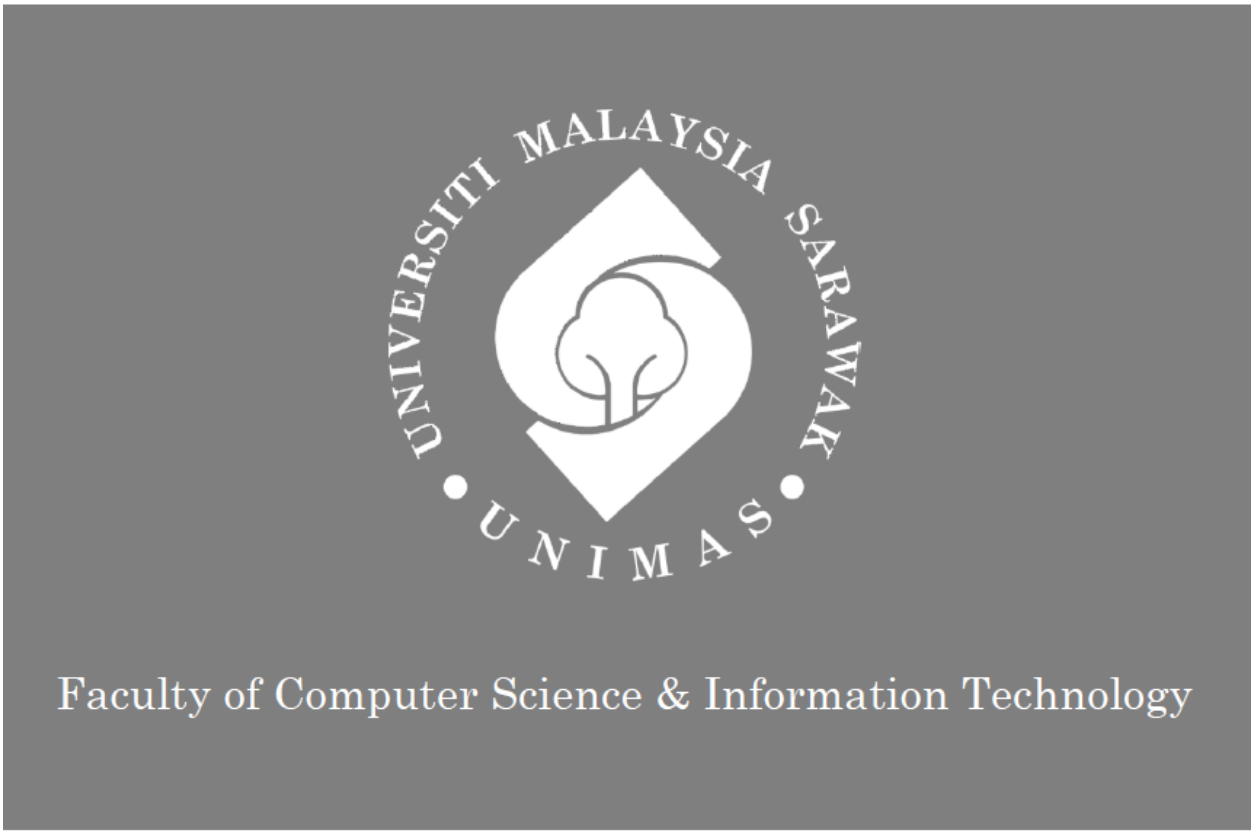

Digital Solutions for Stray Animal Care and Public Health Initiatives

LAW LI WEN

Bachelor of Software Engineering with Honors

2025

Digital Solutions for Stray Animal Care and Public Health Initiatives

LAW LI WEN

This project is submitted in partial fulfilment of

the requirements for the degree of Bachelor of Software Engineering with Honors

Faculty of Computer Science and Information Technology

UNIVERSITI MALAYSIA SARAWAK

2025

Penyelesaian Digital untuk Penjagaan Haiwan Terbiar dan Inisiatif Kesihatan Awam

LAW LI WEN

Project ini merupakan salah satu keperluan untuk

Ijazah Sarjana Muda Kejuruteraan Perisian dengan Kepujian

Fakulti Sains Komputer dan Teknologi Maklumat

UNIVERSITI MALAYSIA SARAWAK

2025

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LAW LI WEN,

Faculty of Computer Science and Information Technology

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ACKNOWLEDGEMENT

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ABSTRACT

The growing population of stray animals in urban and suburban areas poses significant challenges to public health and animal welfare. This project, Digital Solutions for Stray Animal Care and Public Health Initiatives, aims to develop a mobile application, SafePaws, designed to address these challenges by centralizing the management of stray animals, pet adoption, and public health awareness within Sarawak. The application allows users to post about lost or adoptable pets, report incidents involving stray animals, such as bite cases or suspected rabid animals, and access information about nearby veterinary clinics and pet stores. An integrated AI chatbot provides users with advice on pet care and safety guidelines. By offering a streamlined platform for incident reporting and pet adoption, SafePaws aims to improve response times, foster community involvement, and raise awareness about public health initiatives such as rabies prevention. The system was developed using the prototype model, ensuring iterative feedback from users to refine the application. The app's features were validated through functional, non-functional, and user acceptance testing, ensuring it meets user needs. This project contributes to improving both animal welfare and public safety by offering a comprehensive solution for managing stray animal-related issues and promoting responsible pet ownership.

ABSTRAK

Populasi haiwan terbiar yang semakin meningkat di kawasan bandar dan pinggir bandar membawa cabaran besar terhadap kesihatan awam dan kesejahteraan haiwan. Projek ini bertajuk "Penyelesaian Digital untuk Penjagaan Haiwan Terbiar dan Inisiatif Kesihatan Awam", bertujuan untuk membangunkan aplikasi mudah alih, SafePaws, yang direka untuk menangani cabaran ini dengan menyatukan pengurusan haiwan terbiar, pengambilan haiwan peliharaan, dan kesedaran kesihatan awam di Sarawak. Aplikasi ini membolehkan pengguna untuk menyiarkan mengenai haiwan peliharaan yang hilang atau untuk diadopsi, melaporkan insiden yang melibatkan haiwan terbiar seperti kes gigitan atau haiwan yang disyaki rabies, serta mengakses maklumat mengenai klinik veterinar dan kedai haiwan peliharaan berdekatan. Sebuah chatbot AI yang terintegrasi memberi nasihat kepada pengguna tentang penjagaan haiwan peliharaan dan garis panduan keselamatan. Dengan menawarkan platform yang tersusun untuk melaporkan insiden dan pengambilan haiwan peliharaan, SafePaws bertujuan untuk memperbaiki masa tindak balas, memupuk penglibatan komuniti, dan meningkatkan kesedaran tentang inisiatif kesihatan awam seperti pencegahan rabies. Sistem ini dibangunkan menggunakan model prototaip, memastikan maklum balas berulang daripada pengguna untuk memperhalusi aplikasi. Ciri-ciri aplikasi telah disahkan melalui ujian fungsional, bukan fungsional, dan ujian penerimaan pengguna, memastikan ia memenuhi keperluan pengguna. Projek ini memberi sumbangan kepada peningkatan kesejahteraan haiwan dan keselamatan awam dengan menawarkan penyelesaian yang komprehensif untuk menguruskan isu-isu berkaitan haiwan terbiar dan mempromosikan pemilikan haiwan peliharaan yang bertanggungjawab.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The growing population of stray animals in urban and suburban areas has intensified concerns about animal welfare and public safety as these animals often suffer from hunger, injuries and diseases like rabies (World Health Organization, 2024). This issue is compounded by a fragmented response system, where information on lost pets, stray animal incidents and public health measures is scattered across various social media platforms. This fragmentation leads to delayed responses, poor coordination and inefficient management. Additionally, pet owners often struggle to find reliable support on reporting incidents or adopting pets due to the dispersed resources. The lack of a centralized platform also limits public awareness of proper animal care, making it difficult for communities to respond swiftly and effectively to animal-related issues. This project aims to develop a comprehensive mobile application that streamlines the management of pets and stray animals. The proposed platform will facilitate pet adoption and lost pet posts within Sarawak, while also empowering users to report stray animal incidents such as bite cases or suspected rabid animals to relevant local authority. It also provides business information of veterinary clinics and pet stores near user and in areas within Sarawak, including address, operating hours, and distance from the user. Additionally, it helps answer users' questions on pet-related topics such as emergency procedures, training tips, feeding guides, and general pet care via an AI chatbot. By consolidating these features into a single platform, the application seeks to bridge the gap between the community, animal shelters and local authorities, enhancing overall animal welfare.

1.2 Problem Statement

Users mainly rely on social media like Facebook and Instagram to spread the message of their lost pets or seek adoption. However, the information is scattered across the internet, lacking a unified platform to manage this information systematically. This scattered information often results in inefficiencies and delayed response times, especially when it comes to reporting bite case or suspected rabid animals.

Stray animals, particularly dogs and cats, pose serious risks to human health by transmitting dangerous diseases like rabies which can lead to severe illness and even death in humans if not treated promptly if contracted. Research shows that managing stray animals is an increasing public health concern due to the spread of zoonotic diseases like rabies, raising both ethical and animal welfare challenges (Abdulkarim et al., 2021). In many regions of Sarawak, authorities and animal welfare organizations struggle to efficiently manage stray animal populations due to a lack of community engagement, limited resources and slow response times to incidents involving bite care or suspected rabid animals (Munir et al., 2023).

Furthermore, the adoption of stray animals remains low, partly due to the absence of adequate platforms that connect potential adopters with local shelters. Social media is not an optimized platform for pet adoption. The need for a systematic, integrated platform to facilitate pet adoption, animal welfare education and incident reporting has been noted in various studies (Santy et al., 2018). Thus, this can be addressed by developing a mobile application that streamlines the reporting of stray animal incidents, encourages adoption and raises awareness about animal welfare and public health initiatives.

1.3 Scope

This system focuses on providing a mobile application dedicated to stray animal management and pet-related information for the general public. The target users include community members, pet owners, and relevant local authority, but the system does not cater specifically to veterinarians or animal shelter staff. The relevant local authority receives the incident reports submitted by users through the app. However, they do not use the app directly as they only receive information of report via email and may act on it offline through their standard procedures. The system will handle data related only to users and pets. It supports users in creating posts for pet adoption, reporting lost, adopted and found. It also handles report for bite case or suspected rabid animals and communicating through a basic in-app chat feature. However, the system excludes features such as managing shelter operations, veterinary services, and enforcement of animal control regulations.

Integration with external organizations is limited to sending incident reports via email. In addition, there is no live integration with veterinary clinics, shelters, or government databases. Geographically, the app is designed for use within local communities and does not support international functionality. The app uses location-based services such as Google Places API and Geocoding API to help users view nearby vets or pet stores. Additionally, the AI chatbot included in the app provides general pet care information using the Gemini 1.5 Flash API but is not a replacement for professional advice or live consultation. Overall, the system is intended to be a lightweight and accessible tool for community-level engagement with pet adoption and stray animal awareness, without extending into shelter management or public health program enforcement.

1.4 Objectives

a. To help rescuers facilitate adoptions and assist pet owners in finding their lost pets by sharing detailed pet information through the application

b. To minimize the risk of zoonotic diseases like rabies by reporting the case to dedicated local authorities through this platform

c. To provide advice on pet care and safety guidelines related to animals through AI chatbot

1.5 Methodology

In this project, the prototype model is selected as the development methodology, where a prototype is iteratively built, evaluated and refined until the final system meets all user requirements. This approach ensures quicker feedback from customers, offering a clearer understanding of their needs (Lewis, 2023).

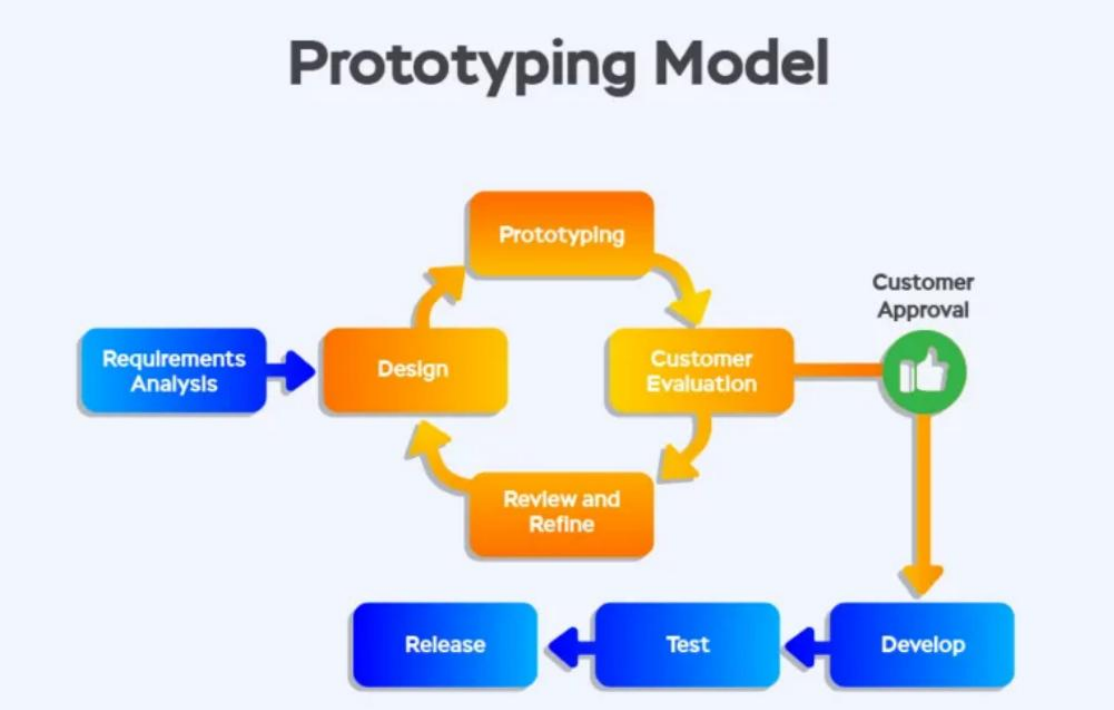


Figure 1: Prototype Model

The detailed breakdown of the stages in this methodology is as follows:

1. Requirements Gathering
    - Interviews and surveys are conducted with stakeholders, including pet owners, animal shelters and local authorities to gather their needs and expectations for the mobile application.
2. Quick Design
    - A preliminary design of the system is developed to provide a simplified outline of the core functionalities and user interface, helping users understand how the system will look and function.
3. Building the Prototype
    - Using the quick design as a foundation, the first prototype of the mobile application is built. This prototype includes basic versions of the system's key features.

4. User Evaluation
    - The prototype is presented to users and tested by them to identify any issues and collect feedback for improvement.
5. Refining the Prototype
    - Based on user feedback, the prototype is iteratively refined to address shortcomings until all user requirements are met, and the application's performance and features are satisfactory.
6. System Implementation
    - After user approval, the final prototype undergoes full testing and is deployed to production. Regular maintenance is conducted to ensure ongoing functionality, address bugs and release updates as needed.

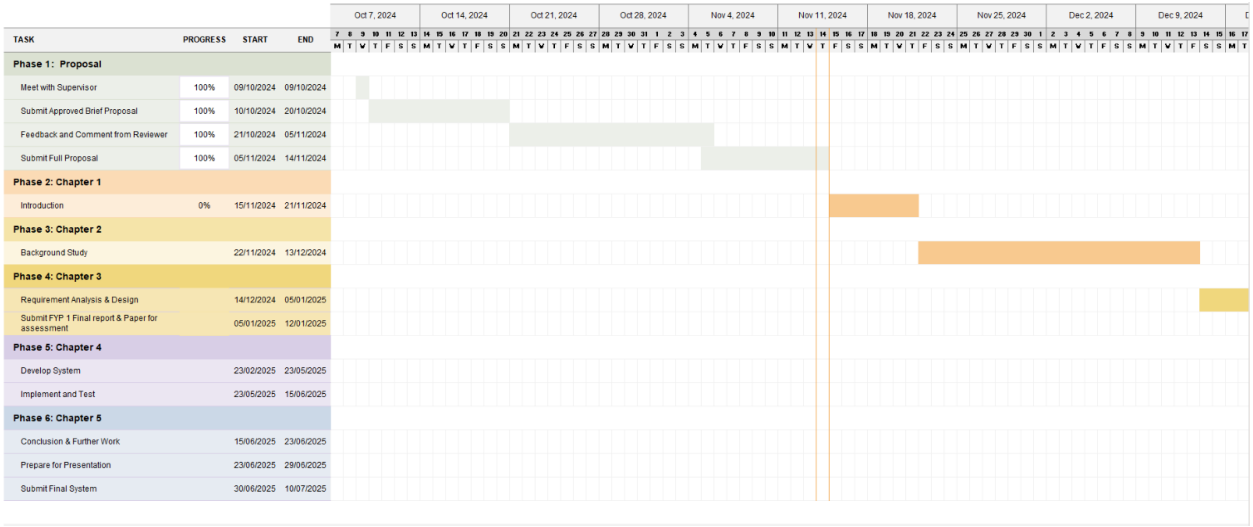
1.6 Significance of Project

The system helps to address key issues related to stray animal management, public health and pet adoption, improving both animal welfare and community safety. By consolidating scattered information into a single platform, the application will streamline the reporting of stray animals, ensuring quicker responses from local authorities and the community, which is crucial in preventing the spread of diseases like rabies. The app will also promote responsible pet ownership and raise awareness of public health initiatives to enhance public safety. Additionally, by facilitating pet adoption and providing an accessible platform for both animal shelters and potential adopters, the project helps reduce the number of stray animals and supports the rehoming process. The project fosters community involvement and enhances animal welfare efforts by unifying systems for managing stray animals and facilitating pet adoption.

1.7 Project Description

This project aims to develop a mobile application designed to streamline the management of pets and stray animals by providing a comprehensive platform for the community. The app's core functionalities such as, facilitating pet posts for seek adoption and lost pet, reporting stray animal incidents (bite case or suspected rabid animals) and showing the business information of veterinary clinics and pet stores based on the areas within Sarawak. Additionally, it will answer questions about responsible pet ownership, including steps to take when bitten by stray animals, how to prevent rabies and other pet-related topics through AI chatbot. By integrating these features, the application addresses the current issue of scattered information across multiple platforms, such as social media, which often results in slow response times and ineffective management of stray animals. The platform will also bridge the gap between potential adopters and local shelters, making the adoption process more accessible and efficient.

1.8 Project Schedule



TASK	PROGRESS	START	END
Phase 1: Proposal			
Meet with Supervisor	100%	09/10/2024	09/10/2024
Submit Approved Brief Proposal	100%	10/10/2024	20/10/2024
Feedback and Comment from Reviewer	100%	21/10/2024	05/11/2024
Submit Full Proposal	100%	05/11/2024	14/11/2024
Phase 2: Chapter 1			
Introduction	0%	15/11/2024	21/11/2024
Phase 3: Chapter 2			
Background Study		22/11/2024	13/12/2024
Phase 4: Chapter 3			
Requirement Analysis & Design		14/12/2024	05/01/2025
Submit FYP 1 Final report & Paper for assessment		05/01/2025	12/01/2025
Phase 5: Chapter 4			
Develop System		23/02/2025	23/05/2025
Implement and Test		23/05/2025	15/06/2025
Phase 6: Chapter 5			
Conclusion & Further Work		15/06/2025	23/06/2025
Prepare for Presentation		23/06/2025	29/06/2025
Submit Final System		30/06/2025	10/07/2025

Figure 2: Project Schedule in Gantt Chart

1.9 Expected Outcome

The expected outcome of this project is to develop a mobile application that addresses key challenges in managing stray animal cases, promoting pet adoption, and improving public awareness of animal-related issues. The system is intended to serve as a centralized platform where community members can easily report incidents involving bite case or suspected rabid animals. This is expected to facilitate quicker community responses and improve the visibility of such cases to relevant authorities or welfare groups.

By enabling users to post and browse pet adoption listings, the system aims to create a more accessible and organized process for rehoming pets, potentially increasing adoption rates and reducing the number of stray animals. It is also expected to empower users with basic tools and guidance on responsible pet ownership through an integrated AI chatbot that provides educational responses to pet care questions.

From a broader perspective, the application aims to raise public awareness about critical topics such as rabies prevention, sterilization, and animal welfare practices. This can lead to improved community knowledge and engagement in managing local stray populations more humanely and proactively.

In the long term, the system is expected to contribute to better coordination between the public and relevant stakeholders, generate useful data on stray animal trends, and support efforts toward safer and more compassionate communities.

1.10 Project Outline

Chapter 1: Introduction

This chapter presents the background and motivation for the project, addressing the increasing concerns related to stray animal populations and their impact on public health and animal welfare. It identifies the need for a centralized digital solution to overcome fragmented information, delayed response times, and low adoption rates. The chapter also states the problem statement, project objectives, scope, methodology, significance, and expected outcomes. These elements provide a comprehensive foundation for the development of the SafePaws mobile application and set the direction for the research and system implementation.

