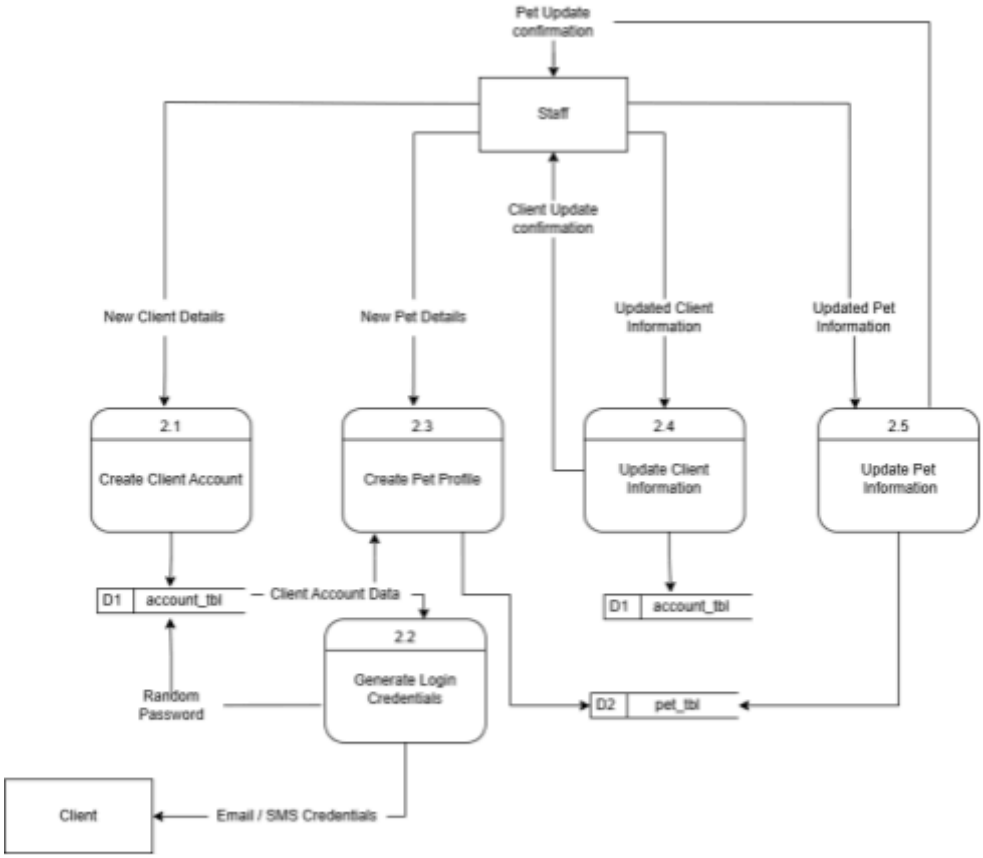

Figure 7.
Level 2 DFD: Process 2

The figure above illustrates the Level 2 Data Flow Diagram for Process 2: Manage Appointments. This diagram details how the system handles the entire appointment lifecycle, from initial request to final notification, ensuring organized scheduling and coordination between the Client, the Lab/Medical Records system, and administrative functions. The primary data store for this process is D2: Appointment & Lab / Medical Data, which maintains all appointments and related medical information.

The process begins when a Client initiates a Create Appointment Request (2.1). This sub-process uses the provided appointment details to create a Temporary Appointment Entry, which is stored in the D2 data store. Next, the Check Schedule Availability (2.2) sub-process is triggered. It Retrieves current schedules from D2 to assess availability. The outcome of this check is an Availability result, which is sent to the Client. This step is crucial for preventing double-booking and ensuring efficient scheduling. Based on the availability, the Confirm or Reschedule Appointment (2.3) sub-process takes place. Here, the system may send an Appointment Confirmation directly to the Client. The Client can also engage in Monitoring and Manual Intervention, potentially leading to a request to Update or Cancel appointment records. The final Appointment Details and status are then stored in D2. The Update or Cancel Appointment (2.4) sub-process handles changes to existing appointments. It takes an instruction to update or cancel and proceeds to Update appointment status in the D2 data store. Finally, the Notify Client (2.5) sub-process is responsible for communication. It uses the Notification details to inform the Client of the final appointment status, such as confirmation, update, or cancellation. Throughout this process, the Lab / Medical

Records (2.6) system interacts by allowing users to View details, Download PDF reports, and Upload Lab / Medical Records, ensuring that relevant medical history is accessible within the appointment management context.