Chapter 2: Literature Review

This chapter provides a detailed review of existing literature and related systems that focus on stray animal management, pet adoption, and rabies prevention. It critically analyzes the features, usability, strengths, and limitations of existing similar applications. The insights gained from these platforms help identify key gaps in current solutions and inform the design of a more comprehensive and community-focused system. The chapter concludes by justifying the need for SafePaws and how it improves upon existing efforts through integrated features and a focus on public health awareness.

Chapter 3: Requirement Analysis and Design

This chapter outlines the process of identifying user needs and defining system requirements through structured questionnaires and user feedback. It includes both functional and non-functional requirements based on the MoSCoW prioritization method. The chapter also presents a detailed design of the system, including use case diagrams, activity diagrams, sequence diagrams, and user interface mockups. These visual and descriptive elements serve as blueprints for system

development, ensuring that the application is tailored to user expectations and provides a seamless, intuitive experience.

Chapter 4: System Implementation

This chapter explains the technical implementation of the SafePaws application, detailing the tools, technologies, and architecture used in development. It describes the three-tier architecture consisting of the presentation layer, business logic layer, and data storage layer. The implementation of key modules such as login, post browsing, post management, incident reporting, AI chatbot as well as vet and store directory is discussed in detail, with interface screenshots illustrating the user experience. The chapter demonstrates how the system integrates various functionalities to deliver a robust solution for stray animal care and public health engagement.

Chapter 5: System Testing

This chapter presents the testing strategies employed to verify that the SafePaws application functions as intended and meets quality standards. It covers functional testing of all major modules to ensure correct behavior, non-functional testing to assess performance, usability, and reliability, and user acceptance testing (UAT) to validate user satisfaction and system effectiveness. The testing results are analyzed to identify areas of improvement and confirm that the system is capable of delivering a reliable and user-friendly experience.

Chapter 6: Conclusion and Future Work

This chapter concludes the project by summarizing its contributions to solving issues related to stray animal management, pet adoption, and public health education. It reflects on the achievements and evaluates how the system meets its objectives. The chapter also discusses limitations encountered during development, such as scope constraints and integration limitations, and provides recommendations for future work. Proposed enhancements include expanding

feature sets, integrating with external databases, and improving AI capabilities to further support animal welfare and community involvement.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

In this chapter, a detailed literature review examines studies on stray animal management, adoption trends and public health issues like rabies. It examines existing systems with their features, usability, strengths and weaknesses, providing insights for the development of SafePaws.

2.2 Reviews of Similar Existing Systems

2.2.1 PetFinder.my

This review will talk about the existing application, PetFinder as a comparable mobile application system to SafePaws. It is developed by PetFinder.my & KindMeal.my Team to help users rehome and adopt pets effectively (Sathiabalan, 2024). This app will be analyzed in terms of its features, usability, strengths and weaknesses to identify areas for improvement and best practices for the development of SafePaws.

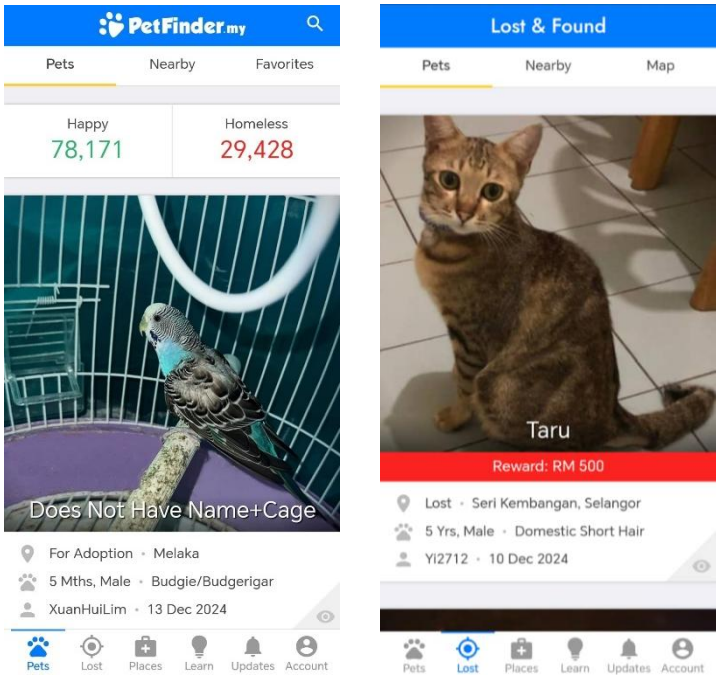


Figure 3: Screenshots of Posts for Adoption and Lost Page

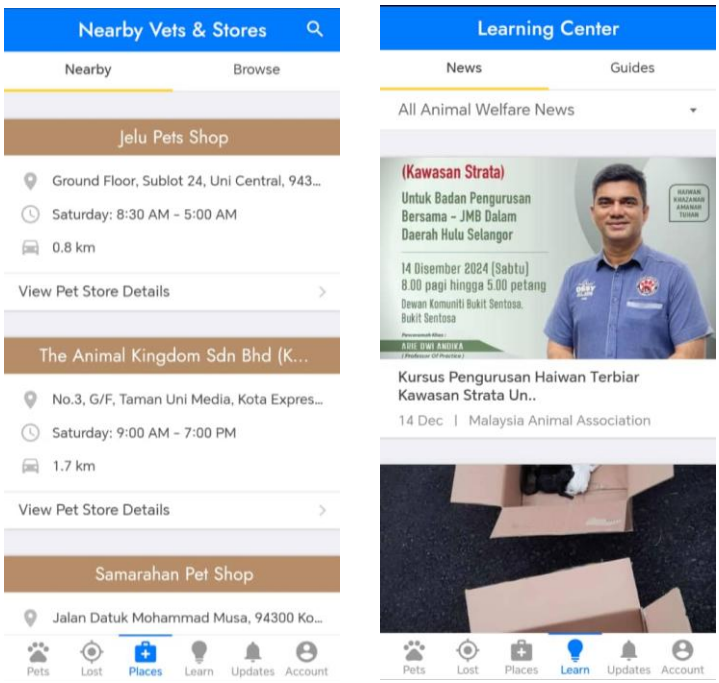


Figure 4: Screenshots of the veterinary clinics & pet stores listing and the Learning Center page

PetFinder.my provides a platform for users to post information about missing pets, including their last known locations, making it easier to reunite lost animals with their owners. The app also features a directory of veterinary clinics and pet stores across Malaysia, searchable by state, ensuring users have access to essential services. Furthermore, PetFinder.my shares news from Malaysian animal welfare organizations and educates users on responsible pet ownership through categorized articles covering topics like rescue and rehoming, first aid, pet adoption and general pet care. Users can explore detailed information about specific organizations by clicking their profiles, which link directly to the organization's website or social media accounts. Furthermore, the app allows users to create and manage pet profiles, including recording microchip IDs for easy tracking (PetFinder.my, n.d.).

The usability of the PetFinder.my mobile app is generally considered to be user-friendly, offering a straightforward and intuitive interface that simplifies navigation for a wide range of users. The app is designed with easy-to-use features, such as filtering options for animal types and

locations, which help users quickly find relevant information. This ease of use is particularly beneficial for users looking to post information about lost or adoptable pets or those seeking services like veterinary clinics and pet stores.

The platform's extensive reach and diverse pet listings make it an effective tool for adoption and finding lost pets. It integrates GPS and Google Maps to display the locations of animals and highlights pets available for adoption or those lost within the user's vicinity. Additionally, it consolidates news from animal welfare organizations like WWF Malaysia, SPCA Sarawak and the Malaysia Animal Association, promoting their work and directing users to their websites or social media accounts. PetFinder.my emphasizes education by providing guidelines on responsible pet care. It also offers a platform for rescuers to seek medical funds for animals.

One notable limitation of PetFinder.my is its reliance on user participation to keep pet listings updated and accurate, which can lead to discrepancies or outdated records. For instance, a pet listed as available for adoption may already have been adopted but still appear on the platform, potentially causing frustration for other users. Furthermore, the platform lacks specialized features for incident reporting or tracking animal health records, making it less effective for addressing urgent scenarios like reporting bite case, potential rabies animals or managing vaccination histories.

Overall, PetFinder.my serves as an effective platform for promoting pet adoption, lost-and-found services and responsible pet ownership education. Its functionality provides valuable insights for improving similar applications and identifying areas for enhancement in future designs.

2.2.2 RabiesApp

RabiesApp is focused as a mobile application that has similar feature with SafePaws. It is a rabies case report management system which is powered by Sarawak Digital Economy Corporation Berhad (SDEC) to create public awareness to rabies case in Sarawak (RabiesApp, n.d.). This system's features, usability, strengths and weaknesses will be evaluated to identify areas for improvement and best practices for the development of the stary animal management app.

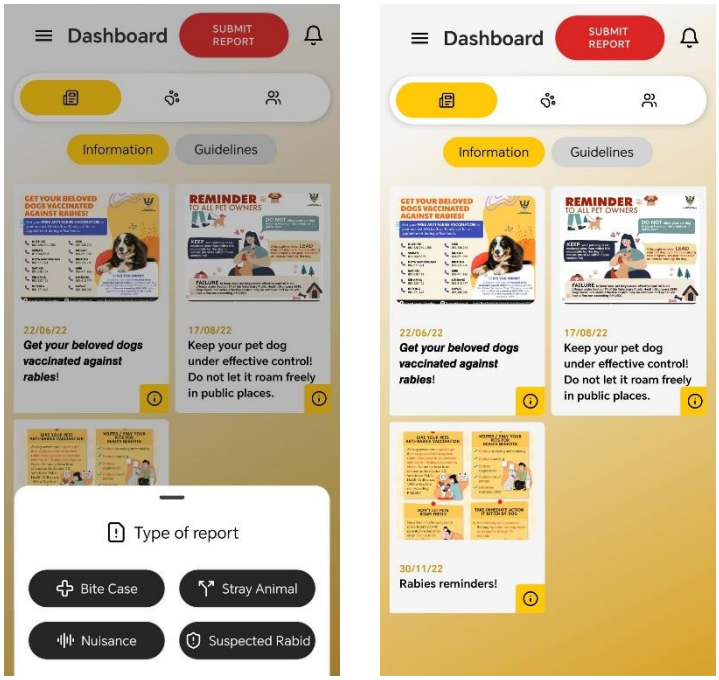


Figure 5: Screenshots of Reporting Cases Feature and Educational Content Page

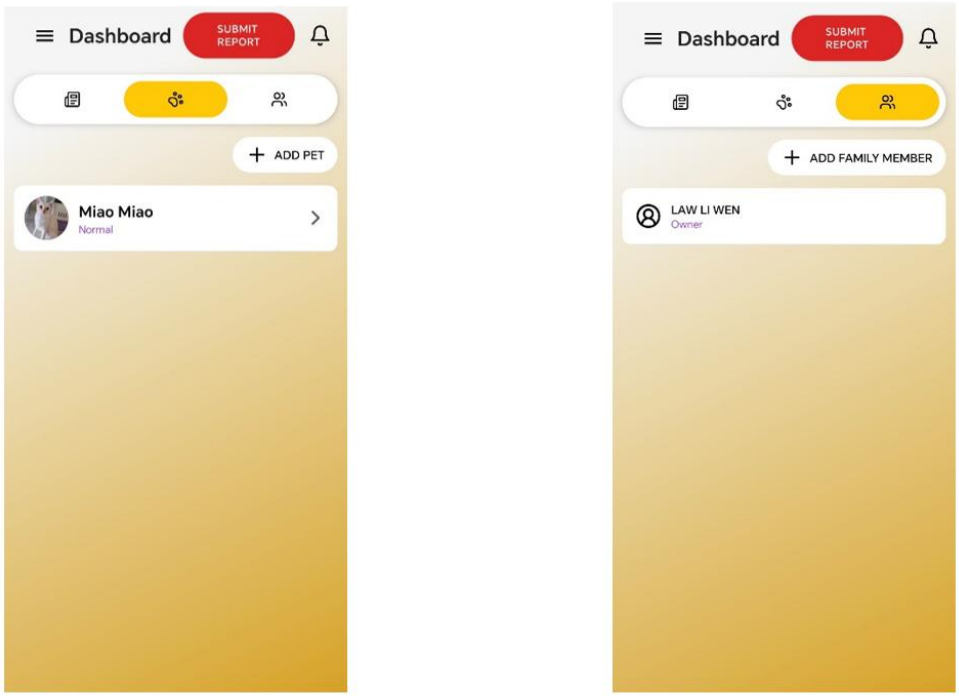


Figure 6: Screenshots of Management of Information Pet and Owner Page

RabiesApp offers essential functionalities for tracking rabies cases and vaccination statuses, ensuring users stay informed about potential public health risks. The app allows users to report sightings of rabid animals and trace their locations, facilitating timely action from authorities. Users can also report stray animals and nuisances by providing relevant information and location details. Additionally, it offers educational resources to guide users on rabies prevention and steps to take when bitten by a potentially infected animal, enhancing public awareness. The system also manages pet and owner information, including vaccination histories, making it easy to track vaccination statuses when needed (RabiesApp, 2024).

With a user-friendly interface focused on public health and safety, RabiesApp ensures that users can quickly access critical information. The integration of real-time updates on rabies hotspots and vaccination data allows users to make informed decisions and take preventive measures. Maps and notifications alert users to nearby risks, especially in high-risk areas.

Additionally, the app offers educational content about pet care, focusing on rabies prevention and vaccination, ensuring users are informed about proper pet care and how to protect themselves from rabies.

RabiesApp plays a crucial role in addressing the public health threat of rabies in Sarawak, particularly in areas with high stray animal populations. By tracking rabies cases and mapping hotspots in real time, the app helps both authorities and the public identify high-risk areas, allowing for targeted preventive measures. This proactive approach aids in controlling outbreaks, while the app's educational resources raise awareness about rabies prevention, safe handling of animals and vaccination importance. The app's functionality is vital in minimizing the spread of rabies, promoting public safety and ensuring quick response actions in critical situations.

However, RabiesApp's specialized focus on rabies-related functionalities limits its scope in addressing broader issues, such as pet adoption or general animal welfare. While it excels in rabies prevention and tracking, it lacks features that support pet adoption or stray animal management beyond rabies. This narrow focus results in a smaller user base, primarily catering to those concerned with rabies and public health rather than the broader pet care community. Consequently, its reach and impact may be more limited compared to more comprehensive pet care platforms that address a wider range of animal welfare concerns.

Overall, RabiesApp is a great example to guide the design of an application focused on public health and animal welfare. Its features like real-time tracking, user reporting and educational resources offer valuable insights for developing an app that addresses specific needs like rabies prevention. Although it has a narrow focus, the app's functionality and ease of use can inspire the creation of a similar platform that promotes safety and awareness.

2.2.3 Petotum

Petotum is a comprehensive app designed to serve pet owners, offering services like pet boarding, grooming and veterinary care. (Chuah, 2022) It is an all-in-one pet care management system that developed by Ptotum Sdn Bhd. The features, usability, strengths and weaknesses of this system will be assessed to highlight potential improvements and establish best practices for developing the stray animal management app.

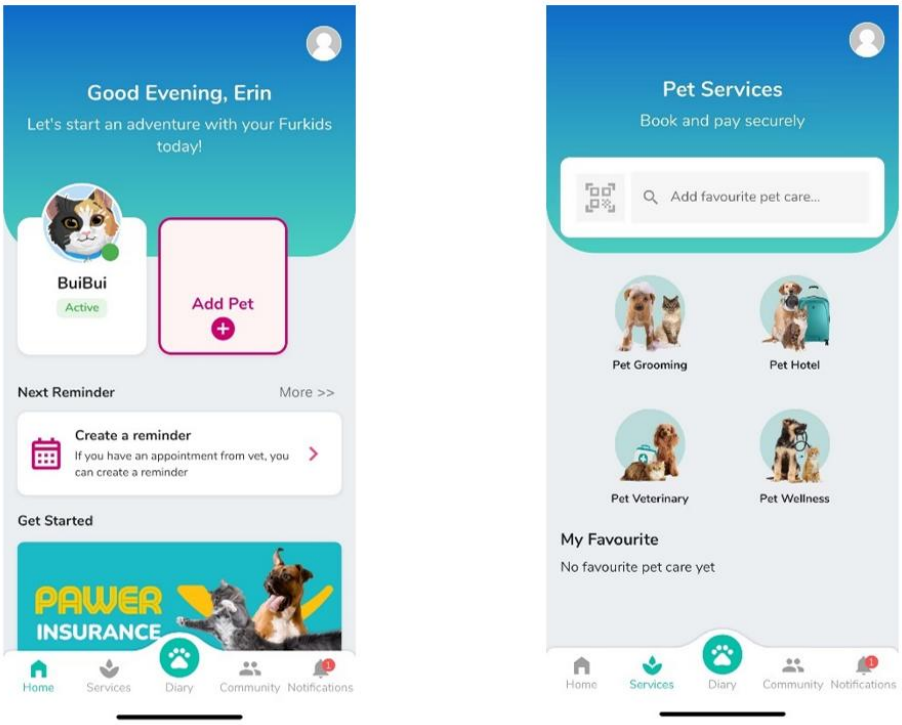


Figure 7: Screenshots of the Homepage and the Offered Services Page

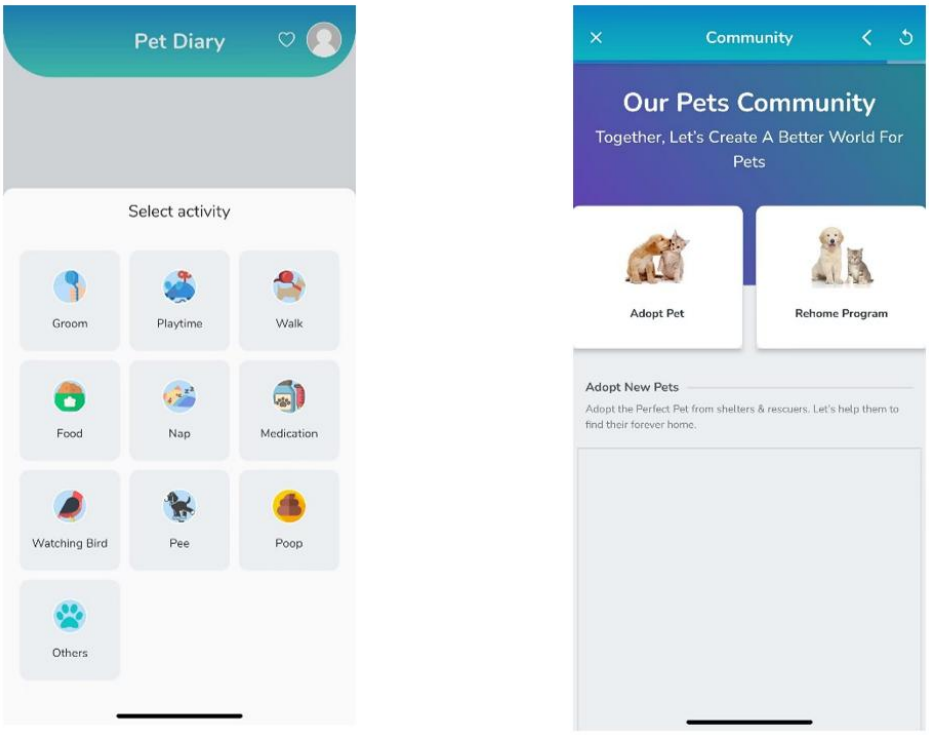


Figure 8: Screenshots of the Pet Diary and Community Page

Petotum offers a variety of services for pet owners, such as pet boarding, grooming and veterinary services, by listing stores that provide these services. The app acts as a marketplace, allowing users to book these services in one place. Additionally, it enables users to maintain a pet diary, recording activities like grooming, playtime and medication, helping to track pet routines. Furthermore, the app also provides community to facilitate pet adoption and rehoming (Tan, 2021).

Petotum mobile app is designed to be straightforward and user-friendly, allowing pet owners to easily manage their pets' health and care needs. The app features a centralized dashboard that makes it easy for users to access and book a wide range of services, such as grooming, veterinary care and pet boarding. The pet diary also enables pet owners to record and manage details such as medications, grooming schedules and playtime, all in one place.

One of the key strengths of Petotum is its versatility, offering a wide array of services for pet owners, including boarding, grooming and veterinary care. This functionality enhances the

convenience of managing a pet's care and documentation. The app also includes a pet diary function, helping owners track activities like grooming, playtime and medication. This organized approach to pet management enhances its usability, ensuring that all relevant services and information are in one place.

However, Petotum's focus is primarily on pet owners, with less emphasis on stray animal management or public health issues like rabies. It offers limited functionalities for pet adoption or fostering compared to platforms like PetFinder.my, which focus more on rehoming animals. As a result, the app's scope is narrower when it comes to addressing broader animal welfare concerns. Additionally, this app is only available on the iOS platform.