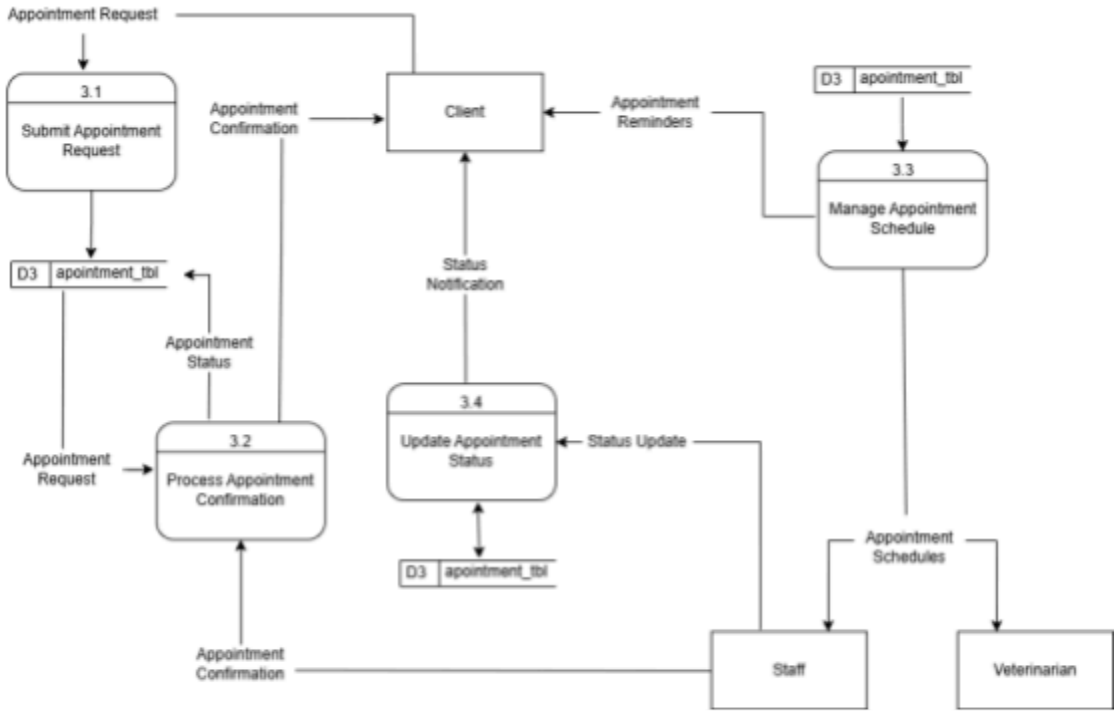

Figure 8.
Level 2 DFD: Process 3

The figure above illustrates DFD Level 2 for Process 3: Handle Diagnostic Tool shows how the system processes and analyzes health information using the diagnostic tool to generate possible results. This process is designed by the veterinarian and admin in assessing the pet's health conditions efficiently based on symptoms provided by the client. The two main data stores involved are D3: pet records and D8: diagnosis result, which keep the system's medical history and generate diagnostic data.

The process starts with the Collect Pet Symptom (3.1) sub process, where the veterinarian or admin collects the pet's symptoms from the system, either based on the client's given symptom through direct observation during consultation. The gathered information is then recorded and stored in Pet Records (D3), updating the existing pet profile with a new symptom entry. After the symptoms are collected, the Retrieval of Historical Data (3.2) sub process takes place. Here, the system accesses Pet Records (D3) to retrieve relevant medical history or previous data of the pet. This step gathers datasets that can be used for comparison and analysis, ensuring the diagnosis considers not only current symptoms but also past medical trends and cases. The Run Regression Model (3.3) sub-process represents the analytical core of this process. The system uses the multiple regression algorithm to analyze the dataset retrieved from historical records. By comparing input symptoms with past medical cases, the model generates predicted data outputs that suggest possible health conditions. One the diagnostic tool produces the predicted data. The Generate Diagnostic Result (3.4) sub-process interprets the output and converts it into an understandable diagnostic report. The system compiles the predicted results, matching them with relevant medical information, and prepares a summary that includes possible conditions or recommendations. Lastly, the Store and Send Results (3.5) sub-process saves the final diagnosis report into the Diagnostic Result (D8). The system then sends the results to both the veterinarian and admin for review and verification.

Figure 9.
Level 2 DFD: Process 4

The figure above represents the Level 2 Data Flow Diagram for Process 4: Manage Consultation through Chat. This diagram details the initial, automated phase of client communication handled by the chatbot system.

The process is initiated when a Client sends a Chat message. This message enters the Receive and Analyze Message (4.1) sub-process, where the system interprets the client's intent and queries the D4: Messages Records data store for relevant Conversation data to maintain context. The analyzed message is then passed to the Generate Chatbot Response (4.2) sub-process. Using the analysis from the previous step, this sub-process formulates an appropriate, automated reply. The resulting Chatbot-generated reply is sent back to the Client. Simultaneously, the conversation log, including both the client's

message and the chatbot's reply, is stored in the D4: Messages Records data store to preserve the chat history.

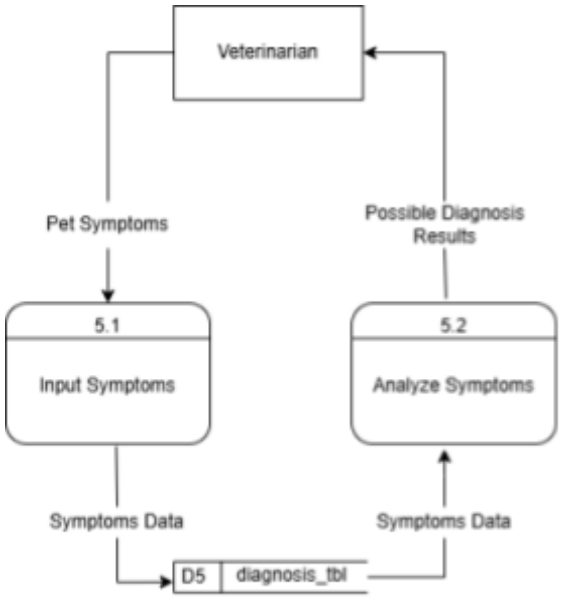

Figure 10.
Level 2 DFD: Process 5

The figure above represents Process 5: Pet Breed Detection, which illustrates how the system identifies a pet's breed through an image uploaded by the client. The process begins when the client uploads an image of their pet through the system interface. This uploaded file enters Upload Pet Image (5.1), where the system receives and stores the raw image data. Once the file is successfully uploaded, the data proceeds to Preprocess Image (5.2). In this stage, the image undergoes preprocessing, which includes cleaning, resizing and adjusting the image to ensure it meets the model's input requirements for accurate analysis. After preprocessing, the cleaned and resized image is sent to the Run Detection Model (5.3). Here, the system uses a trained breed detection model to analyze the pet;s physical features and show the likely breed. The result of this analysis produces a breed prediction, which is passed on to Generate Detection Result (5.4). In this stage, the breed

prediction is formatted into a detection summary, which contains the identified breed along with relevant details or confidence scores. This result is then sent to Store and Display Result (5.5), where the system both saves and displays the detected breed to the client. The detection data, including the image and its corresponding results, are stored in Breed Records (D5). Finally, the client can view the displayed detected breed directly from the system interface, allowing them to easily verify their pet's breed.

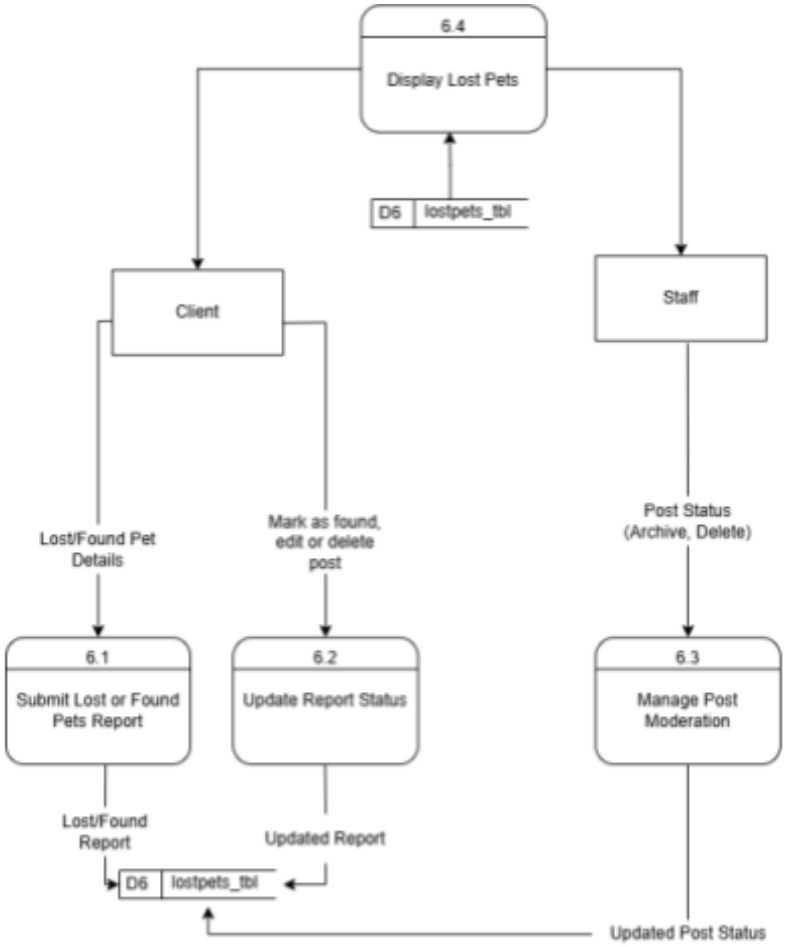

Figure 11.
Level 2 DFD: Process 6

The figure above illustrates the Level 2 Data Flow Diagram for Process 6: Lost and Found Forum Management. This diagram details the core workflow for creating, publishing, and maintaining lost and found pet posts, involving both the Client and the Admin.

The process begins when a Client provides Pet details, image, contact, and description. This information is received by Create Lost/Found Post (6.1), which processes the details to generate a Newly created post. This new post then moves to Publish and Display Post (6.2). This sub-process is responsible for making the post visible on the platform, resulting in a Display of all posts for users to view. Simultaneously, the post data is saved as a new record in the D6: Forum Posts data store. The Update or Delete Post (6.3) sub-process handles the maintenance of forum content. An Admin can send an Update info command to modify a post or delete it entirely. This sub-process then executes the change by performing an Update or remove post record action in the D6: Forum Posts data store.

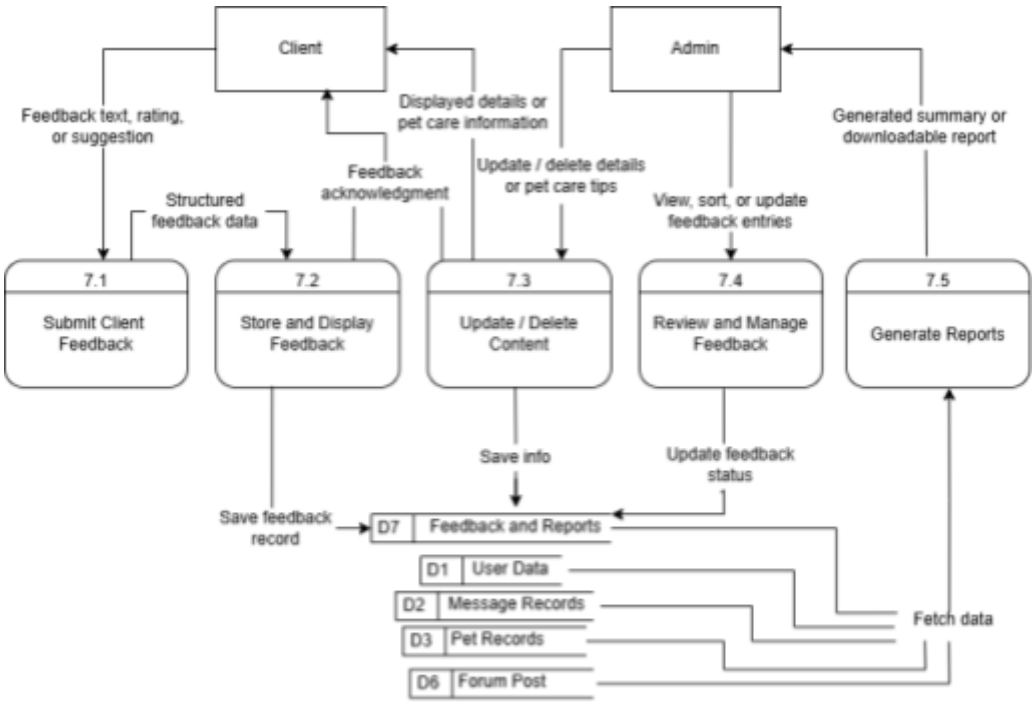

Figure 12.
Level 2 DFD: Process 7

The Level 2 illustrated Process 7: Feedback and Report Management, which represents how the system manages client feedback, pet care content updated, and administrative reporting. It shows the interaction between the client and admin in ensuring continuous service improvement and transparency through structured feedback and analytical reporting.