Overall, Petotum serves as an excellent example of a pet care app, offering a centralized platform for managing pet health, services and adoption. While the app primarily caters to pet owners, its strengths in service integration and health tracking can provide valuable insights for the development of my own application, especially in terms of streamlining user experience and addressing various pet care needs.

2.3 Comparison of Features among Different Systems

When comparing the features of the PetFinder.my, RabiesApp and Petotum to SafePaws, it is essential to consider the specific needs and requirements. Table 2.1 will compare all three of the existing mobile application system with SafePaws.

Table 1: Comparison of Three Similar Existing Systems with Proposed System

Features	**PetFinder.my**	**RabiesApp**	**Petotum**	**SafePaws**
Report bite case or potential rabies	✗	✓	✗	✓
Upload lost pet post	✓	✗	✗	✓
Publish pet adoption post	✓	✗	✓	✓
Locate animal via map	✓	✓	✗	✓
Provide guidelines about pet care via AI Chatbot	✗	✗	✗	✓
Contact pet owner via in-app chat	✓	✗	✗	✓
Provide veterinary clinics and pet stores information	✓	✗	✓	✓
Favorite a pet post	✓	✗	✗	✓

From the comparison in Table 1, it is clear that while each existing system offers valuable features, none provide a complete solution. PetFinder.my excels in pet adoption and lost pet listings, offering map-based location tracking and access to vet and pet store information. However, it lacks the ability to report health-related incidents such as bite cases or suspected rabid animals, and it does not include AI-based educational support.

RabiesApp focuses primarily on public health by allowing users to report rabies cases and track related risks on a map. Although effective for rabies awareness, it lacks support for pet adoption, lost pet reporting, in-app communication, and veterinary service information, limiting its overall usefulness for broader animal welfare efforts.

Apart from that, Petotum, serves as a pet service marketplace, supporting functions like grooming, boarding, and limited adoption. However, it does not provide tools for managing stray animal incidents or health threats like rabies, nor does it offer map-based location features or AI-driven guidance.

SafePaws, the proposed system, addresses these limitations by integrating all the essential features into a single mobile application:

- Create and browse posts under Find Adoption, Adopted, Lost, and Found categories.
- Report bite cases or suspected rabid animals with images and location tagging.
- Use in-app chat to connect with post owners.
- Access an AI chatbot (powered by Gemini 1.5 Flash API) for general pet care advice.
- View nearby veterinary clinics and pet stores, including address, hours, and distance.
- Favorite pet posts for convenient access.

By offering this comprehensive set of features, SafePaws stands out as a community-centered and health-aware solution that promotes responsible pet ownership, improves response times for animal-related incidents, and fosters engagement between the public and relevant stakeholders.

2.4 Summary

Overall, these applications each serve specific needs within the pet care and animal welfare sectors, but there is a gap in addressing the broader issues of stray animal management, urgent reporting of incidents and integration of public health education. The insights gained from these systems highlight opportunities for improvement and inform the development of the SafePaws application, which aims to address these shortcomings while integrating features for pet adoption, stray animal reporting and rabies awareness.

CHAPTER 3: REQUIREMENT ANALYSIS AND DESIGN

3.1 Introduction

This chapter outlines the approach taken to analyze the requirements for the proposed pet management system and the design of the system to meet those needs. The requirement analysis section includes an overview of the current state of pet management, followed by the proposed solution to address identified challenges. This chapter presents the result of the survey among respondents and can be one of the foundations of system development. After finishing the survey, the prototype of SafePaws will be designed to ensure it is user-friendly. The in-depth analysis and design phase provides a roadmap for developing the SafePaws application.

3.2 Project Development Methodology

The project development methodology is a set of systematic and disciplined ways applied in the software development aspect for planning, execution and management while developing a project. It describes what phases, activities, processes and deliverables are involved in constructing and delivering a product.

3.2.1 Prototype model

The prototype model in software development is an iterative approach used to create prototype of a software product in order to gathering user feedback and continuously refining the system before final production (Sabale, 2012). This model is particularly useful when project requirements are unclear or likely to change, allowing for flexibility and early user involvement. It not only enhances user satisfaction by ensuring that the final product aligns closely with user

needs but also helps identify potential issues early in the development process. Thus, a higher quality software can be produced.

For this project, the prototype model is used to create a prototype of SafePaws from the feedback collected from the users through questionnaire. The prototype includes the core functions of SafePaws, such as displaying pet posts categorized as 'Find Adoption,' 'Lost,' 'Adopted,' and 'Found,' and allowing users to submit reports for bite cases or suspected rabid animals. It also enables users to view information about veterinary clinics and pet stores based on their location or selected areas within Sarawak and provides an AI chatbot to answer pet-related questions. According to the feedback gathered from user, some adjustment will be made to the application.

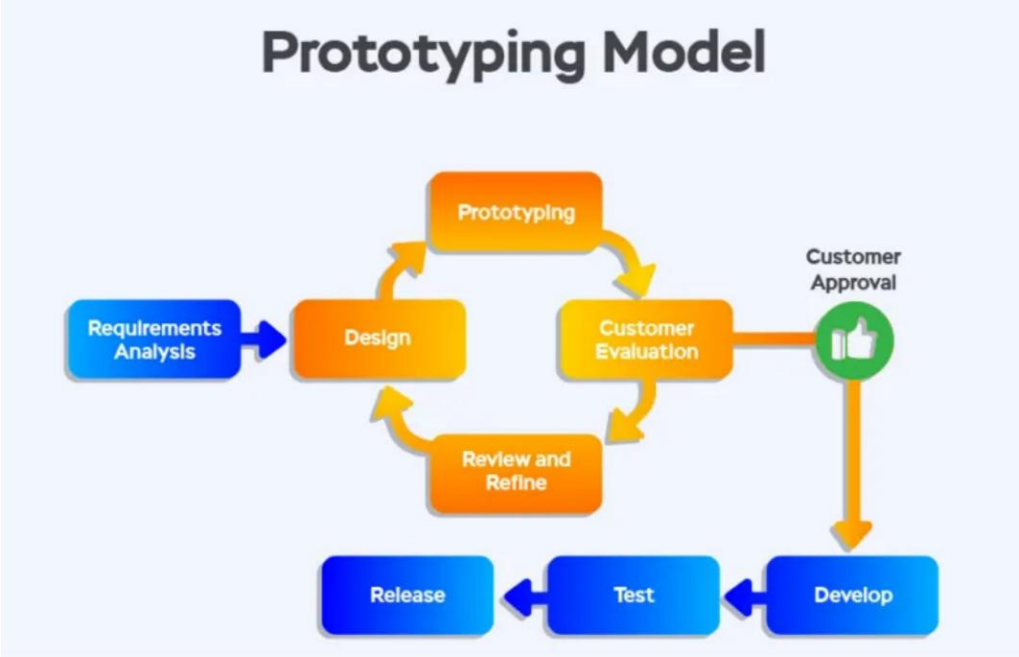


Figure 9:Prototype Model

3.3 Requirement Analysis of the Proposed System

This section presents the requirement analysis for the SafePaws mobile application. It focuses on identifying the functional and non-functional requirements essential for developing the app, analyzing the current challenges faced by pet owners and communities in managing lost, adoptable, and rabid animals, and exploring how the proposed system addresses these issues. Data for the requirement analysis was gathered through surveys and research to ensure the app meets user and societal needs effectively.

3.3.1 Analysis of the Current Situation in Pet and Stray Animal Management

The idea for this project originates from the challenges faced in managing the welfare of stray animals and lost pets in Sarawak, including a lack of awareness and effective channels for reporting and adoption. When people want to share information about adoptable or lost pets, they often rely on social media platforms. However, these posts are often disorganized and lack proper visibility as they are quickly buried by other content. People who interested in adopting pets also have difficulties to find the pets that match their preferences. As a result, the chances of successful adoptions and finding lost pets are significantly reduced. In addition, there are also have limited resources for reporting bite case or suspected rabid animals. When individuals encounter serious bite cases or suspected rabid animals, they often do not know where to seek help. This leads to delays in providing necessary aid which can endanger both public safety and animal welfare.

3.3.2 The Proposed Solution

To address the challenges highlighted in the current situation, this project proposes to develop a mobile application called SafePaws. SafePaws provides a unified platform that brings together essential features to improve the management of pets and stray animals while fostering community engagement.

The app will facilitate pet adoption and lost pet posts within Sarawak. Pet owners can post adoptable pets, and potential adopters can browse these posts based on specific criteria such as pet type, location, and age. Similarly, users can post information about lost pets, and others can view lost pets in their area, helping to reconnect pets with their owners.

Additionally, SafePaws empowers users to report stray animal incidents, such as bite cases or suspected rabid animals, directly to the relevant local authorities through the app. This feature ensures a quick and organized way to report such incidents, which can otherwise lead to delays in providing necessary aid.

The app also provides business information for veterinary clinics and pet stores near the user and within Sarawak. This includes important details such as the address, operating hours, and distance from the user’s current location, helping users easily find the services they need.

Furthermore, SafePaws features an AI Chatbot that helps answer users' questions on various pet-related topics, including emergency procedures**,** training tips**,** feeding guides, and general pet care. This AI-powered support provides users with immediate access to reliable information, fostering better pet care and responsible ownership.

By consolidating these features into a single platform, SafePaws seeks to bridge the gap between the community, animal shelters, and local authorities, ultimately enhancing overall animal welfare and public safety. The design of the app will prioritize user-friendliness with an intuitive,

visually appealing interface, making it easy for users to access key features like reporting incidents, searching for adoptable pets, or posting lost pet information.

In conclusion, SafePaws will be designed for mobile devices, ensuring accessibility and convenience for all users in Sarawak, contributing to more effective and timely responses to pet and stray animal issues. SafePaws aims to address the challenges in pet and stray animal management by providing a comprehensive mobile platform that integrates adoption, incident reporting, pet education, and access to veterinary services, all in one place.

3.3.3 Requirement Elicitation

In this project, questionnaires were carried out to gather system requirements for analysis. This method provides an efficient and effective way to collect the necessary information and conduct data analysis. Mobile device users served as the target respondent. Surveys were distributed to a total of 30 respondents. The questionnaire was thoughtfully designed to ensure it effectively captured the required information, including respondents' awareness of pet and stray animal management, their preferred features and expectations for the app, and overall feedback on this concept.

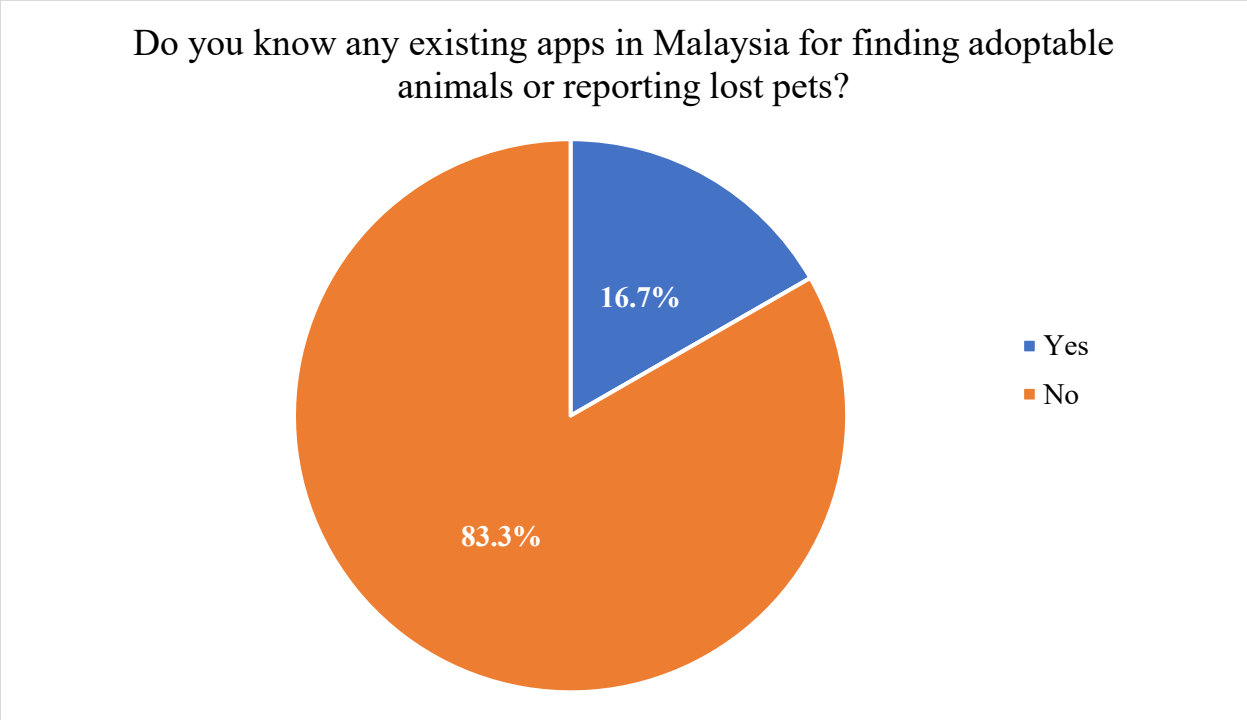


Figure 10: The Questionnaires - Do you know any existing apps in Malaysia for finding adoptable animals or reporting lost pets?

Figure 10 shows that 83.3% (25 out of 30) of the respondents know the apps that can find adoptable animals or reporting lost pets in Malaysia while 16.7% (5 out of 30) of them do not know any app with such function. This indicates that the awareness of such apps is relatively high among respondents but there is still a portion who are not. This requires relevant people to continue to promote such application.

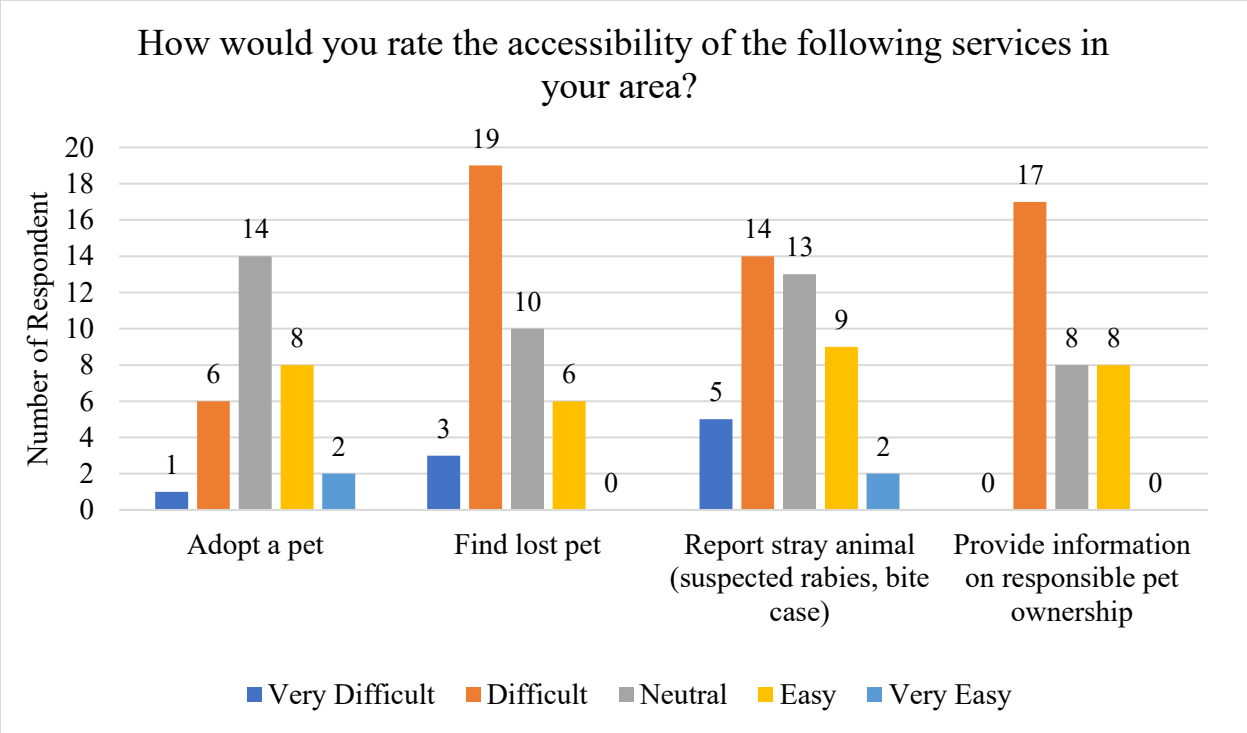


Figure 11: The Questionnaires - How would you rate the accessibility of the following services in your area?

Figure 11 represents the ratings of the accessibility of various animal-related services in respondents' areas. The "Find lost pet" service was predominantly rated as "Very Difficult," with the highest number of respondents rating it as "Difficult," indicating that it is a challenge for people to find lost pets in their areas. Similarly, "Provide information on responsible pet ownership" received a high number of "Easy" ratings, suggesting that it may be easier to access information regarding responsible pet ownership, but there are still areas of improvement. The "Adopt a pet" service had a more balanced distribution, with a notable portion of respondents rating it as "Neutral" or "Easy." This indicates that while pet adoption services are generally accessible, there may still be room for improvement in accessibility for some individuals. The "Report stray animal (suspected rabies, bite case)" service received a significant number of "Difficult" ratings, indicating that many respondents find it challenging to report stray animals or incidents like bites

and rabies cases. Finally, only a small number of respondents found these services "Very Easy" to access, emphasizing that there is still a lot of work to be done in improving the availability and ease of access to these essential services.

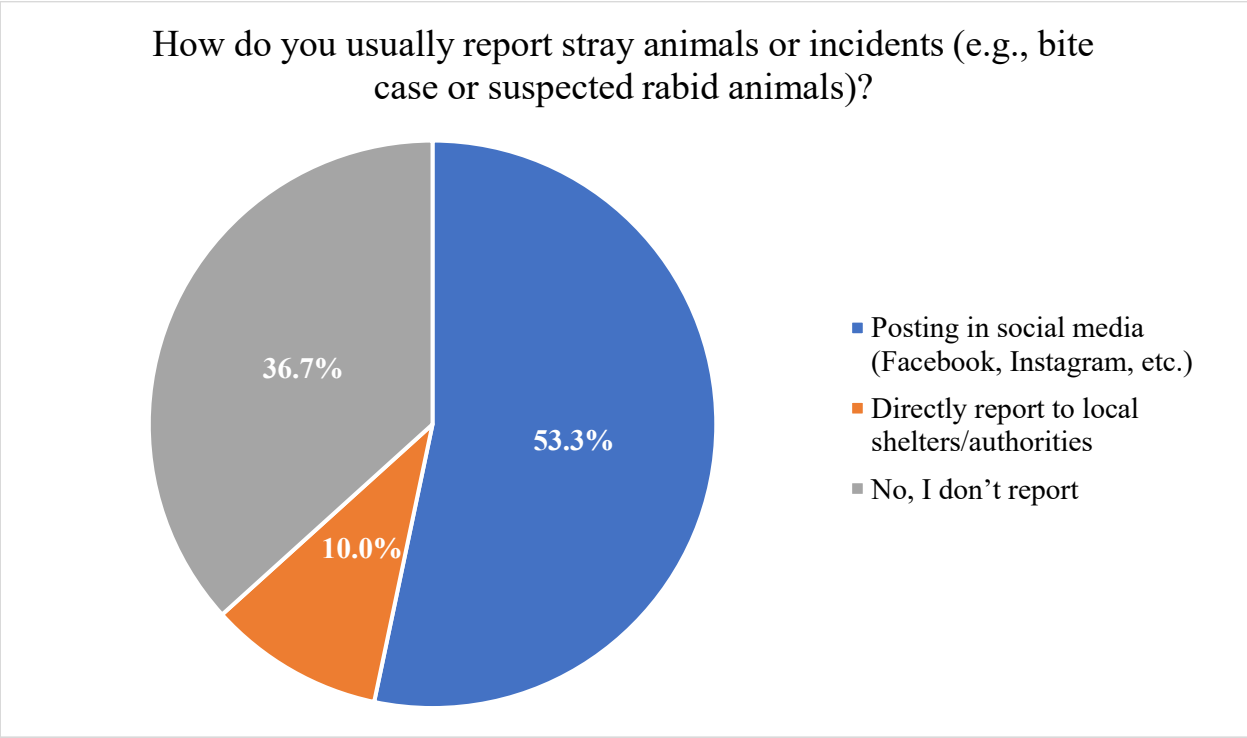


Figure 12: The Questionnaires - How do you usually report stray animals or incidents (e.g., bite case or suspected rabid animals)?

Figure 12 illustrates the various ways used by respondents to report stray animals or incidents (e.g., bite case or suspected rabid animals). The majority of respondents, 53.3% (16 out of 30), use social media platforms like Facebook or Instagram to notify others. A smaller group, 36.7% (11 respondents), reported that they would not report such incidents. Only 10% (3 respondents) would directly report incidents to local shelters or authorities. This data highlights the predominant reliance on social media for reporting, with formal reporting mechanisms being used less frequently.