The process begins when a client provides feedback, rating, or suggestions through Submit Client Feedback (7.1). This stage involves collecting structured feedback data that reflect the client's experience with the system or veterinary services. Once submitted, the feedback is saved in Feedback and Reports (D7) for record-keeping and future references. Next, the feedback is processed and displayed in Store and Display Feedback (7.2). Here, the system organizes the feedback data, acknowledges receipt to the client, and displays relevant feedback content on the platform. This function ensures that users can view existing reviews or pet care tips that may help enhance their understanding and trust in the service. Meanwhile, Update/Delete Content (7.3) allows both clients and admins to make necessary modifications to feedback entries or pet care information. Clients can edit or remove their previous submissions, while admins may update informational content to maintain accuracy and relevance. The system then saves any updated details back into Feedback and Reports (D7), ensuring that all data remains

consistent and up to date. The admin also performs moderation and evaluation tasks in Review and Manage Feedback (7.4). This usage involves reviewing, sorting, and managing feedback data to ensure compliance with the system policies. Admins can flag inappropriate comments, summarize general user sentiment, and track performance metrics. The updated feedback status is then reflected in the database. Finally, Generate Reports (7.5) is responsible for compiling insights from various data stores, including User data (D1), Appointment records (D2), Pet records (D3), Forum Posts (D6), and Feedback and Reports (D7), to produce summaries or downloadable reports. These reports help the admin evaluate system performance, user satisfaction, and operational trends.

Entity Relationship Diagram

Entity relationship diagrams (ERDs) establish the connection between different tables or entities used in a database schema. By leveraging its visual representation capabilities, the developers will be able to communicate the interaction between entities more efficiently. Furthermore, this approach allows even the less experienced members of the team to comprehend the overall structure, allowing everyone to have a brief understanding of how the data correlates and flows through the system.

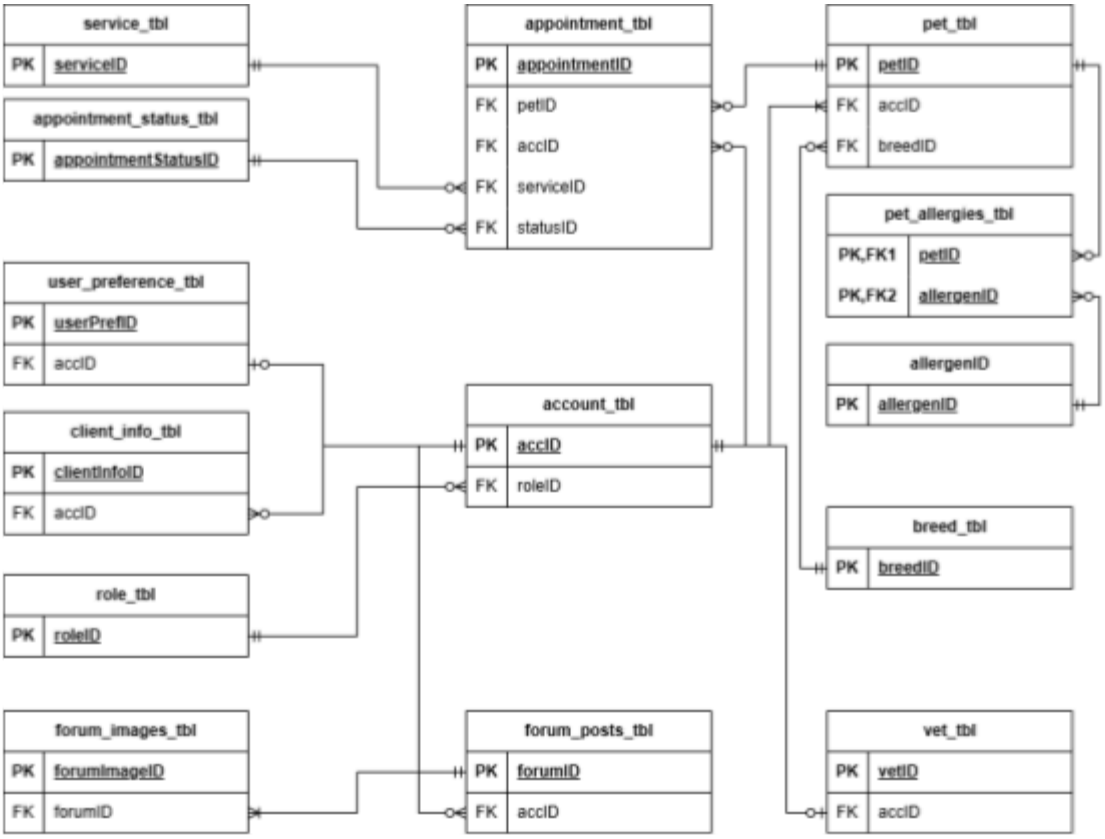

Figure 13.
Entity Relationship Diagram

Figure 13 illustrates the ERD of the RaphaVets web application, it features the entities for the Account, Client Information, User Preferences, Roles, Veterinarians, Appointment, Appointment Status, Services, Pet, Allergens, Pet Allergies, and Breeds. The diagram highlights the relationship between these entities through foreign keys where we can see that the Account entity plays a central role by being associated with multiple entities such as the Appointments, Pets, and Forum. These main entities are themselves connected to relevant tables within its corresponding functional area such as Forum being connected to Forum Images who has a one-to-many relationship, where each forum entry can be associated with multiple image entries . Additionally, the Pet entity is referenced in the Appointment entities, demonstrating that relationships can span

across different functional areas of the system . In the Pet functional area, we can see that Pet and Allergens have a many-to-many relationship, joined by a junction entity called Pet Allergies. This linking table may associate a pet with one or more allergens, enabling the system to accurately record the allergies of each pet.

Data Dictionary

The data dictionary describes the attributes of a database, how they are being stored, and what purpose they serve. It defines each entity, its attributes, data types, constraints, and relationships with other entities, serving as a reference for the developers and database administrators. Documenting the data dictionary helps maintain consistency, provide better understanding of the database schema, and facilitates accurate implementation and maintenance of the system.

Table 1.
account_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
accID	INT	11	Primary identifier for each account.	PK, AUTO_INCREMENT
roleID	INT	11	References the role of an account in role_tbl; determines the authority level of an account.	FK (role_tbl.roleID)
firstName	VARCHAR	250	First name of the account's user.	
lastName	VARCHAR	250	Last name of the account's user.	

email	VARCHAR	250	Unique email used for account log in.	UNIQUE
password	VARCHAR	250	Hashed password used for account log in.	
createdAt	DATETIME		Date and time when the account was created; used for data auditing.	DEFAULT CURRENT_TIMESTAMP
lastUpdatedAt	DATETIME		Date and time when the account was last updated; used for data auditing.	ON UPDATE CURRENT_TIMESTAMP
isDeleted	BOOLEAN		Boolean value that indicates whether an account is deleted. Ensures data persistence.	

Table 2.
role_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
roleID	INT	11	Primary identifier for each role type.	PK, AUTO_INCREMENT
roleName	VARCHAR	50	Descriptive name of each role type.	

Table 3.
pet_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
petID	INT	11	Primary identifier for each pet.	PK, AUTO_INCREMENT

accID	INT	11	References the account of the pet's owner in account_tbl.	FK (account_tbl.accID)
petName	VARCHAR	255	Name of the pet.	
breedID	INT	11	References to the pet's breed in breed_tbl; can also be used to determine the pet's species.	FK (breed_tbl.breedID)
dateOfBirth	DATE		Stored attribute from which the pet's age is derived.	
sex	ENUM		Pet's biological sex.	Allowed values: ('Male', 'Female')
weight_kg	DECIMAL	(5,2)	Pet's weight in kilograms.	
imageName	VARCHAR	255	Unique name of each image used for displaying.	UNIQUE
createdAt	DATETIME		Date and time when the pet record was created; used for data auditing.	DEFAULT CURRENT_TIMESTAMP
lastUpdatedAt	DATETIME		Date and time when the pet record was last updated; used for data auditing.	ON UPDATE CURRENT_TIMESTAMP
isDeleted	BOOLEAN		Boolean value that indicates whether a pet is deleted. Ensures data persistence.	

Table 4.
breed_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints

breedID	INT	11	Primary identifier for each breed.	PK, AUTO_INCREMENT
breedName	VARCHAR	255	Name of the pet's breed.	
species	ENUM		Species to which the breed belongs	Allowed values: ('Canine', 'Feline')

Table 5.
allergen_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
allergenID	INT	11	Primary identifier for each allergen.	PK, AUTO_INCREMENT
allergenName	VARCHAR	255	Name of each allergen.	FK (breed_tbl.breedID)

Table 6.
pet_allergies_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
petID	INT	11	Part of the composite primary key; references a unique pet in pet_tbl.	PK, FK (pet_tbl.petID)
allergenID	INT	11	Part of the composite primary key; references a unique allergen in allergen_tbl.	PK, FK (allergen_tbl.allergenID)
severity	ENUM		Describes how severe the pet's reaction to the associated allergen is.	Allowed values: *('Mild','Moderate','Severe')*

Table 7.
appointment_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
appointmentID	INT	11	Primary identifier for each appointment record.	PK, AUTO_INCREMENT
accID	INT	11	References the account associated with the appointment in account_tbl.	FK (account_tbl.accountID)
petID	INT	11	References the pet associated with the appointment in pet_tbl.	FK (pet_tbl.petID)
service	VARCHAR	255	Describes the service rendered to the pet in each appointment.	
appointmentDate	DATE		The scheduled date of the appointment.	
startTime	TIME		The time at which the appointment begins.	
endTime	TIME		The time at which the appointment ends.	
statusID	INT	11	References to the status of the appointment in appointment_status_tbl.	FK (appointment_status_tbl.appointmentStatusID
createdAt	DATETIME		Date and time when the appointment record was created; used for data auditing.	DEFAULT CURRENT_TIMESTAMP
lastUpdatedAt	DATETIME		Date and time when the appointment record was last updated; used for data auditing.	ON UPDATE CURRENT_TIMESTAMP

Table 8.
appointment_status_tbl — Data Dictionary

Field Name	Data Type	Size	Description	Key/ Constraints
appointmentStatusID	INT	11	Primary identifier for each status.	PK, AUTO_INCREMENT
statusName	VARCHAR	50	Descriptive name of each appointment status.	

User Story

User stories serve as a foundation for introducing the system's features from the perspective of its end users. This will provide a clear and concise description of how users will interact with each feature of the RaphaVets web application. Each user story connects user experience and technical development by identifying specific goals and expected outcomes. This method helps the development team focus on delivering the functions of the features that directly address user needs. The table below presents the user stories categorized according to their corresponding features (Epic), and personas(User, Vet, and Admin) highlighting how each role engages with the application.