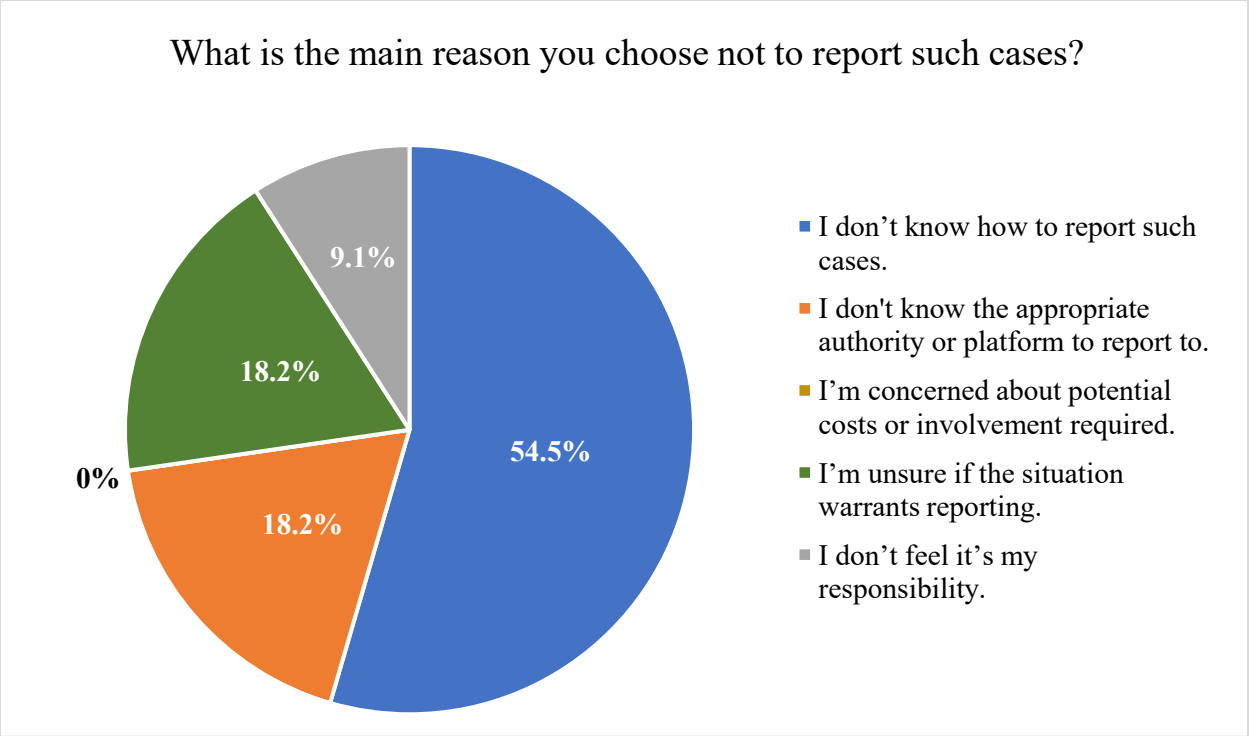


Figure 13: The Questionnaires - What is the main reason you choose not to report such cases?

Figure 13 shows the main reasons why respondents choose not to report stray animals or incidents (e.g., bite case or suspected rabid animals) derived from previous question. The majority, 54.5% (6 out of 11), do not report such cases because they did not know how to report them. This indicates the lack of guidance on the reporting process. There were two main reasons, they did not know the appropriate authority or platform to report to and unsure if the situation warranted reporting, each cited by 18.2% (2 respondents). The second most common reason was that respondents felt it was not their responsibility to report such cases with 9.1% (1 respondent). Concern about potential costs or involvement would not influence the decision not to report for any of the respondents.

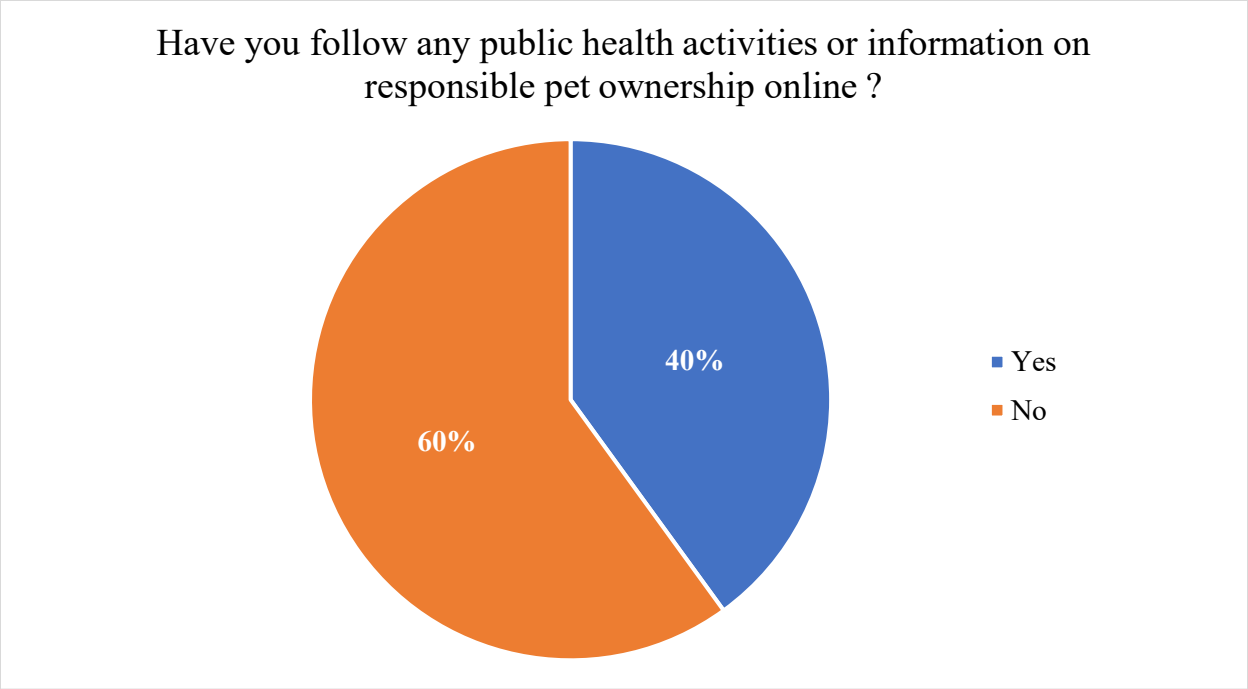


Figure 14: The Questionnaires - What is the main reason you choose not to report such cases?

Figure 14 indicates the visibility of public health activities or information on responsible pet ownership online among respondents. The majority, 60% (18 out of 30), reported that they follow public health activities or information on responsible pet ownership online. However, 40% (12 respondents) do not follow such activities or information online. This suggests that although a significant portion of the respondents are engaged with online resources, a substantial number may not be actively seeking information on these topics.

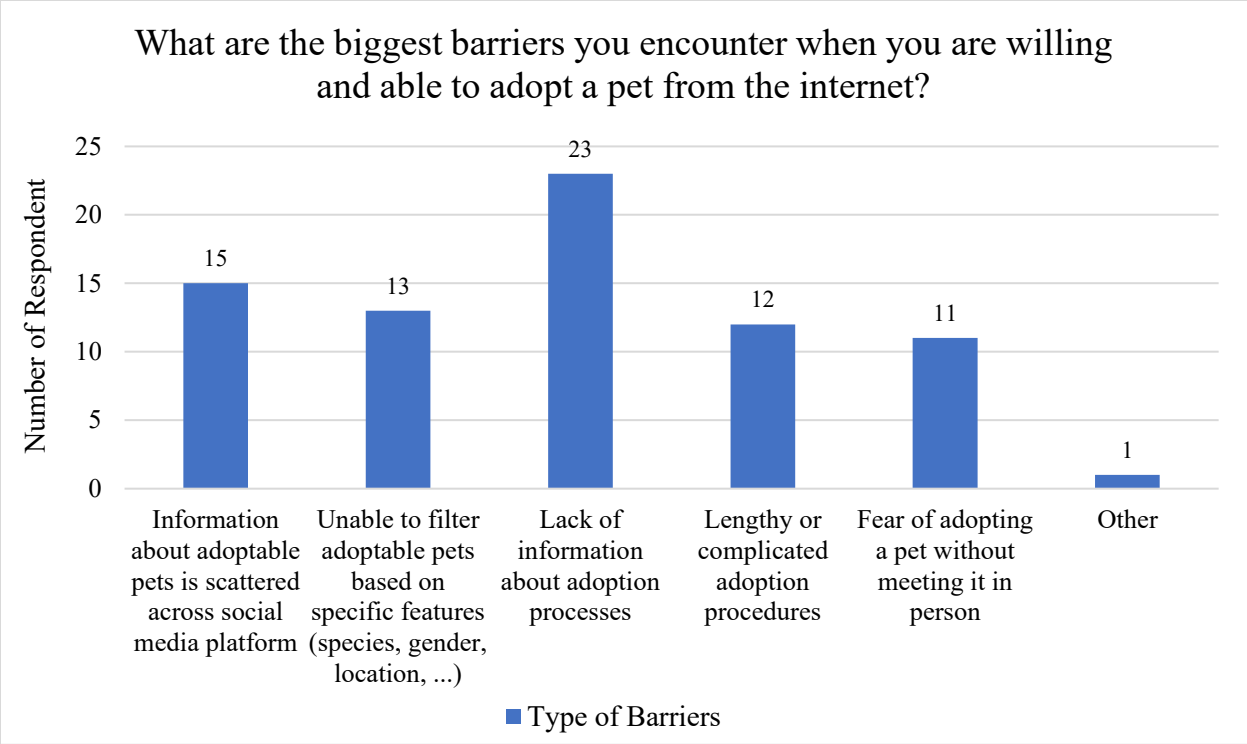


Figure 15: The Questionnaires - What are the biggest barriers you encounter when you are willing and able to adopt a pet from the internet?

Figure 15 illustrates the biggest barriers respondents encounter when they are willing and able to adopt a pet from the internet. The lack of information about the adoption process is the biggest barrier for the majority of respondents, 23 out of 30 (76.7%). This shows that many potential adopters feel overwhelmed by the lack of clear and accessible information regarding the steps involved in adopting a pet online. The second biggest barrier is that information about adoptable pets is scattered across social media platforms, reported by 15 out of 30 respondents (50%). This is followed by the inability to filter adoptable pets based on specific features, lengthy or complicated adoption procedures, and the fear of adopting a pet without meeting it in person, reported by 13 (43.3%), 12 (40%), and 11 (36.7%) respondents respectively. Additionally, one respondent mentioned that the biggest barrier to adopting a pet from the internet was the financial cost involved.

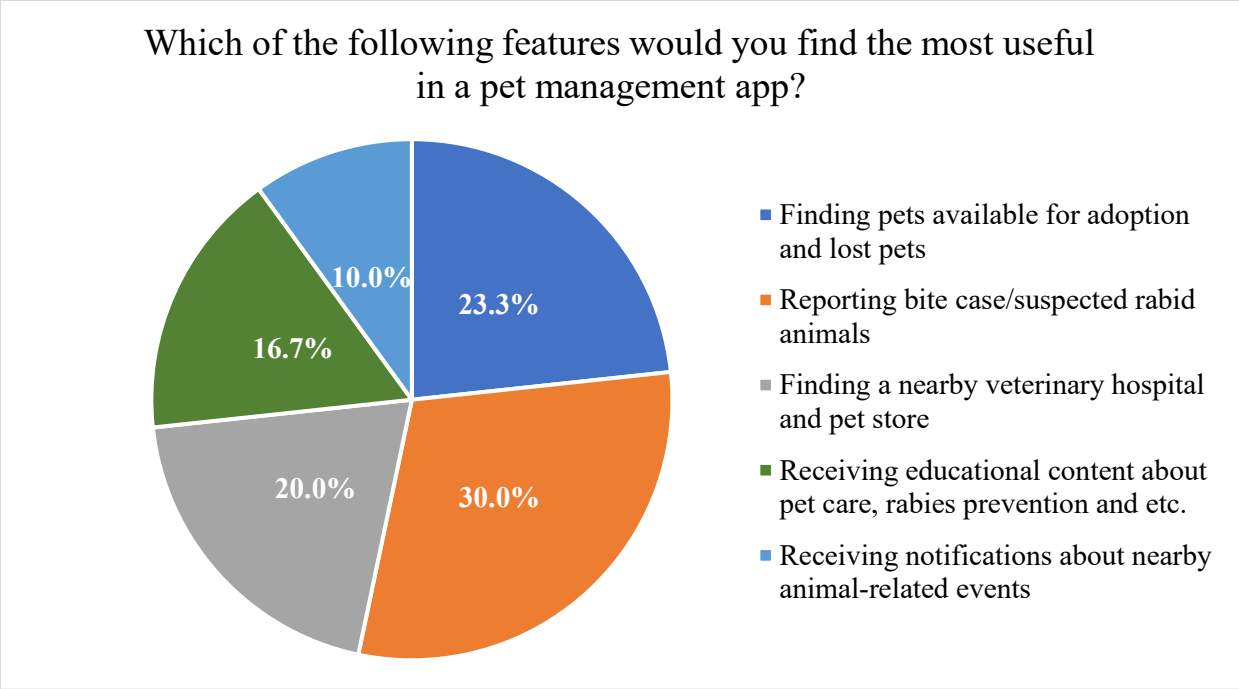


Figure 16: The Questionnaires - Which of the following features would you find the most useful in a pet management app?

Figure 16 represents the proportions of features that respondents find most useful in a pet management app. The most useful feature, reported by the majority of respondents (30%, or 9 out of 30), is the ability to report bite case or suspected rabid animals. The second most popular feature is finding a pet available for adoption and lost pets, with 23.3% (7 out of 30) of respondents choosing this option. The third most useful feature, with 20% (6 respondents), is finding a nearby veterinary hospital and pet store. Receiving educational content about pet care, rabies prevention, and other related topics is the second least popular feature, with 16.7% (5 respondents). Finally, the least useful feature, according to 10% (3 respondents), is receiving notifications about nearby animal-related events.

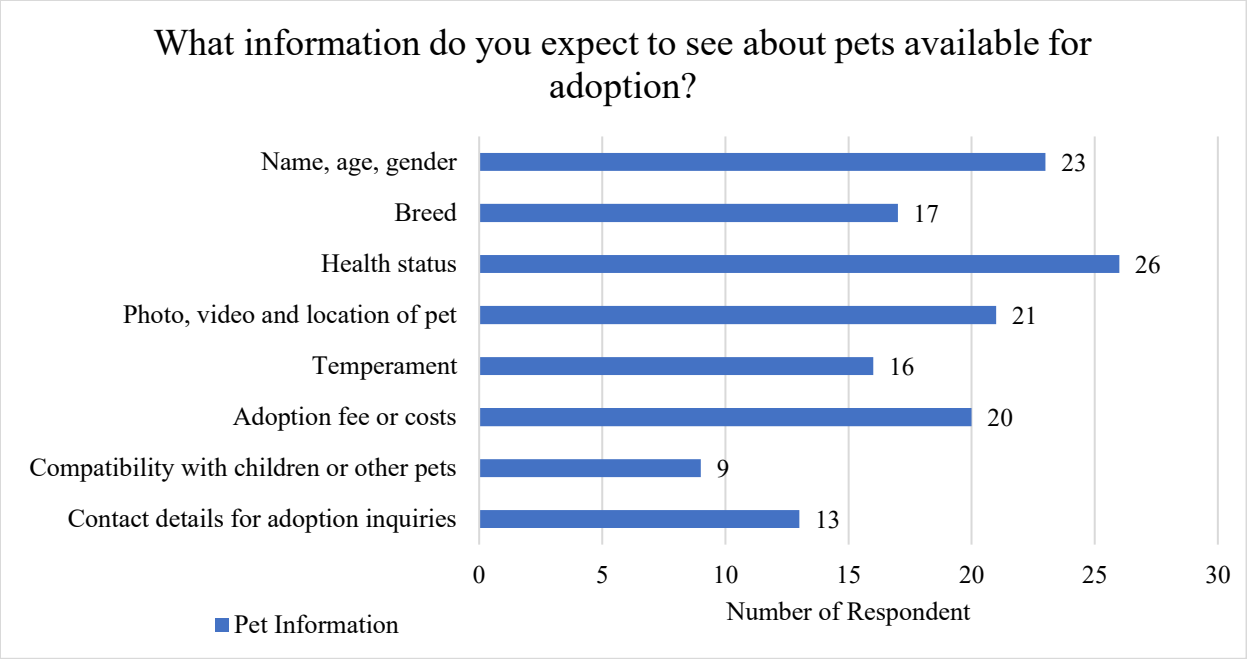


Figure 17: The Questionnaires - What information do you expect to see about pets available for adoption?

Figure 17 shows the information that respondents expect to see about pets available for adoption before they adopt them. The health status of the pet is the biggest concern for the majority of respondents, with 26 out of 30 (86.7%) indicating this as important. This is followed by the name, age, and gender of the pet, with 23 out of 30 respondents (76.6%). Next, photo, video, and location of the pet, as well as the adoption fee or cost, were closely ranked, with 21 (70%) and 20 (66.7%) respondents respectively voting for these features. The breed and temperament of the pet received fewer votes, with 17 (56.7%) and 16 (53.3%) respondents, respectively. The second least expected information is the contact details for adoption inquiries, with 13 (43.3%) respondents choosing this option. The least expected information is the compatibility of the pet with children or other pets, with only 9 respondents (30%) indicating this as an concern.

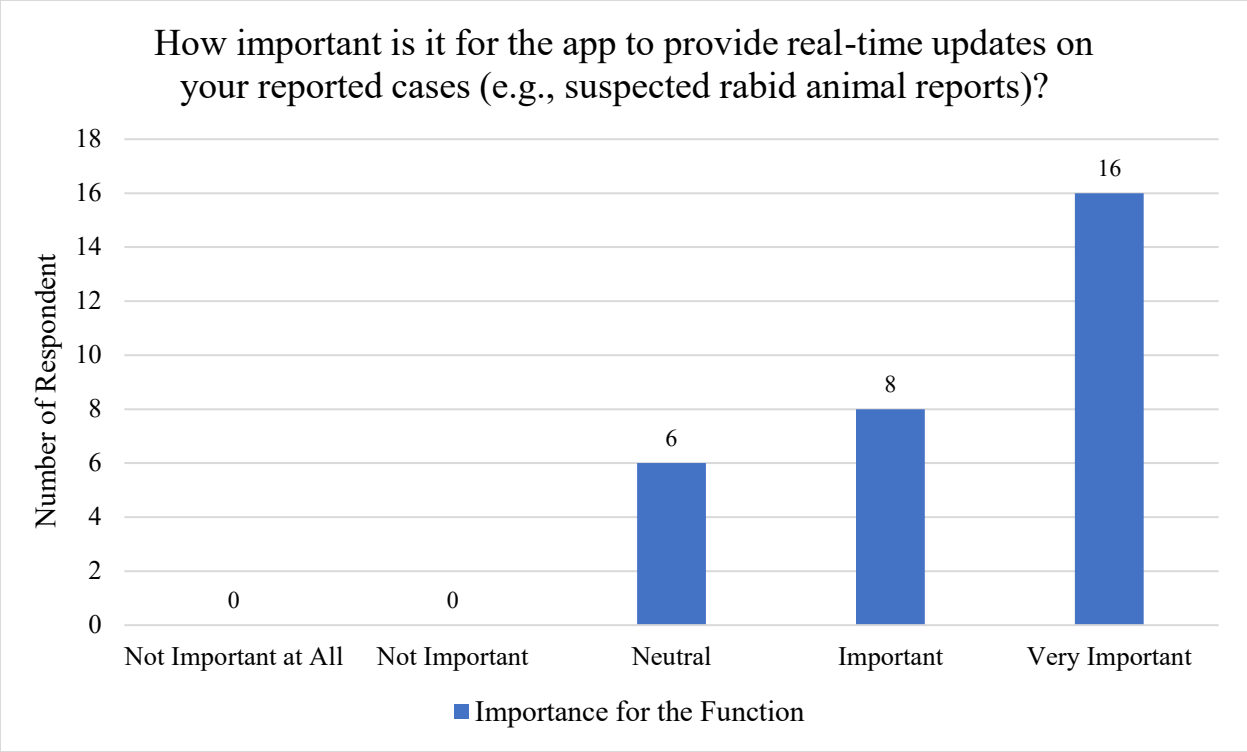


Figure 18: The Questionnaires - How important is it for the app to provide real-time updates on your reported cases (e.g., suspected rabid animal reports)?

Figure 18 indicates the importance of the proposed app providing real-time updates on reported cases. The majority, 16 out of 30 respondents (53.3%), reported that this feature is very important, while 8 respondents (26.7%) considered it important. This is followed by 6 respondents (20%) who had a neutral opinion about this feature. Notably, none of the respondents thought this feature was unimportant or not important at all.

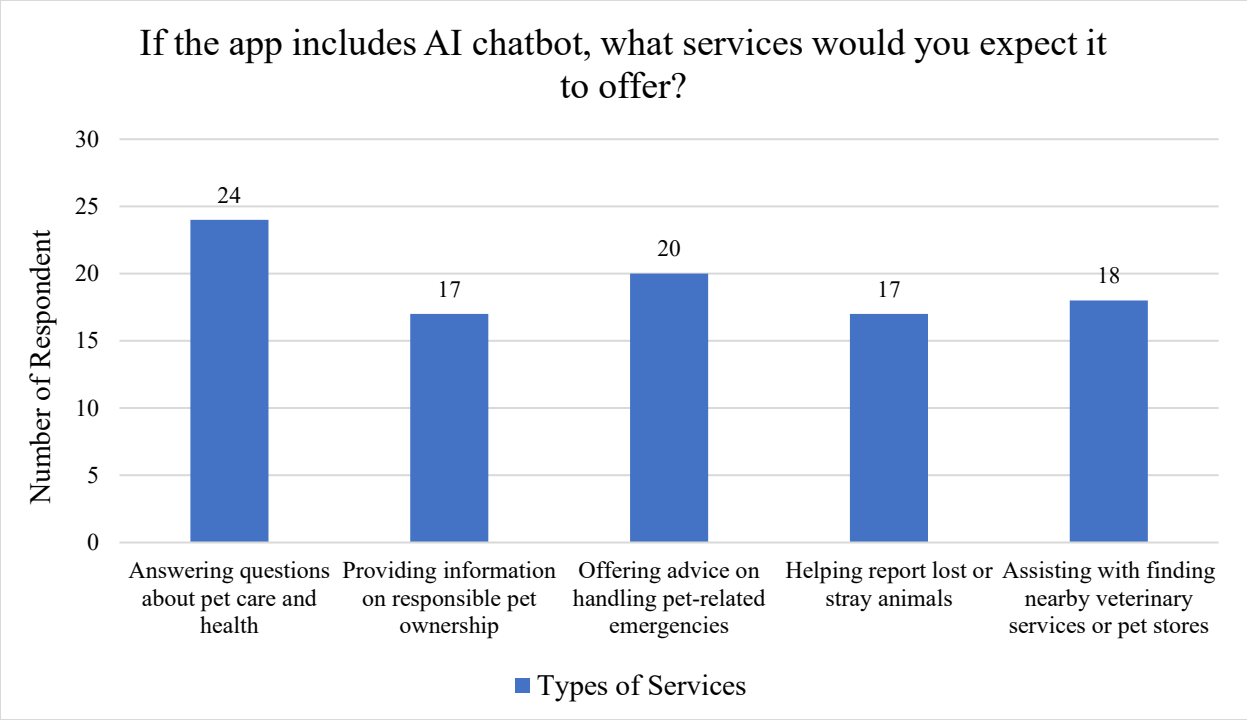


Figure 19: The Questionnaires - If the app includes AI chatbot, what services would you expect it to offer?

Figure 19 shows the various services respondents expect an AI chatbot to offer. Answering questions about pet care and health received the highest number of votes, with 24 out of 30 respondents (80%) selecting this service. The second most popular service is offering advice on handling pet-related emergencies, chosen by 20 respondents (66.7%). The third most preferred service is assisting with finding nearby veterinary services or pet stores, with 18 respondents (60%) selecting this option. The two least selected services, each with 17 respondents (56.7%), are providing information on responsible pet ownership and helping report lost or stray animals.

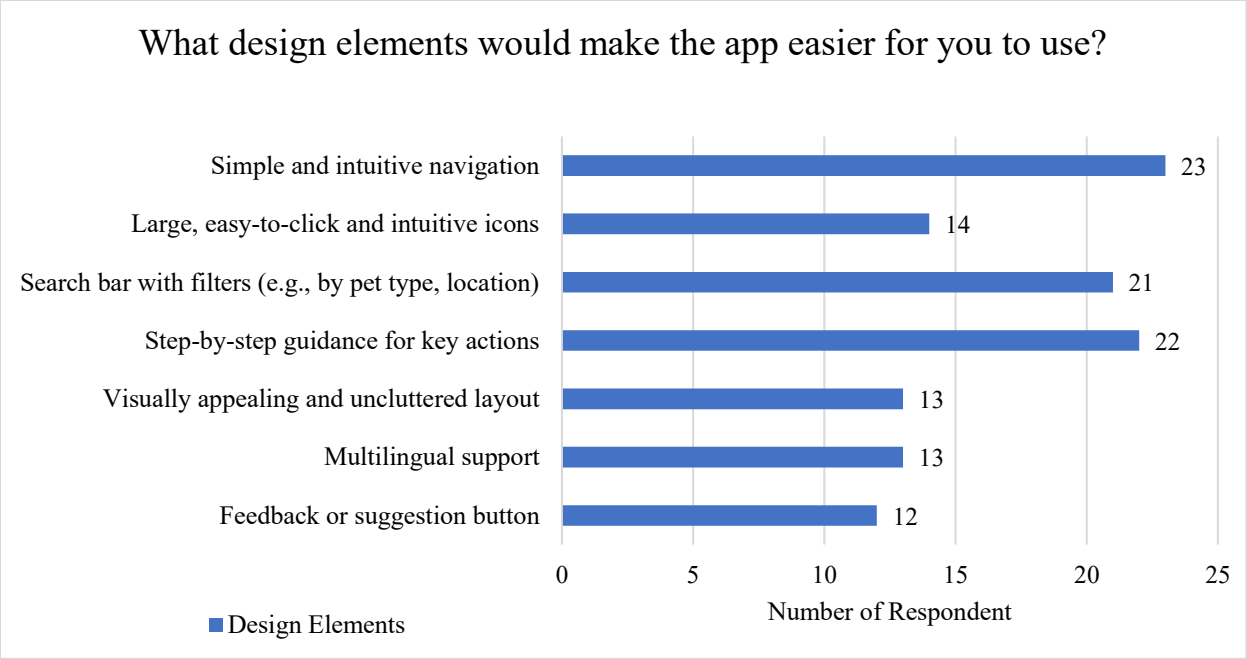


Figure 20: The Questionnaires - What design elements would make the app easier for you to use?

Figure 20 illustrates respondents' opinions about the design elements that make the app easier to use. In ascending order, the top three design elements are simple and intuitive navigation, step-by-step guidance for key actions, and a search bar with filters. These elements were selected by 23 out of 30 respondents (76.7%), 22 respondents (73.3%), and 21 respondents (70%), respectively. The fourth most voted design element is large, easy-to-click, and intuitive icons, chosen by 14 respondents (46.7%). The is followed by two design elements that both voted by 13 respondents (43.3%), which are visually appealing and uncluttered layout and multilingual support. The least voted design element is the feedback or suggestion button with 12 respondents (40%). This means that respondents might feel this feature does not significantly contribute to making the app easier to use.

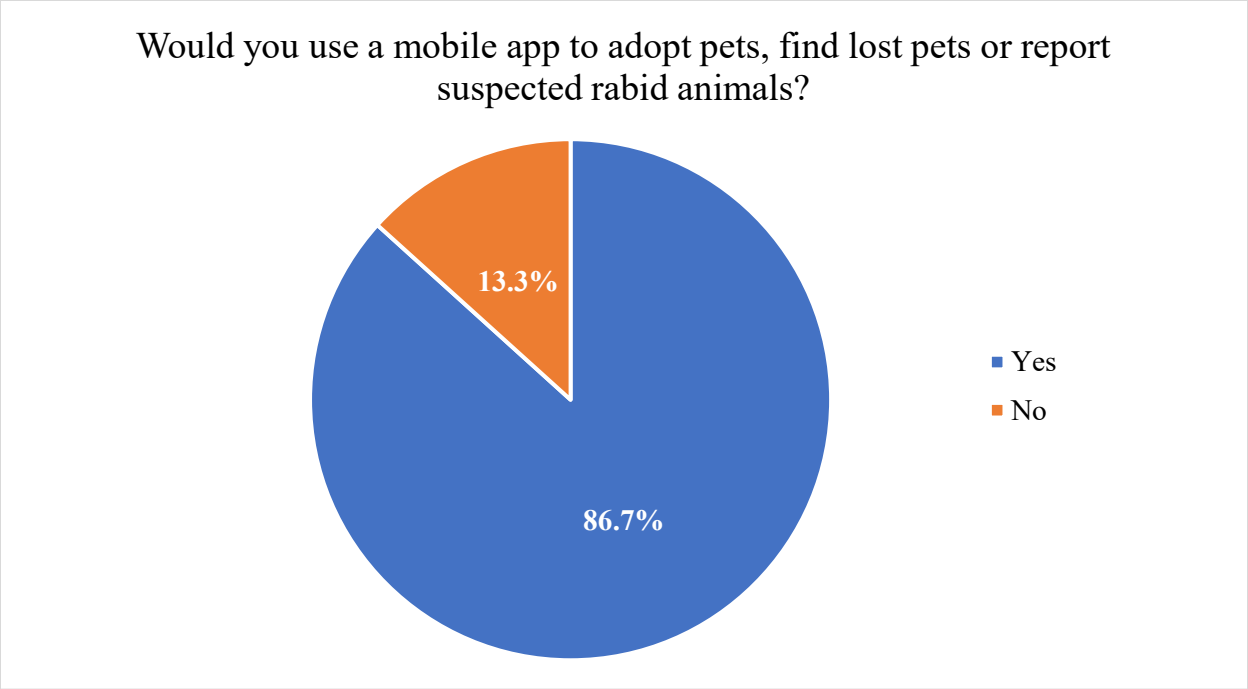


Figure 21: The Questionnaires - Would you use a mobile app to adopt pets, find lost pets or report suspected rabid animals?

Figure 21 shows the willingness of respondents to use a mobile app to adopt pets, find lost pets, or report suspected rabid animals. The majority, 86.7% of the respondents (26 out of 30) expressed their willingness to use a mobile app with such functions by reported “Yes”. However, there were 13.3% (4 respondents) reported “No”. This states that they would not use the app for these purposes.

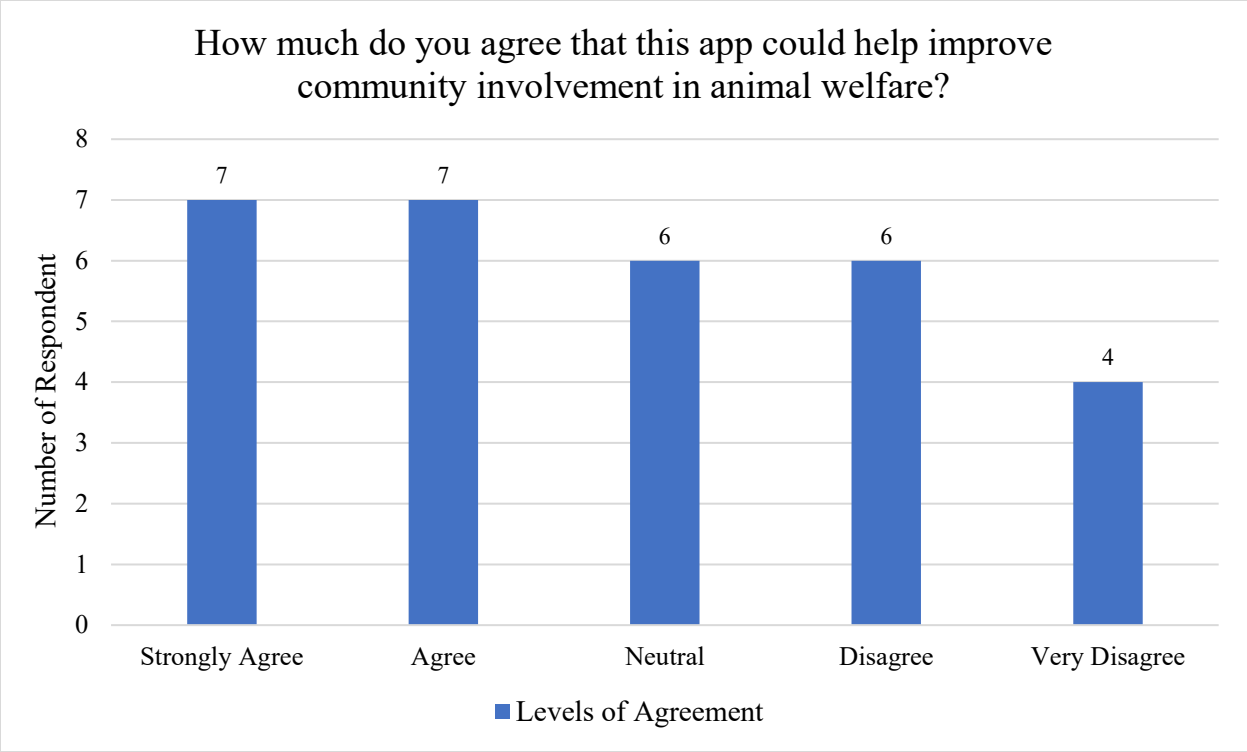


Figure 22: The Questionnaires - How much do you agree that this app could help improve community involvement in animal welfare?

Figure 22 shows the levels of agreement among respondents regarding whether the mobile app can help improve community involvement in animal welfare. The highest number of respondents, 7 out of 30 (23.3%), strongly agreed and agreed that the app would contribute to improving community involvement in animal welfare. Six respondents (20%) had a neutral stance on this statement, indicating mixed opinions. Similarly, 6 respondents (20%) disagreed, thinking that the app would not help improve community involvement. Lastly, the least number of respondents, 4 out of 30 (13.3%), strongly disagreed with the statement.

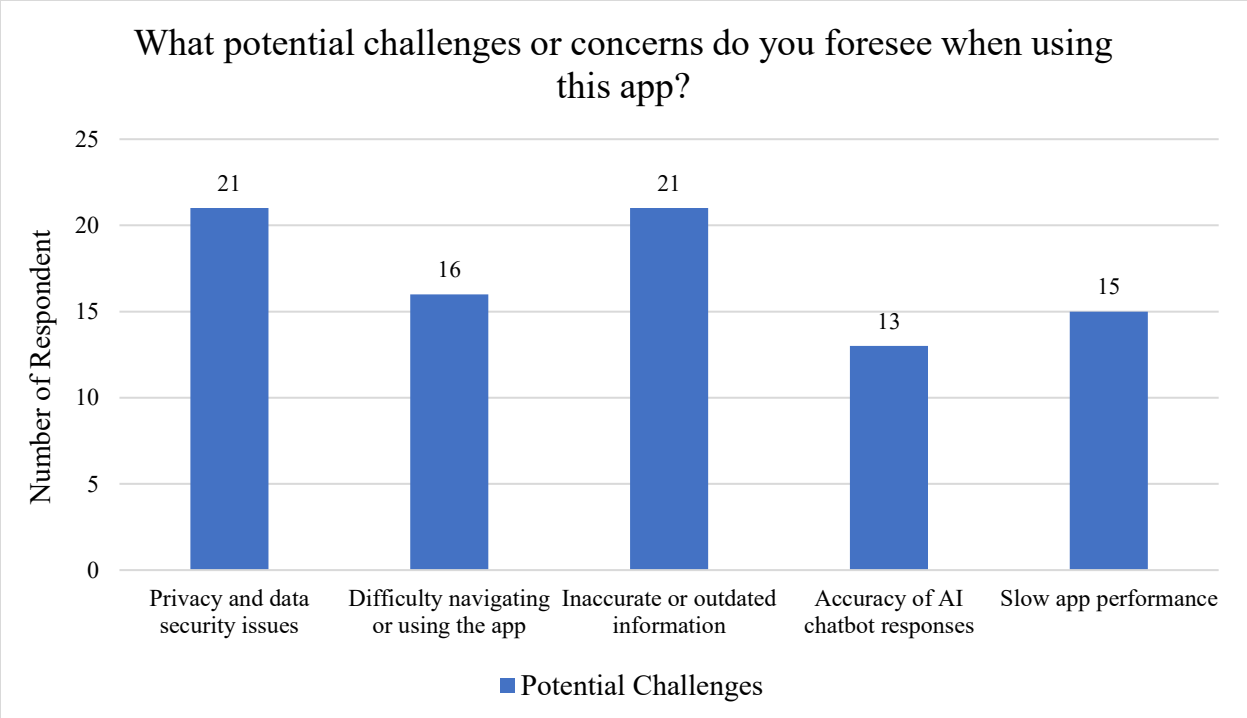


Figure 23: The Questionnaires - What potential challenges or concerns do you foresee when using this app?

Figure 23 indicates the potential challenges or concerns respondents will foresee when using this app. The two highest potential challenges, privacy and data security issues as well as inaccurate or outdated information were both voted by 21 out of 30 respondents (70%). This shows that respondents are particularly concerned about the reliability and safety of the data handled by the app. This means that user-friendliness is a critical factor for success. The third most anticipated challenge is difficulty navigating or using the app, reported by 16 respondents (53.3%). Slow app performance is the fourth potential challenge foreseen by 15 respondents (50%), reflecting concerns about the responsiveness and efficiency of the app. Lastly, the accuracy of AI chatbot responses was considered the least of a concern, with only 13 respondents (43.3%) selecting this issue. This suggests that, although it is a concern for some respondents, most of them may feel that the app's functionality and user experience take precedence over the chatbot's accuracy.

3.4 Functional Requirements

To ensure the performance and efficiency of the SafePaws app, the following functional requirements have been listed based on the MoSCoW method. This method categorizes the requirements into Must Have, Should Have, Could Have, and Will Not Have. The app will be designed for one type of user which also refers to pet owners, animal reporters and adopters.

For users:

Table 2: Functional Requirements for Users

Requirement	Priority
Able to create account and log in the app	Must Have
Able to browse all pet posts with statuses such as “Find Adoption”, “Lost”, “Adopted” and “Found” and filter the posts based on specific criteria	Must Have
Able to submit reports for bite cases or suspected rabid animals	Must Have
Able to view business information of veterinary clinics and pet stores near their location and selected areas within Sarawak.	Must Have
Able to query the AI chatbot about emergency procedures, feeding, training, pet care, and other pet-related topics	Must Have
Able to view, edit and delete their own pet posts	Must Have
Able to view their own submitted reports	Should Have
Able to contact post owners via external communication apps such as call, SMS, or WhatsApp, or through the in-app chat feature	Should Have
Able to view their favorite pets	Should Have
Able to update their own profile information	Should Have

Able to receive alerts about nearby lost pets	Could Have
Able to provide multilingual support for diverse community members	Could Have
The app will not allow the purchase of pets from breeders or commercial sources.	Will Not Have
The app will not include detailed tracking for pets' health records.	Will Not Have

3.5 Non-functional Requirements

Table 3: Non-functional Requirements of SafePaws

Non-functional Requirement	Description
High Availability	SafePaws must be available 24/7 with minimal downtime with maximum 3-4 downtime per week.
Scalability	The system must support at least 20 concurrent users without significant performance degradation.
Responsiveness	The app must respond to user actions (e.g., navigating between screens, submitting a report, opening a post) within 3 seconds in 95% of use cases.
High Security	The sensitive data is encrypted and password is stored securely (Firebase default practices)
User-friendly Interface	The application must pass usability testing with a minimum 85% success rate, where users can complete core tasks like post creation, report submission without external assistance.
Compliance	The system ensures that user consent is obtained before storing any data and adheres to Firebase's privacy guidelines
Testing and Validation	The system must achieve a minimum 90% pass rate on all functional and non-functional test cases before deployment, with no critical or high-severity defects remaining unresolved.

3.6 System Design

System Design is a process of specifying architecture, components, modules and interfaces for the system. This focuses on the functionality of the system to meet users' needs with efficiency, scalability and maintainability. The system design fills in the gap between system requirements and the actual implementation during software development. The system design of this project includes use case diagram to shows the functional requirements of the system, activity diagram to models the workflow of activities within a process, and sequence diagram to represent the sequential interaction between objects over time are used.

3.6.1 Use Case Diagram

A use case diagram in Unified Modeling Language (UML) illustrates the interactions between actors and a system for functionality of the system. It utilizes use cases and the relationships between the actors and system to help stakeholders, developers, and designers understand what the system does, who interacts with it, and the scope of its features. Use case diagram is useful for identifying system requirements and ensuring that the system meets user needs.