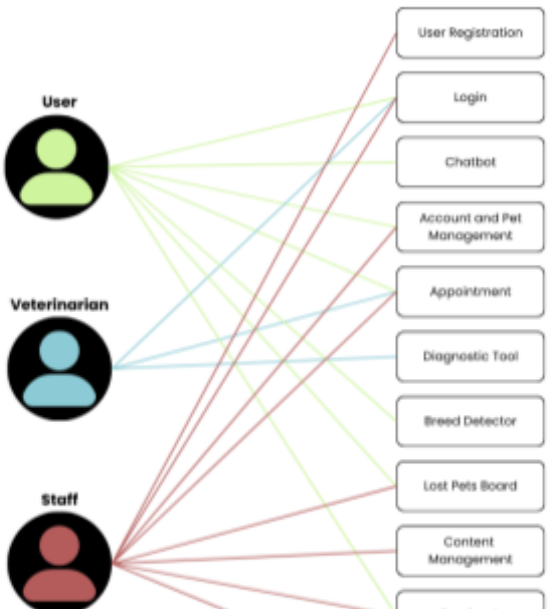

Table 11.
User Story

No	Epic	Persona	Goal	Expected result
1	User registration	As a staff	I want to register an account for a client.	To create an account for a client, and gain access to RaphaVet's services
2	Login	As a user	I want to login to my account.	To access my pets information, and gain access to RaphaVets services.
		As a vet	I want to login to the system using my credentials.	To access incoming appointments, and access the diagnostic tool.
		As a staff	I want to login with admin access	To oversee and manage users and system activities.
3	Account and Pet management	As a user	I want to manage my account and pet information	To manage my account and pet information and make sure its accurate
		As a staff	I want to manage and verify user accounts	To secure that only authorized users can access the system
4	Appointment	As a user	I want to schedule, reschedule, or cancel an appointment with a veterinarian.	To plan my pet's checkup with ease

		As a vet	I want to view my scheduled appointments.	To prepare for upcoming consultations efficiently
		As a staff	I want to oversee the appointment schedules and manage reports	To ensure coordination between clients and veterinarians
5	Diagnostic tool	As a vet	I want to use a diagnostic tool model	To efficiently generate accurate and quick assessments on pet conditions.
6	Chatbot	As a user	I want to ask questions to a chatbot or consult a vet online	To receive initial pet care advice
7	Breed detector	As a user	I want to upload my pet image for breed detection	To identify my pets breed and related health information.
8	Lost Pets Board	As a user	I want to post my lost pet	To seek help from others to locate or return lost pet
		As a staff	I want to moderate posts in the forum	To make the community safe and verified
9	Content management	As a staff	I want to update or remove content	So that users can reliable and current pet care information
10	Feedback	As a user	I want to submit feedback or suggestions about the system	To share my experience and help improve the platform
		As a staff	I want to review and analyze user feedback	To identify areas for improvement and enhance the system’s quality
11	Reports	As a staff	I want to generate reports of the system	Verify that the system can generate accurate and complete reports based on user activities

System Testing

Testing Procedures

An extensive set of tests was carried out to verify that the web application developed meets its specified functional requirements in full. During the test phase, it was ensured that the RaphaVets Web Application executes all the features intended effectively, such as scheduling appointments, responsiveness on all browsers and devices, lost and found forum, real-time communication with the veterinarian or chatbot, and dog and cat breeder module. The following table provides the system components, testing stages, and comprehensive explanations of the procedures followed to assess the performance and reliability of each module.

Table 12:
Application Functionality Testing Procedures

COMPONENT/PHASE	TEST TO BE CONDUCTED
Account management and user registration	A. Test if the registration module functions properly and successfully connects to the database. B. Verify that existing user accounts stored in the database can log in successfully using valid credentials. C. Test the password reset process, ensuring that reset instructions or verification links are sent correctly to the user's email.
Appointment booking	A. Test the scheduling, rescheduling, and cancellation of appointments to ensure accuracy and proper database updates. B. Verify that time conflicts between

	appointments are prevented. C. Check that appointment confirmations and details are displayed correctly to both users and administrators. D. Ensure that appointment data synchronizes correctly across browsers and devices.
Regression-based predictions	A. Verify that the module correctly receives and processes all input variables from the chatbot. B. Test the accuracy of the regression outputs by comparing predicted diagnoses against actual veterinary assessments. C. Ensure that the system provides predictions within acceptable accuracy or confidence levels (e.g., 80% or higher). D. Validate that results are clearly displayed in a user-friendly format for both pet owners and veterinarians.
Chatbot	A. Verify that the chatbot is available 24/7 and can respond to user queries without downtime. B. Test whether the chatbot can correctly interpret and respond to multiple pet symptoms entered by the user. C. Check that regression-based prediction provides reliable preliminary advice based on input symptoms. D. Confirm that after an appointment is booked, the chatbot's initial consultation details are automatically forwarded to the veterinarian.
Pet care tips module	A. Test that all pet care articles, videos, and resources load correctly on different devices and browsers. B. Ensure that users can easily navigate and access the pet care materials.

	C. Verify that all content displays with correct formatting and loads efficiently without errors.
Cat and dog breed detector	A. Test the accuracy and reliability of the breed detection feature using various pet images. B. Verify that the system correctly processes uploaded images and identifies the corresponding breed. C. Ensure that detection results are displayed clearly and that response time remains optimal. D. Check that image uploads follow the correct file type and size validation.
Lost Pets Board	A. Test the posting, editing, and deleting of lost or found pet entries. B. Verify that uploaded images, pet details, and user information are saved and retrieved correctly. C. Ensure that users can search and view posts efficiently based on keywords or filters. D. Test that forum data updates dynamically and is properly stored in the database.
Profile management	A. Test updating, viewing, and deleting of user profile information. B. Verify that all changes are correctly reflected in real time within the database. C. Ensure that profile image uploads meet format and size requirements. D. Confirm that user data is stored securely and that unauthorized edits are prevented.
Content management	A. Verify that administrators can add, edit, and

	delete content through the system interface. B. Ensure that all content updates are displayed correctly across relevant pages. C. Test input validations to prevent errors or incomplete content submissions. D. Check database synchronization when content is modified or removed.
User interface and user experience design	A. Incorporates high-quality images and videos to enhance visual presentation and engagement. B. Features a user-friendly layout that promotes ease of use and accessibility. C. Provides an intuitive and well-structured navigation menu for effortless browsing. D. Utilizes an aesthetically appealing design to capture user attention and maintain interest.