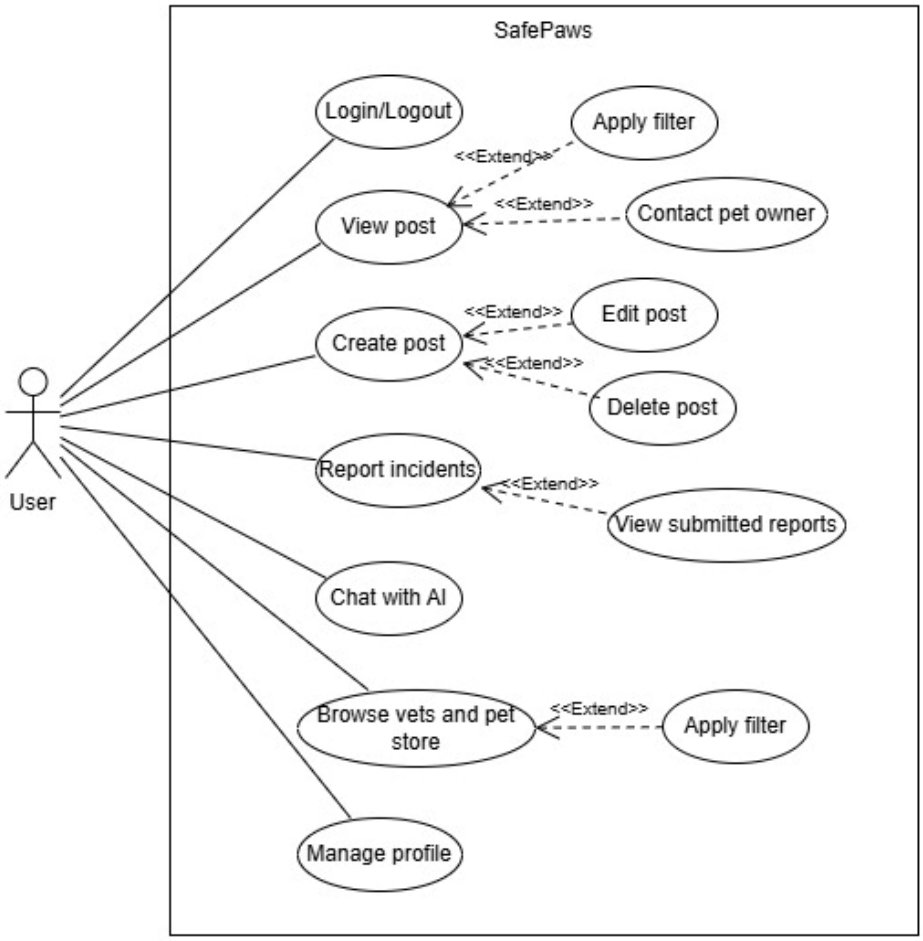


Figure 24： Use Case Diagram

Figure 24 illustrates the use case diagram that representing the interaction between SafePaws system and its users. Users can view posts about adoptable, lost, found and adopted pets. They can also apply filters to refine their search based on preferences such as pet type, status, location, age range and pet name. After viewing a pet post details, users have the option to contact the pet owner directly through the external communication apps like call, SMS, WhatsApp or via in-app chat. Additionally, users can create, edit and delete their posts as needed.

The system also allows users to report incidents such as bite case or suspected rebid animals. Users can view all the reports submitted by themselves in profile page. Another key feature is the

AI chatbot, PetMentor, which provides educational content like guidance on the pet-related topics like emergency procedures, training tips, feeding guide, pet care and so on. It will ask user to ask questions that is related to pet when user ask not pet-related question. Furthermore, nearby veterinary clinics and pet stores is set as default to allow user view. They can also filter the veterinary clinics and pet stores based on areas within Sarawak. Lastly, users can manage their profiles by viewing and updating their personal information.

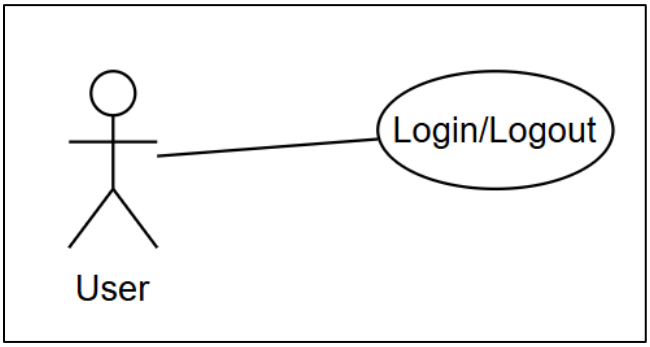


Figure 25: Use Case of User's Login/Logout

Table 4: Use Case Specifications of Login/Logout

Use Case: Login/Logout	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: N/A	
Precondition: The user must have an existing account to log in or can create a new one.	
Brief Description: User wants to login or logout from their account.	
Flow of Events: 1. The user opens the application. 2. The system displays the login page. 3. The user enters their email and password.	

4. The system validates the credentials.

5. If valid, the user is logged in, and the system redirects them to the home page.

6. The user can choose to log out by clicking the "Logout" button from the profile page.

7. The system logs the user out and redirects them to the login page.

Alternative Flow:

i. Forgot Password

- If the user forgets their password, they click the "Forgot your password?" link on the login page.
- The user resets the password and logs in.

ii. Invalid Credentials

- User unable to login if the user has not registered before.
- The user needs to register an account.

Postconditions:

i. For Login: The user is successfully logged into their account.

ii. For Logout: The user is successfully logged out from their account.

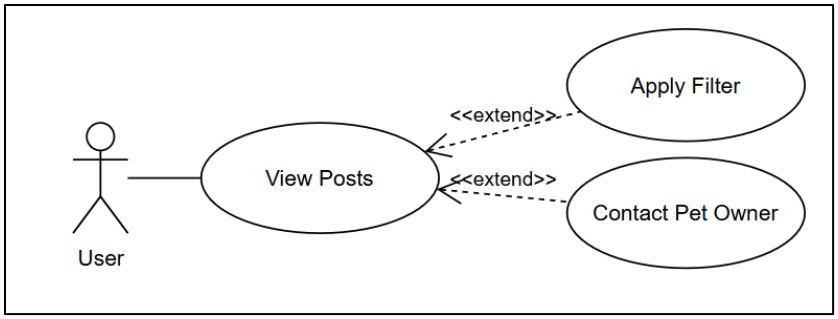


Figure 26: Use Case of View Post

Table 5: Use Case Specifications of Post Browsing

Use Case: View Posts	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: Apply Filter, Contact Pet Owner	
Preconditions: i. The user must be logged into the app. ii. There must be at least one post available in the database.	
Brief Description: Users can view posts for adoptable or lost pets, apply filters based on preferences and proceed to contact the pet owner if they are interested in a specific pet. User can also see all their own posts in the profile page.	
Flow of Events: 1. The system displays a list of posts for adoptable or lost pets. 2. The user views all the posts based on adoptable and lost pets. 3. The user selects one of interest. 4. The system displays the details of the selected post.	
Alternative Flow: **[A1] No posts available:**	

1. If there are no posts available, the system displays a message: "No pets currently listed. Please check back later."

[A2] User applies filters:

1. The user clicks magnifying icon to apply filter.
2. The system prompts the user to select filter criteria such as pet type, age and location.
3. After applying filters, the system displays the relevant posts.

[A3] User contacts owner:

1. The user selects a post and navigates to the pet's detail page.
2. The user chooses the "Contact Owner" option.
3. The system initiates communication between the user and the pet owner.
4. The user can see the chat inbox history with other users in “Chat Inbox” in profile page.

[A4] User view all their own posts:

1. The user goes to “My Posts” in profile page.
2. The user clicks into the post to see the details.

Postconditions:

i. The user successfully views posts for adoptable or lost pets.

ii. The system records the communication attempt when user contacts a pet owner.

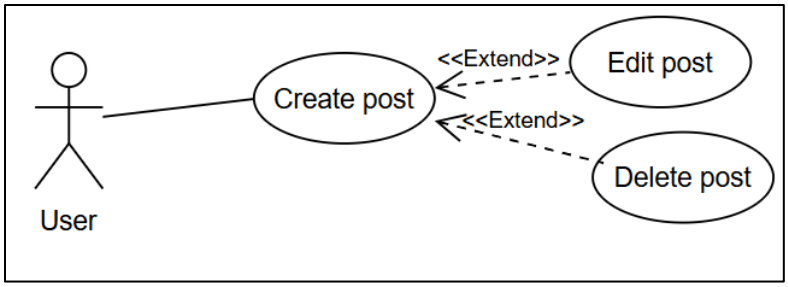


Figure 27: Use Case of Create Post

Table 6: Use Case Specifications of Post Management

Use Case: Create Post	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: Edit Post, Delete Post	
Preconditions: i. The user must be logged into the app.	
Brief Description: Users can create a post to facilitate pet adoption or report a lost pet. After the post is created, users can also choose to edit or delete it.	
Flow of Events: 1. The system displays a form of post. 2. The user fills the information required to create a post such as the pet's name, age, breed, type of post and upload image. 3. The user reviews the post and submits it. 4. The system validates the submission to ensure mandatory fields are filled and content complies with guidelines. 5. The system confirms the successful creation of the post and makes it visible to other users.	
Alternative Flow:	

[A1] Missing mandatory information:

1. If the user fails to complete all mandatory fields, the system displays an error message: "Please fill in all required fields."
2. The user completes the missing information and resubmits the post.

[A2] User cancels post creation:

1. The user opts to cancel the post creation process.
2. The system discards any entered data and returns the user to the previous page.

[A3] User Edits an Existing Post

1. The system displays the selected post data in an editable form.
2. The user updates the desired fields and submits the changes.
3. The system saves the updates after validation.

[A4] User Deletes a Post

1. The user selects a post to delete.
2. The system prompts for confirmation message.
3. The user confirms the deletion.
4. The system deletes the post and removes it from public view and database.
5. A success message is shown to the user.

Postconditions:

i. The system successfully saves and publishes the post based on the chosen post type.

ii. The post is now visible to other users in the appropriate section of the app.

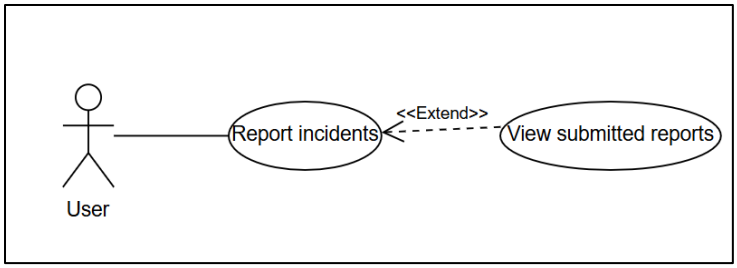


Figure 28: Use Case of Report Incidents

Table 7: Use Case Specifications of Incident Reporting

Use Case: Report Incidents	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: View Submitted Reports	
Preconditions: i. The user must have an account in this app.	
Brief Description: Users can submit the report for suspected rabid animals or bite cases. They can view the list of submitted reports in the app.	
Flow of Events: 1. The system displays a form for reporting incidents. 2. The user selects the type of incident and fills in the details such phone number, location and photo evidence. 3. The user submits the incident report. 4. The system validates the data and sends confirmation message. 5. The user approves the confirmation. 6. The system forwards the report to the relevant authority for action.	
Alternative Flow: [A1] User does not complete the report:	

1. If the user exits the form without submitting, the system displays a confirmation prompt:
    - "Do you want to save this report as a draft?"
2. If the user selects "Yes," the report is saved for later completion.
3. If the user selects "No," the system discards the report.

[A2] Location services unavailable:

1. If GPS is not enabled or unavailable, the system prompts the user to manually enter the location of the incident.

[A3] Media upload fails:

i. If the user attempts to upload a photo or video but fails, the system notifies the user and allows submission without media.

Postconditions:

i. The incident report is logged in the system.

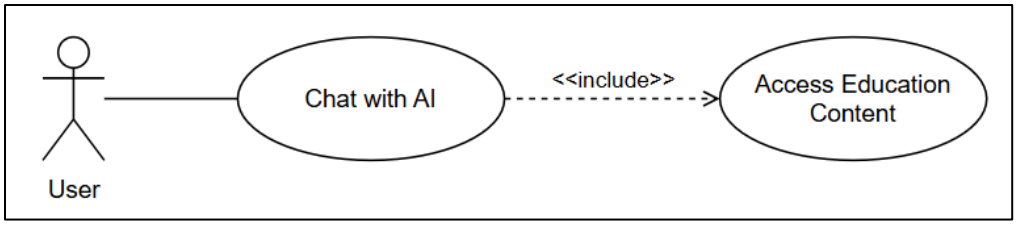


Figure 29: Use Case of Chat with AI

Table 8: Use Case Specifications of AI Chatbot

Use Case: Chat with AI	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: Access Education Content	
Preconditions: i. The AI chatbot must be active and available for interaction.	
Brief Description: User interacts with an AI chatbot to seek information and educational content related to pets, such as emergency procedures, training tips, feeding guidance, pet care and so on.	
Flow of Events: i. The user navigates to the "PetMentor" section of the app. ii. The system loads the AI chatbot interface. iii. The user inputs a question related to pets. iv. The AI processes the query and extracts relevant information from its knowledge base. v. The system displays the answer to the user. vi. The user can choose to ask follow-up questions or end the chat.	
Alternative Flow: A1: Users ask question that not related to pets 1. Prompt user to ask question that replated to pets only	

Postconditions:
i. The user receives information or resources related to their query.

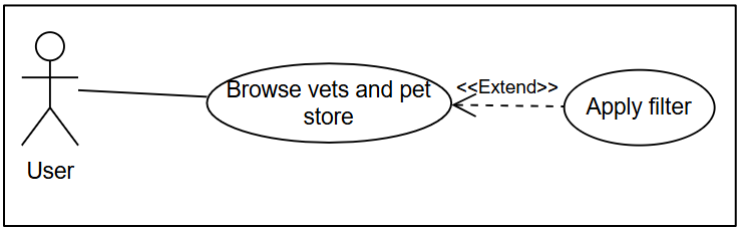


Figure 30: Use Case of Browse Vets and Pet Store

Table 9: Use Case Specifications of Vet and Pet Store

Use Case: Browse Vets and Pet Stores	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: Apply Filter	
Preconditions: i. The system must have internet access. ii. The Places API and Geocoding API for retrieving veterinary clinics and pet store data must be available and functioning. iii. The user must grant location access or select a specific location manually.	
Brief Description: Users can view a list of vets and pet stores based on their location and access their details, such as address, contact information, and operating hours.	
Flow of Events: 1. The system prompts the user to allow location access or select a location manually. 2. The system retrieves and displays a list of nearby veterinary clinics and pet stores based on the user location. 3. The user selects a specific vet or pet store from the list.	

4. The system displays detailed information about the selected vet or pet store.
Alternative Flow: [A1] No vets or pet stores found: 1. If no vets or pet stores are found in the specified location, the system displays a message: "No results found in this area. Please try a different location." [A2] Apply filter: 1. Filter the veterinary clinics and pet stores based on the areas within Sarawak
Postconditions: i. The user successfully browses a list of veterinary clinics and pet stores.

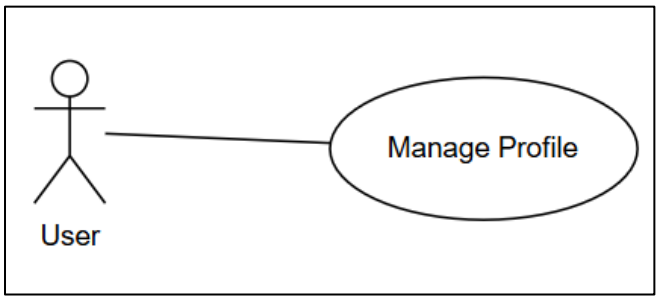


Figure 31: Use Case of Manage Profile

Table 10: Use Case Specifications of User Profile

Use Case: Manage Profile	**Primary Actor:** User
Include Use Case: N/A	
Exclude Use Case: N/A	
Preconditions: i. The user must be logged into the app.	
Brief Description: User can view and update their personal information, such as name, email, phone number, and other relevant details.	

Flow of Events:

1. The user navigates to the profile page of the app.
2. The system displays the user's current profile information.
3. The user views the profile.
4. The user edits specific fields if they wanted.
5. The user saves the changes.
6. The system validates the updated information and saves it to the database.
7. The system displays a successfully message: "Profile updated successfully."

Alternative Flow:

[A1] Invalid information entered during editing:

1. The system detects invalid information (e.g., invalid email format).
2. The system displays an error message such as: "Please enter a valid email address."
3. The user corrects the information and saves the changes.

[A2] User cancels changes:

1. The user chooses to cancel the editing process before saving.
2. The system discards any unsaved changes and reverts to the original profile information.

Postconditions:

i. The user's profile information is successfully updated in the system.

ii. The system displays the updated profile to the user.

3.6.2 Activity Diagram

An activity diagram is used to model the workflow of activities in a system or process. It helps all stakeholders have a clear understanding of system workflow by visualizing the flow of control and the decision points in a process. This diagram provides a high-level overview of both sequential and parallel processes so that it is easier to identify potential inefficiencies or areas for improvement.

3.6.2.1 Login Module

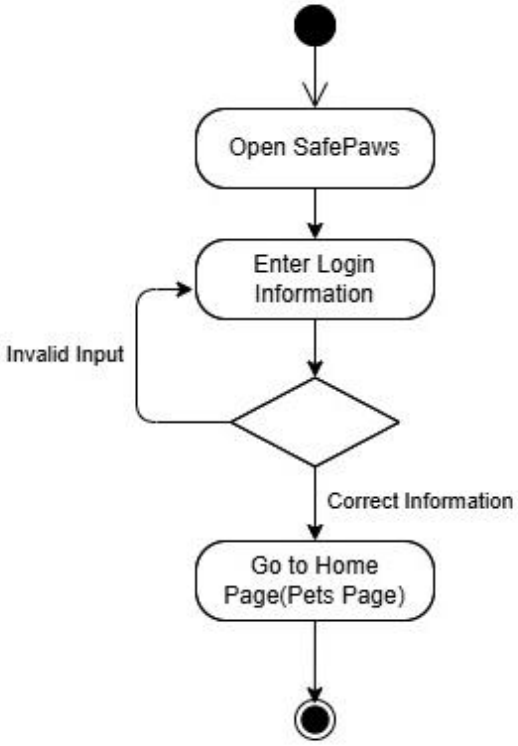


Figure 32: Activity Diagram for Login Module

Figure 32 is the activity diagram of the login process in SafePaws app begins when the user opens the application. Upon opening, the user is prompted to enter their login information, which includes their email address and password. The system then checks whether the entered details are

correct. If the information is invalid, the system requests the user to try again by re-entering the correct login credentials. This loop continues until valid information is provided. Once the system verifies that the details are correct, the user is granted access to the home page, specifically the Pets Page, where they can interact with features like pet adoption, lost pet reports, and other related services. The login process concludes when the user successfully accesses the home page, allowing them to proceed with the app's core functionalities.

3.6.2.2 Post Browsing Module

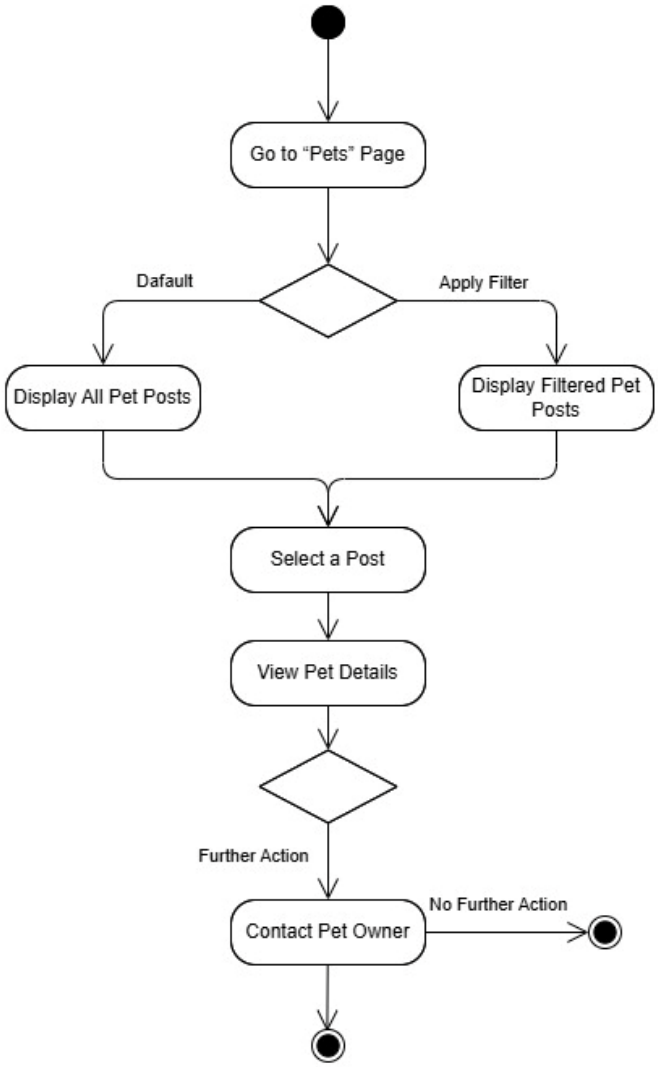


Figure 33: Activity Diagram for Post Browsing Module

Figure 33 shows the activity flow for the post browsing module within the SafePaws app. The process begins when the user navigates to the "Pets" page, which displays all pet posts, including statuses like find adoption, lost, found and adopted. Upon entering this page, the user is presented with two options: either to view all pet posts by default or to apply filters to narrow down the search results based on specific criteria such as pet type, status, location or age range. If

the user chooses to apply a filter, only the pet posts that match the filter criteria will be displayed. Otherwise, all available posts are shown by default. After the posts are displayed, the user can select a specific post to view more details about the pet. Once the pet details are opened, the system provides the user with an option for further action, such as contacting the pet owner. If no further action is required, the process ends. However, if the user decides to contact the pet owner, they are guided to the external communication channels like call, SMS, WhatsApp or in-app chat, completing the browsing and interaction process.