Each component undergoes a series of tests to ensure the functionality and performance of the main features of the RaphaVets Application. In testing the features, registration, appointment booking, chatbot with AI, pet care tips module, regression-based prediction, lost and found forum, and content management are included in order to verify the accuracy, reliability, and usability of each module while making sure that data integrity and smooth user interaction are maintained. Any system errors or inconsistencies that have been found using these tests will serve as a basis for further optimization and enhancement by the developers.

Testing starts with the registration of accounts and follows through their successful login. The module for registration is put to test in areas such as proper

database connection, handling duplicate entries, and validation of correct data entry. The email verification is checked through an OTP system for secure authentication, and the reset password feature must ensure the users can retrieve accounts through verification links sent to the email address registered with the website or app.

The appointment booking module is tested to verify that users can rightly schedule, reschedule, and cancel appointments. Also, the process confirms that all the data about appointment details are appropriately stored and updated in the database. Tests also confirm that appointment overlaps or conflicts are avoided, while confirmation details are accurately shown to users and administrators. Synchronization on different browsers and devices has been conducted to verify data consistency and proper functionality.

Testing procedure for chatbot components with AI integration focuses on ensuring the 24/7 availability and responsiveness to user queries. The chatbot is evaluated on its accuracy or confidence level that it can interpret inquiries provided by the users and to generate relevant and useful responses. It is also tested for the integration of the regression-based prediction system for proper processing of all fed variables into the model. Moreover, accuracy verification is performed by comparing the system outputs with real-life veterinary assessments. Performance will be verified regarding the reliability of prediction so that the system maintains acceptable levels of accuracy and shows results clearly and in a user-friendly manner.

The cat and dog breed detector is tested for accuracy of the system's ability to correctly process uploaded images and identify the corresponding pet breeds. The accuracy and response time of the detection process are assessed, while image uploads are validated to ensure file type and size compatibility is met. Results must be displayed clearly and consistently to maintain user satisfaction. Testing for the lost and found forum focuses on ensuring that registered users can post entries regarding their missing or found pets, edit, and delete those entries. Uploaded images, descriptions, and contact details are checked for proper saving and retrieval from the database. It is also tested for keyword search and filtering functions to a user's capability to browse efficiently and locate relevant places.

The administrator can add, edit, and delete content using the platform's interface, and this is tested. Updates are checked for synchronization across related pages, and input validation is performed to prevent incomplete or incorrect data entries. Testing also ensures that any modification of content can be stored and reflected in the database correctly. This includes the checking of the user interface and the user experience design for visual appeal, intuitiveness, and ease of navigation. Checking for accessibility, consistency in layout, and responsiveness on devices; ensuring images, icons, and multimedia display as they should in terms of quality and how they load, all contribute to an engaging and user-friendly environment. Testing is also carried out in variable network conditions, device types, and browsers to ensure the stability of the application. Various simulated conditions include low internet connections, multiple users logging in at the same time, and disrupted sessions; these have all been tested to ensure the system

maintains data integrity and errors are relayed back in clear messages. These procedures confirm that RaphaVets performs efficiently and consistently across all environments.

System Development

The development of the system required developers to create a well designed and user-friendly web design prototype and translate it into a functional well developed working web application using the chosen combination of technologies used to build and run a software application or website of the developers. This involves a set of codes via programming languages or frameworks for each functionality. This includes debugging, testing, and improving written code ensuring proper functionality and responsiveness.

System Evaluation

The system development, testing, and integration using selected technology stack. The system was developed using React.js for the front-end, Node.js with Express for the backend, and MySQL for database management. A series of code debugging and refinement is made to address detected errors and improved overall funphase focuses on converting the system design and wireframes of the RaphaVets web-application into a functional software. This phase involved the implementation of features via coding, functionality.

Documentation

Documentation is the process of recording all information related to the development of the system. It includes written details about the design, codes, database, and instructions on how to use the system. Having complete documentation helps developers, users, and future researchers understand how the system works. It also makes it easier to fix errors, update features, or improve the system later on. Good documentation provides clear and organized records that can serve as a guide for anyone who will maintain or study the system in the future.

Operation Procedure

The figure below shows the operating procedure of the proposed project of RaphaVets Pet Clinic System:

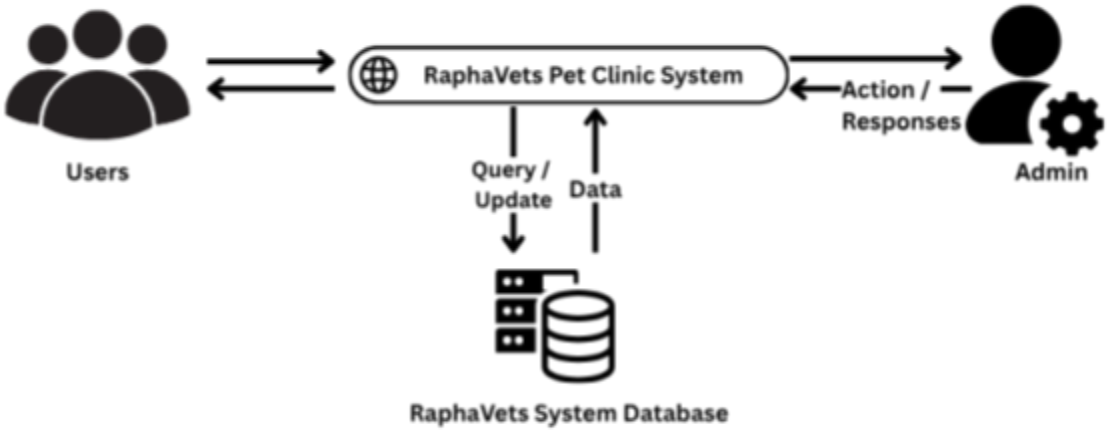

Figure 15.
RaphaVets Pet Clinic Platform

The RaphaVets operates as a user-friendly, clinic-centered web service that starts with simple, secure account creation and email verification. The RaphaVets platform allows different types of users. Users with no accounts using the website are considered

guests and could continue to use the platform and other features using guest accounts, but with very limited access and cannot use the full capacity and features of the platform.

Second are the primary users, they have to create an account or their account must be created by the admin or veterinarian. They have full user side access, if they wanted to book then the system guides pet owners through an easy appointment flow: submit preferred date/time, the system checks veterinarian availability, and the clinic confirms or proposes alternatives while sending timely SMS and email reminders, before consultations users can interact with an AI assistant that collects symptoms or use other features so veterinarians arrive informed, and all consultation notes, pet records, and any regression-based suggestions are stored in the clinic's electronic record for clinician review only; realtime chat enables brief triage or follow-up while a community lost-and-found forum amplifies local help through moderated posts.

Lastly, administrators manage schedules, moderate content, audit logs, and generate simple analytics to surface trends. Privacy and safety are built in — the chatbot and breed detector are explicitly advisory, image quality limits are acknowledged, and serious or ambiguous cases are escalated to clinicians; the system is deployed with repetitive testing, a maintenance plan, and a human in the loop governance model so RaphaVets improves over time without substituting professional veterinary judgment.

Evaluation Procedure

To evaluate the system, the following activities will perform:

Preliminary Evaluation

After the project is completed the researchers will conduct a testing to the program modules/component or phase. With this, the functionality and reliability of the system will be evaluated.

Final Evaluation

To test the system, the researchers will conduct a survey with participants who have directly used or interacted with the RaphaVets Pet Clinic System. All respondents will be selected through purposive sampling, as outlined in the research design, and will be grouped into two categories: Internal Users (veterinarians and clinic staff) and External Users (pet owners or clients). A total of 25 respondents will take part in the evaluation, consisting of 5 clinic staff and veterinarians and 20 pet owners or clients. The evaluation will focus on assessing the system's functionality, usability, efficiency, reliability, and overall user satisfaction using a structured questionnaire based on the ISO/IEC 25010 software quality model.

Evaluation Instrument

The web-applications evaluation instrument is intended to measure the usability and overall functionality of the system based on predefined standards. The researchers will be utilizing the evaluation instrument as a primary tool for the tabulation, analysis, interpretation, and summarization of the gathered data. It will aid in determining the system's level of acceptability and effectiveness from

the users' perspective. The evaluation will be guided by specific criteria or indicators that serve as measurable aspects in assessing the system's functionality and quality. These criteria are as follows:

Functionality

This measures the systems how well the system performs its intended functions and meets user expectations. It focuses on the system's ease of operation, comfort, and convenience, ensuring that users can navigate and perform tasks without difficulty

Reliability

Ensuring that the system's consistency and accuracy in performing its designed task is free of errors and consistent. Moreover, this will be evaluated based on the accuracy of tasks in performing their functions.

Usability

This criterion evaluates the effectiveness, efficiency, and satisfaction in which emphasizing the clarity of design and the overall user experience, determining whether the system can be efficiently used by new and returning users.

Efficiency

This will assess the system's responsiveness in performing veterinary functions such as appointment scheduling, AI chat interactions, and record management. It focuses on how efficiently the application utilizes resources while maintaining smooth performance and quick data display based on user experience.

Maintainability

The RaphaVets Pet Clinic web application should be easily maintained by the system administrator and developers. This evaluates how conveniently management tasks can be performed and how flexible the system is in adapting to updates, enhancements, and issue resolution to keep the platform functional and up to date.

Treatment of Data

This section addresses the statistical tools and procedures used in analyzing the data gathered from respondents. The functionality and usability of the RaphaVets Pet Clinic System were evaluated using a four-point Likert scale as part of the survey instrument. Respondents were asked to rate each criterion on a scale of one (1) to four (4), corresponding to qualitative judgments such as *"Poor" to "Excellent"* or *"Strongly Disagree" to "Strongly Agree"*, depending on the type of question. Each response was assigned a corresponding numerical value, enabling the quantitative analysis of qualitative perceptions.

The data collected were subjected to statistical computation to determine the mean and overall mean, which serve as the basis for interpreting the level of user satisfaction and system performance. The mean represents the average score for each criterion, while the overall mean indicates the general performance across all criteria.

Table 13.
Mean Formula

Mean Formula: $M = \sum fx/n$	Where: M = Mean f = frequency (number of respondents who chose a particular answer) x = score n = total number of responses on that criterion
Overall mean = Sum of X/n	X = sum of all scores in each criteria n = total number of criteria

The following scale was used as the basis for interpreting the computed mean values for each criterion:

Table 14.
Mean values

Scale	Range	Rating	Description	Mean Interpretation
4	**3.26 - 4.00**	**Excellent**	Greatly surpasses expectations	The mean value indicates a high level of user satisfaction and exceptional system performance.

3	**2.51 - 3.25**	**Good**	Meets expected standards	The mean value signifies satisfactory system performance and positive user experience.
2	**1.76 - 2.50**	**Fair**	Falls short of expectations	The mean value reflects moderate satisfaction, suggesting that certain areas need improvement.
1	**1.00 - 1.75**	**Poor**	Requires substantial improvement	The mean value indicates low user satisfaction and inadequate system performance.

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