3.6.2.3 Post Management Module

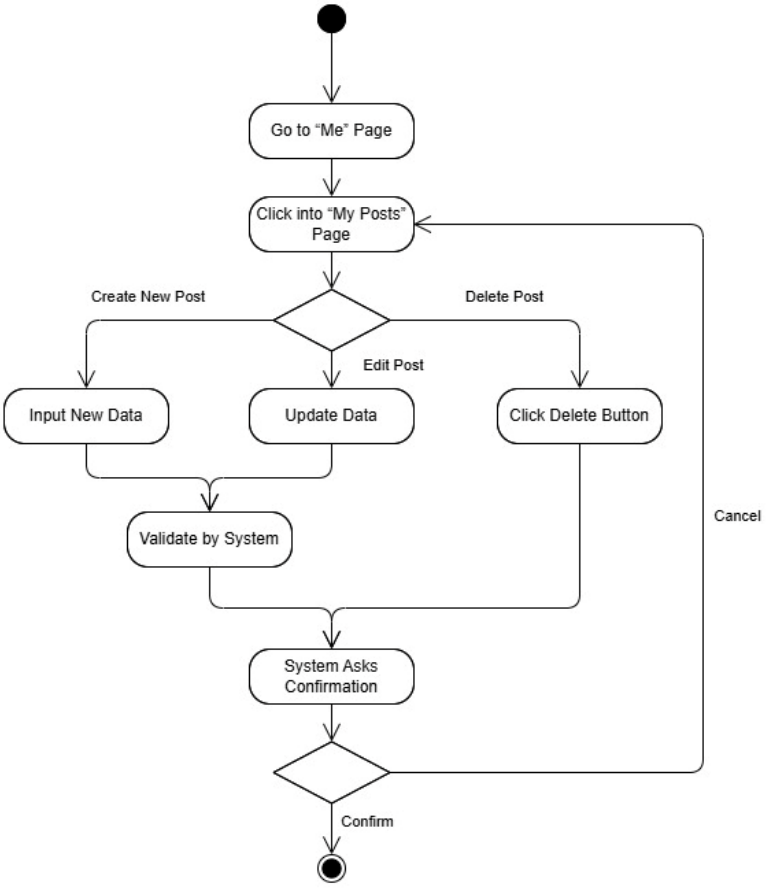


Figure 34: Activity Diagram for Post Management Module

Figure 34 shows the activity flow for the post management module in the SafePaws app. The process begins when the user navigates to the "Me" page and clicks on the "My Posts" section, where they can manage their pet-related posts. The user is then presented with three options: to create a new post, edit an existing post, or delete a post. If the user opts to create a new post, they are prompted to input new data, such as pet information and adoption details. Once the data is entered, the system validates the information to ensure it is correct before saving the post. If the user decides to edit an existing post, they can update the data as needed. The system will validate the updated information to ensure it is accurate.

For deleting a post, the user clicks the delete button, and the system asks for confirmation before the post is permanently removed. If the user confirms the deletion, the post is deleted. If the user cancels any action at any point, the process is stopped, and no changes are made. This activity diagram ensures that users can efficiently create, edit, or delete posts with proper validation and confirmation steps, maintaining data integrity throughout the process.

3.6.2.4 Incident Reporting Module

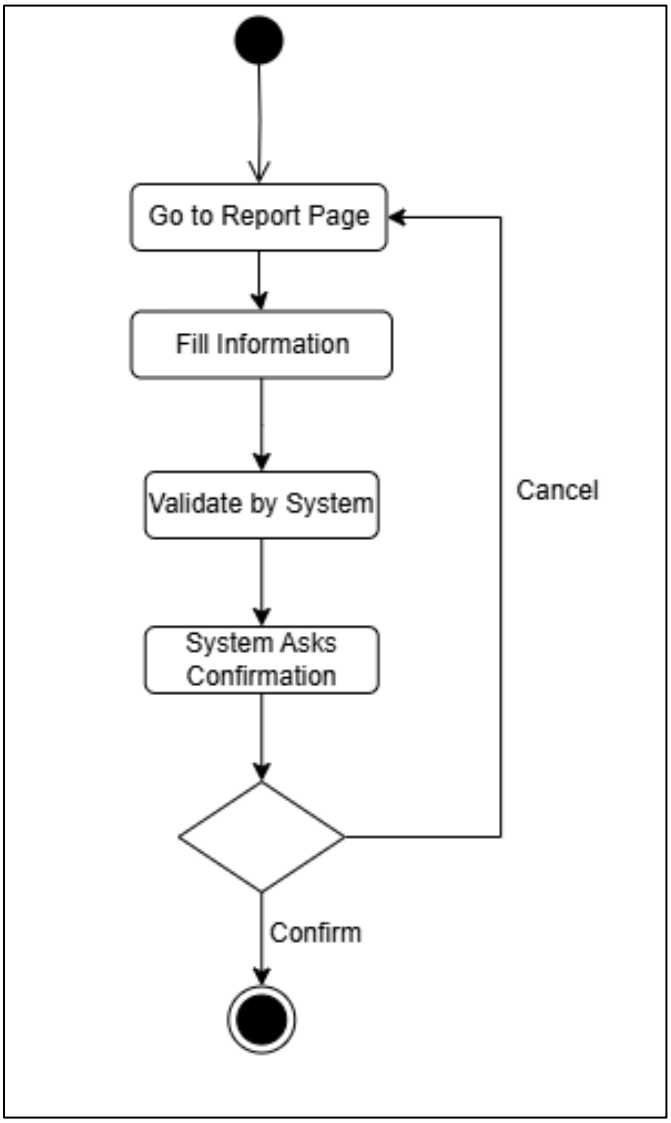


Figure 35: Activity Diagram for Incident Reporting Module

Figure 35 shows the activity flow for the incident report module in the SafePaws app. The process begins when the user navigates to the "Report" page, where they can report incidents related to animals, such as bites or suspected rabies cases. The user then fills in the required information detailing the incident. Once the information is entered, the system validates the data to ensure its correctness. After the system has verified the data, it prompts the user for confirmation before submitting the report. If the user confirms, the report is submitted to the system. If the user

cancels at any point, the process is halted, and no report is submitted. This flow ensures that the system captures accurate and verified information about incidents, while providing users with the option to cancel or confirm before final submission.

3.6.2.5 Vet and Pet Store Module

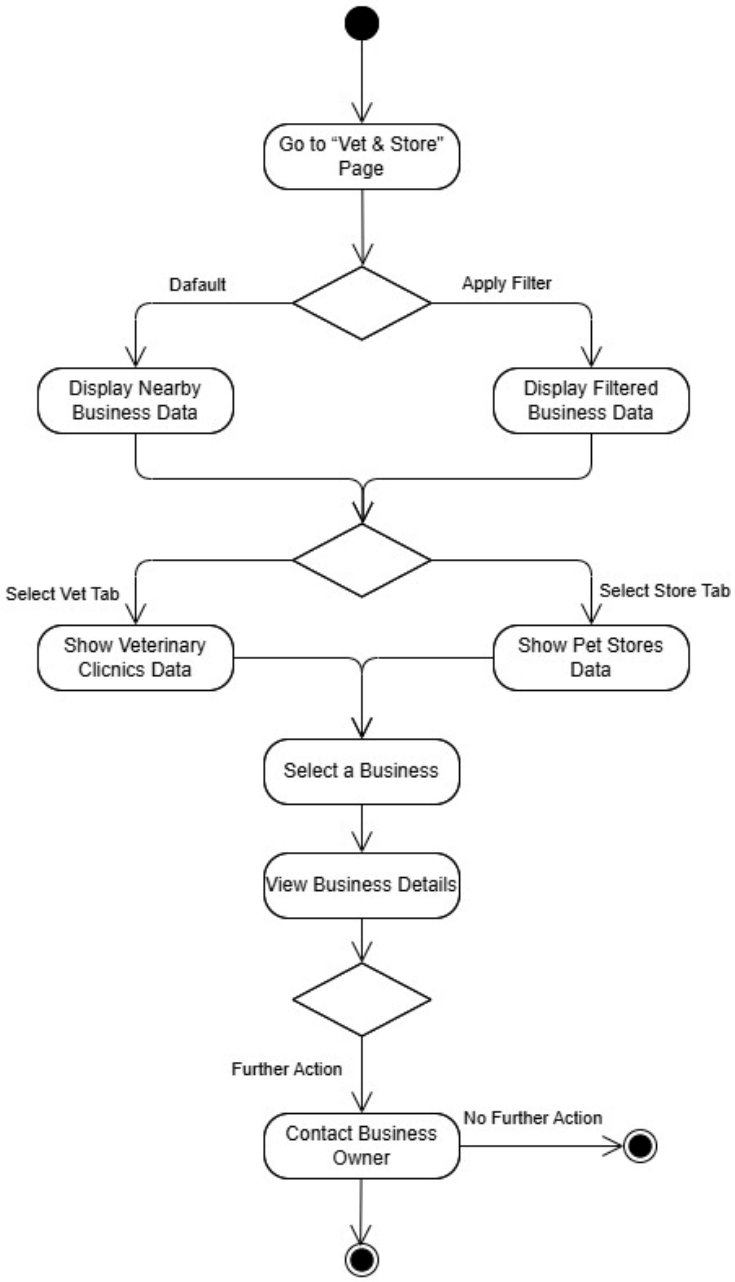


Figure 36: Activity Diagram for Vet and Pet Store Module

Figure 36 shows the activity flow for the "Vet & Store" module in the SafePaws app. The process begins when the user navigates to the "Vet & Store" page, where they can view nearby veterinary clinics and pet stores. The user has the option to either display all nearby businesses by

default or apply a filter to narrow down the search results based on specific criteria. If the user applies a filter, only businesses that meet the selected criteria will be displayed. Otherwise, all nearby businesses are shown. Once the businesses are displayed, the user can choose between two tabs: the "Vet" tab to view veterinary clinics or the "Store" tab to view pet stores. After selecting a tab, the respective business data (veterinary clinics or pet stores) is shown.

The user can then select a specific business from the list to view detailed information about it. After viewing the details, the user has the option to take further action. If desired, the user can contact the business owner for more information or services. If no further action is needed, the process ends. This flow ensures that users can easily find and interact with veterinary clinics and pet stores based on their preferences and proximity.

3.6.2.6 AI Chatbot Module

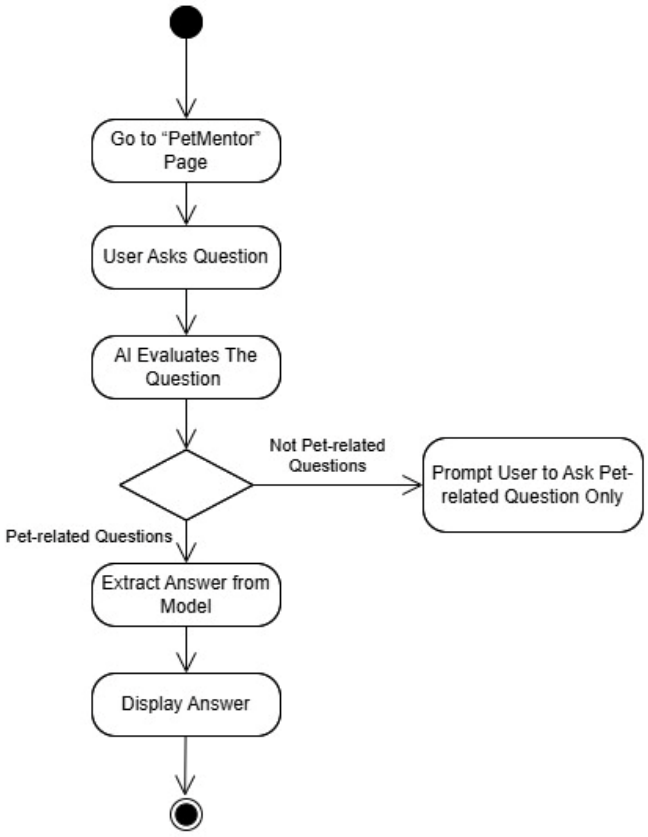


Figure 37: Activity Diagram for AI Chatbot Module

Figure 37 shows the activity flow for the AI chatbot module, called "PetMentor," within the SafePaws app. The process begins when the user navigates to the "PetMentor" page, where they can ask questions related to pet care. The user submits their question, and the AI evaluates it to determine whether it is pet related. If the question is pet-related, the AI extracts the appropriate answer from the model. The answer is then displayed to the user. However, if the question is not related to pets, the AI prompts the user to ask a pet-related question only, ensuring that the system maintains its focus on providing pet-related advice. This flow ensures that users receive relevant and accurate information related to their pets while maintaining the integrity of the app's purpose.

3.6.2.7 Profile Module

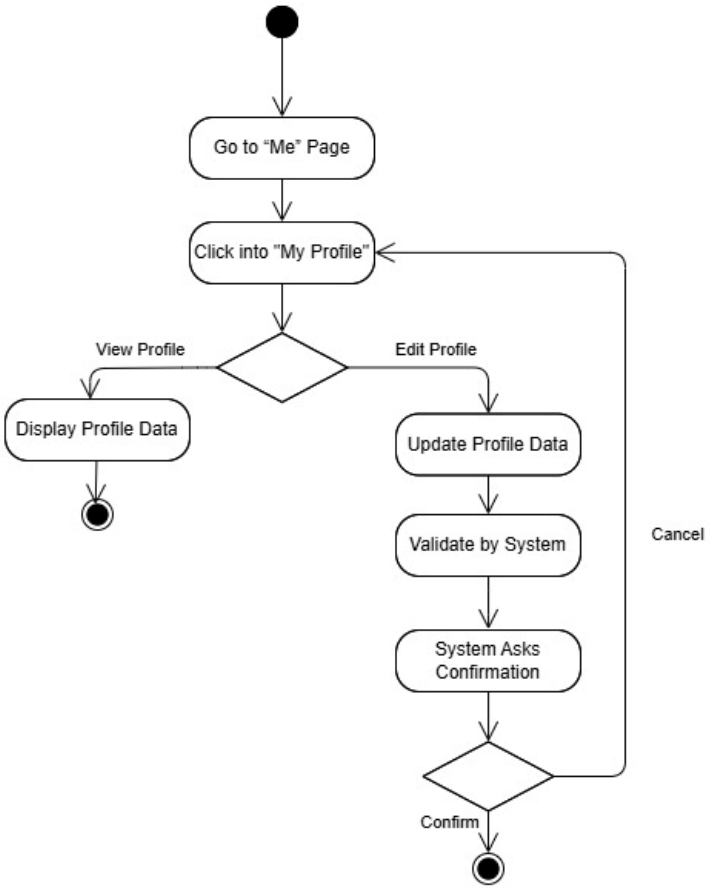


Figure 38: Activity Diagram for Profile Module

Figure 38 shows the activity flow for the profile management module within the SafePaws app. The process begins when the user navigates to the "Me" page and clicks on the "My Profile" section. This allows the user to either view or edit their profile. If the user chooses to view their profile, the system displays the profile data as is. If the user opts to edit the profile, they are prompted to update their profile information. Once the changes are made, the system validates the updated data to ensure it is correct. After validation, the system asks the user to confirm the changes before they are saved. If the user confirms the update, the changes are saved to the profile. However, if the user cancels at any point, the process is halted, and no changes are made. This flow ensures

that users can effectively manage their profile information with the option to view or update details as needed, with validation and confirmation steps to maintain data accuracy.

3.6.3 Sequence Diagram

A sequence diagram is an interaction diagram in software development that presents the sequence of interaction between objects of a system over time. It shows the sequence of messages or actions exchanged between different entities, usually shown by vertical lifelines, in response to specific actions. This diagram represents a visual about the flow of control, method calls, and responses between them; thus, the stakeholders are clear how this system generally works and how data will flow in the system during certain use cases.

3.6.3.1 Login Module

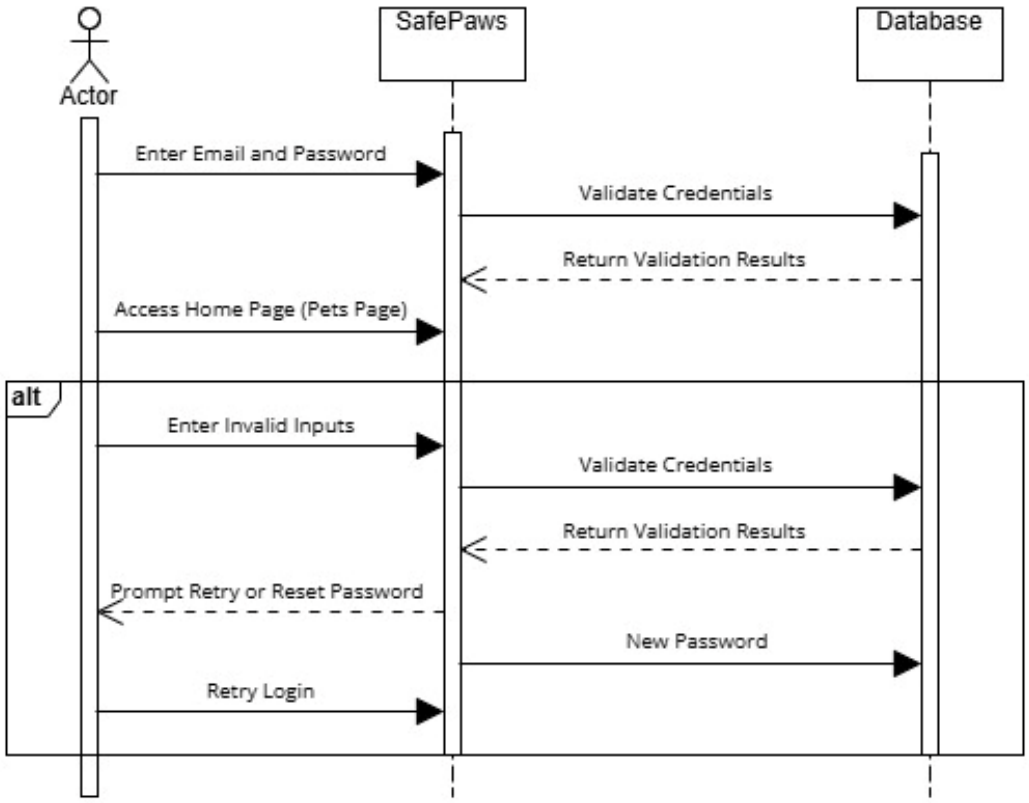


Figure 39: Sequence Diagram of Login Module

Pre-condition:

- The device must have stable internet connection to open the app.

Main Flow:

1. The process begins when the user enters their email and password into the login form on the SafePaws application.
2. The system sends the entered email and password to the database for validation. The system queries the database to verify the authenticity of the credentials provided.
3. The database processes the validation request, comparing the entered credentials with the stored data. If the credentials are correct, the database sends a validation success response.

4. If the credentials are valid, the system grants access to the user, allowing them to proceed to the home page (Pets Page). The flow ends here, with the user successfully logged in and able to use the app.

Alternative Flow:

1. User enters invalid credentials: If the user enters incorrect credentials, the system recognizes the invalid input and sends a failure response to the user.
2. System informs user of invalid input: The system prompts the user to correct the credentials or choose another action, such as resetting the password.
3. User prompted to retry or reset password: The user is given two options: to retry entering the correct credentials or to reset the password if they have forgotten it.
4. Password reset initiated: If the user selects the option to reset the password, the system communicates with the database to initiate the password reset process.
5. New password set: Once the password is successfully updated in the database, the system informs the user that the password has been reset.
6. User retries login with new credentials: After resetting the password, the user can now attempt to log in again using the newly set credentials.
7. Validation process continues: The system repeats the validation process with the new credentials. The login will continue through the validation steps until the user is successfully granted access to the home page.

Post-condition:

The user either successfully logs in or resets their password and logs in with the updated credentials. The login process ensures that only valid users can access the application’s features.

3.6.3.2 Post Browsing Module

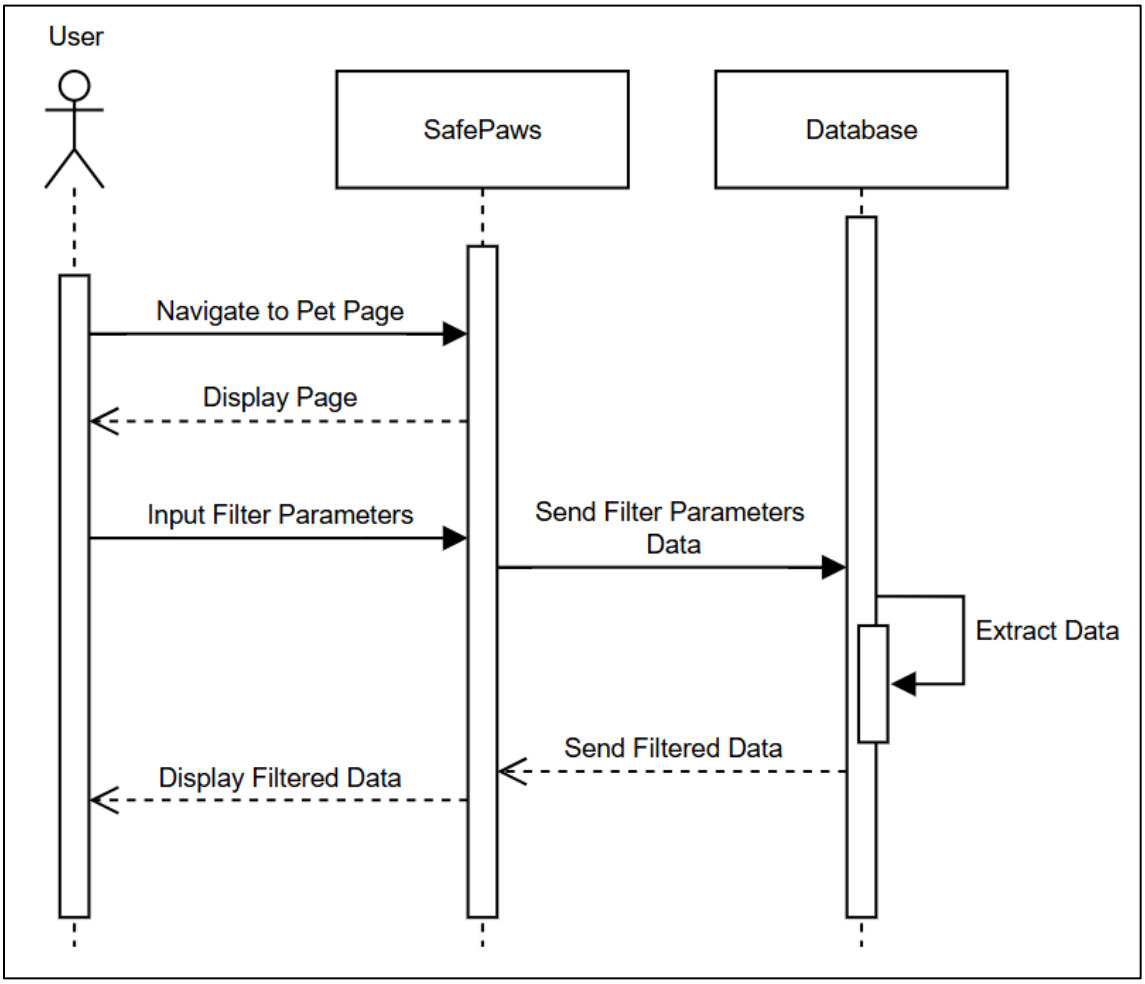


Figure 40: Sequence Diagram of Post Browsing Module

Pre-condition:

- The user must be logged into the SafePaws application.

Main Flow:

1. The user navigates to the "Pets" page, where pet-related information is displayed.
2. The system displays the pet page with all available information, including details about the pets that are available for adoption, lost pets, and other relevant data.
3. The user can apply filters to refine the data displayed on the pet page. These parameters may include pet type, location, adoption status, or other criteria.

4. Once the user inputs the filter criteria, the system sends the filter parameters to the database to fetch the relevant data.
5. The database receives the filter parameters and processes the request by extracting the appropriate pet data based on the criteria provided.
6. After retrieving the filtered data from the database, the system sends the relevant pet information back to the user interface.
7. The system displays the filtered pet data, showing only the pets that match the user's specified criteria.

Post-condition: The user successfully views the filtered pet data based on the criteria provided, enhancing their ability to make informed decisions related to pet adoption or lost pet reports.

3.6.3.3 Incident Reporting Module

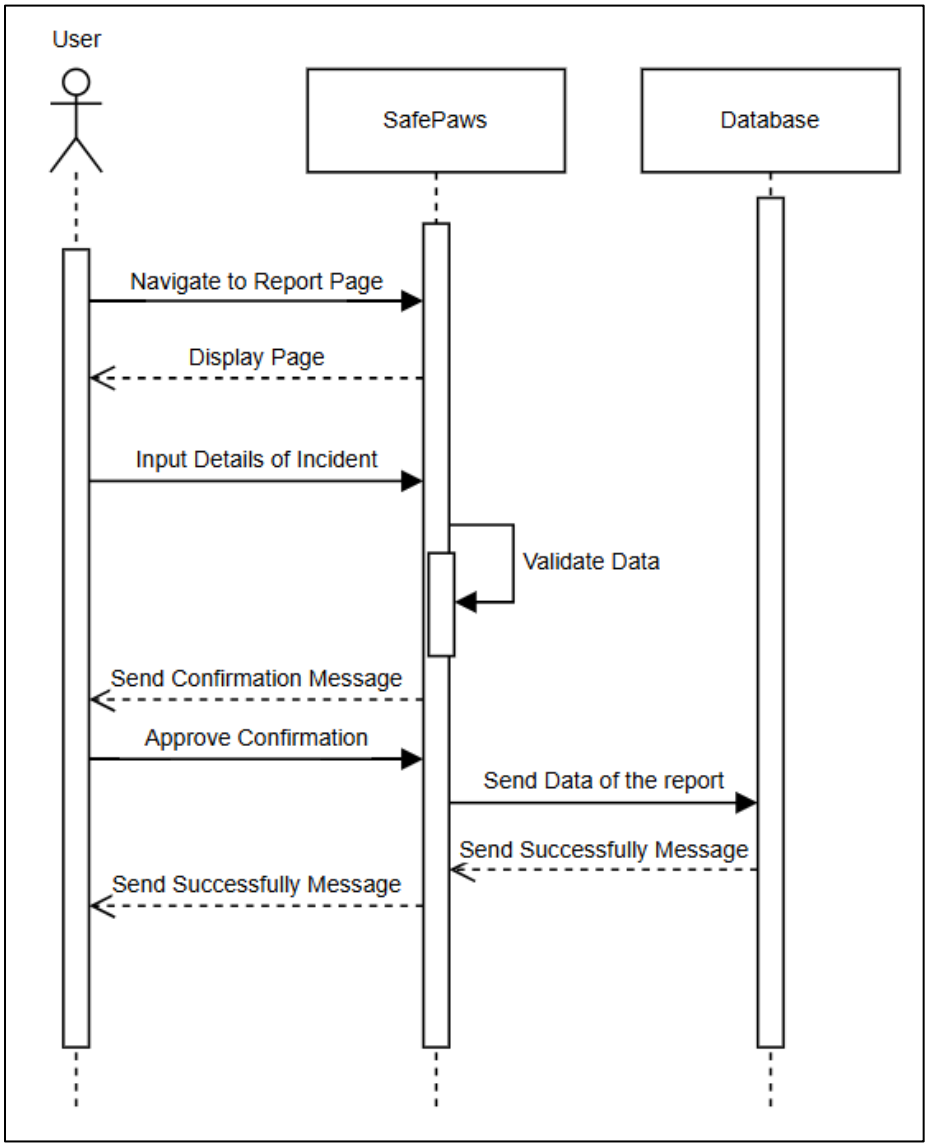


Figure 41: Sequence Diagram of Incident Reporting Module

Pre-condition:

- The user must be logged into the SafePaws application.

Main Flow:

1. The user navigates to the "Report Page" where they can report incidents related to stray animals, such as bites or suspected rabies cases.

2. The system displays the "Report" page where the user can enter details regarding the incident.
3. The user enters the necessary information about the incident, such as type, location, and other relevant details. The user must complete all required fields for a valid report.
4. After the user submits the incident details, the system validates the information to ensure it meets the required criteria and is not incomplete or erroneous.
5. Once the data is validated, the system sends a confirmation message to the user, informing them that the incident has been successfully recorded and is awaiting their approval.
6. The user reviews the confirmation message and approves it. This step ensures the user is aware of the submitted report and confirms its accuracy.
7. After the user confirms, the system sends the validated report data to the database for storage and further processing by the authorities or animal welfare organizations.
8. Send successfully message: Finally, the system notifies the user that their report has been successfully submitted and recorded.

Post-condition:

The user’s incident report is successfully submitted to the database, ready for review and action by local authorities or animal welfare organizations. The report is now part of the system's records, ensuring the incident is addressed promptly.

3.6.3.4 Vet and Pet Store Module

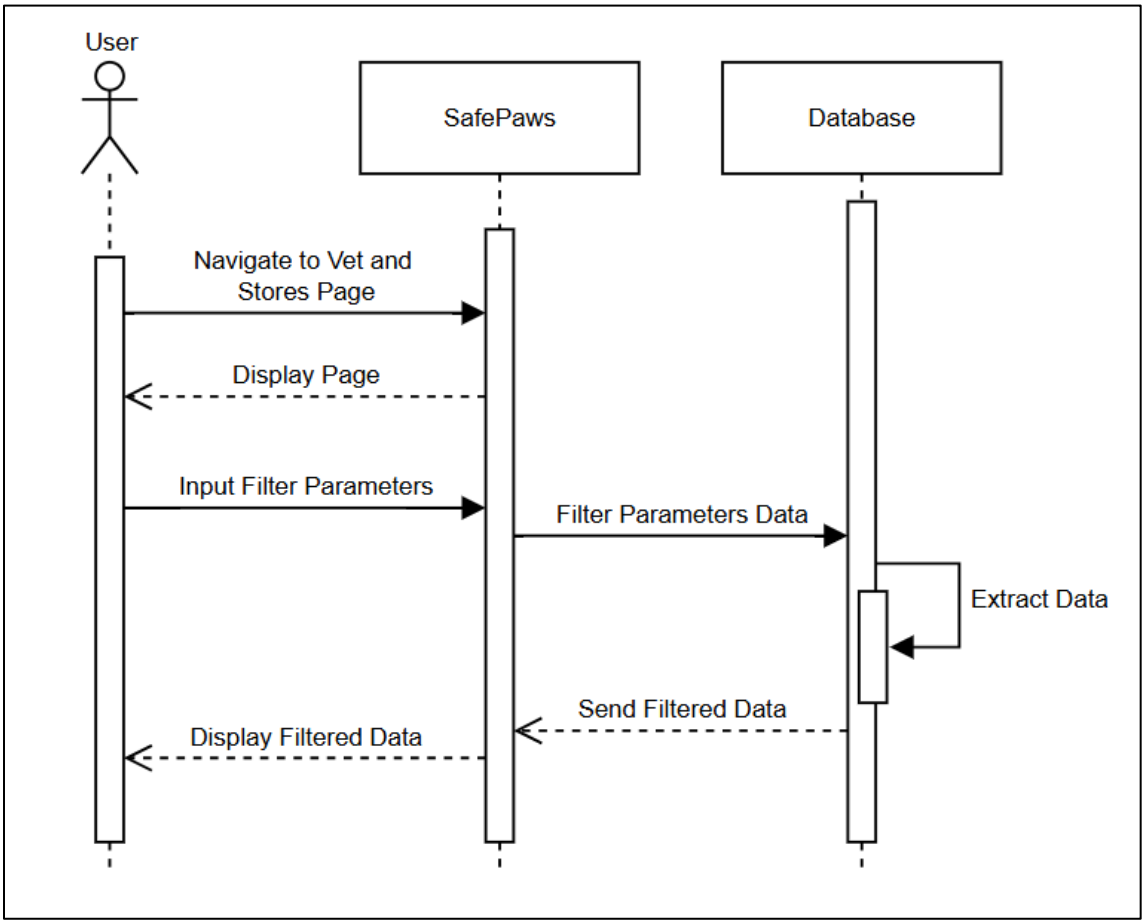


Figure 42: Sequence Diagram of Vet and Pet Store Module

Pre-condition:

- The user must be logged into the SafePaws application.

Main Flow:

1. The user navigates to the "Vet & Stores" page, where they can find information on veterinary clinics and pet stores.
2. The system displays the Vet and Stores page, showing an initial list of businesses available in the user's vicinity (either veterinary clinics or pet stores).

3. The user can refine the displayed data by inputting specific filter parameters. These may include business type (vet clinic or pet store), location, or other relevant factors.
4. Once the filter parameters are entered, the system sends these details to the database to retrieve matching data.
5. The database processes the filter parameters and extracts relevant data based on the criteria provided, such as showing only the vet clinics or pet stores that match the selected filters.
6. The system receives the filtered data from the database and sends it back to the user interface.
7. Finally, the system displays the filtered business data, showing only the relevant veterinary clinics or pet stores based on the user's input. This enables the user to easily find businesses that meet their needs.

Post-condition:

- The user successfully views filtered business data on veterinary clinics or pet stores according to their selected criteria.

3.6.3.6 AI Chatbot Module

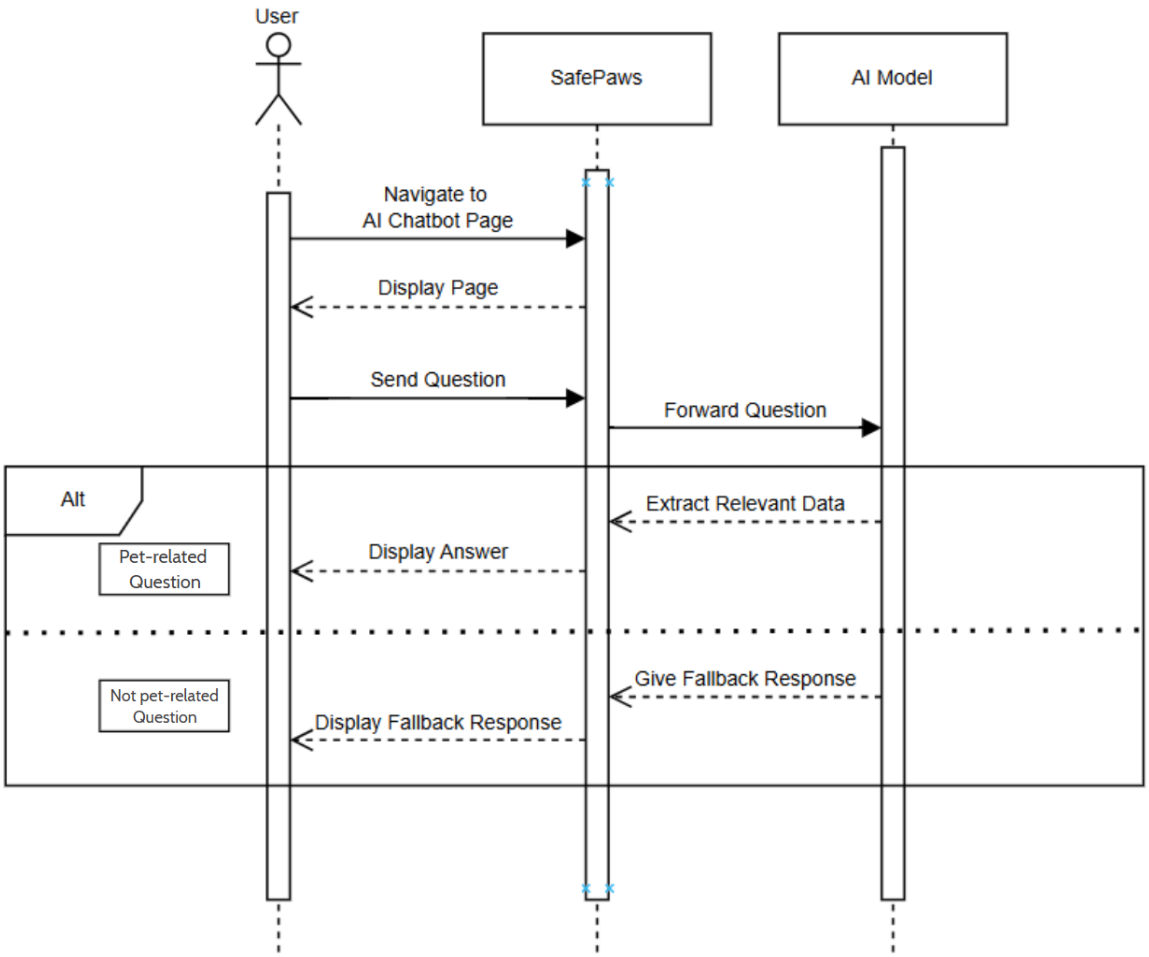


Figure 43: Sequence Diagram of AI Chatbot Module

Pre-condition:

- The user must be logged into the SafePaws application.
- The AI chatbot is pre-configured to handle pet-related queries.

Main Flow:

1. The user accesses the "PetMentor" page from within the SafePaws application. This page allows users to interact with the AI chatbot for pet-related questions.
2. The system displays the AI Chatbot interface, which is ready to accept user queries.

3. The user types their question into the chatbot input field and submits it.
4. The system forwards the user's question to the AI model for processing.
5. The AI model processes the question and extracts the relevant data from its knowledge base to formulate an appropriate response.
6. If the question is pet-related, the system displays the answer provided by the AI model to the user.

Alternative Flow:

1. Not pet-related question: If the user asks a question that is not related to pets, the AI model identifies the question as irrelevant.
2. Display fallback response: The system displays a fallback response informing the user that the question is not related to pets and directs them to ask a pet-related question.

3.6.3.7 Profile Page

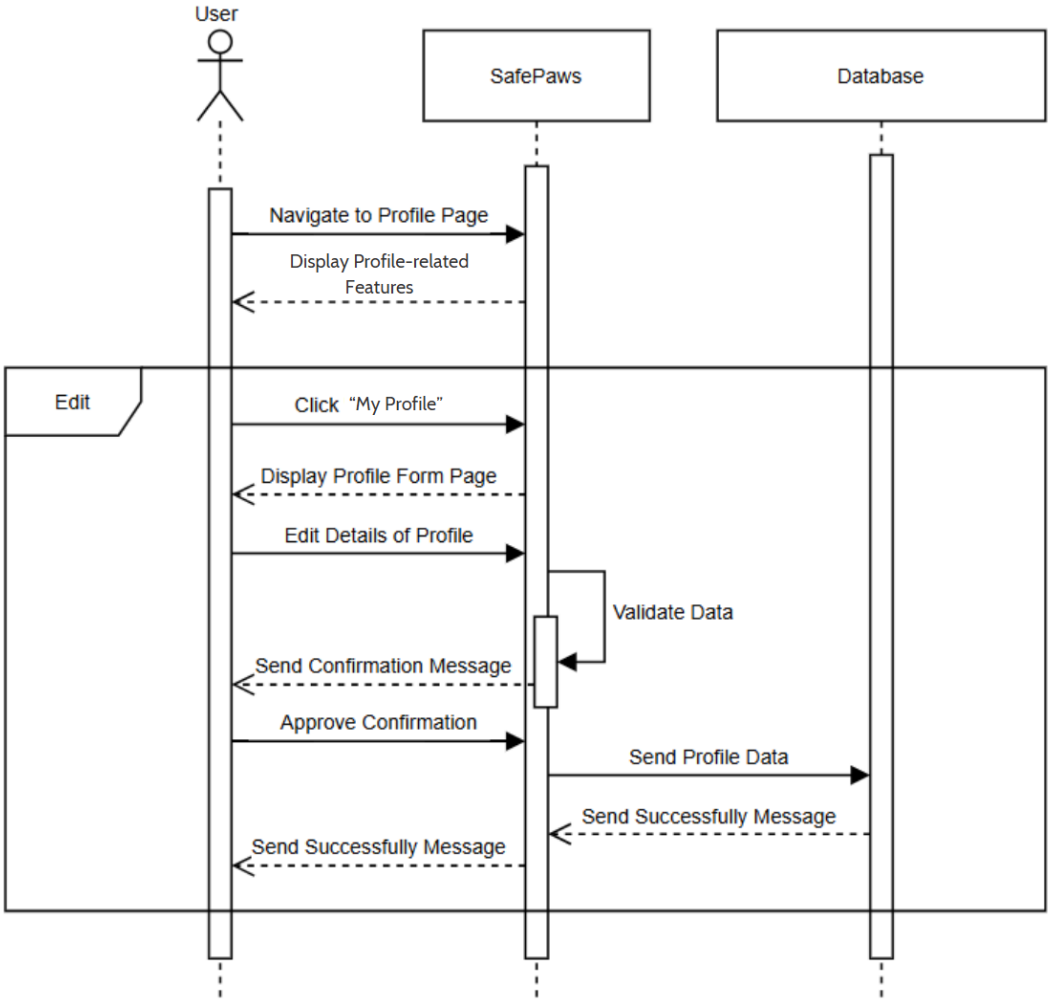


Figure 44: Sequence Diagram of User Profile Module

Pre-condition:

- The user must be logged into the SafePaws application.
- The user should have the profile information available for updating.

Main Flow:

1. The user navigates to the "Me" page where they can view and edit their profile details.
2. The system displays the profile-related features, including options to view or edit profile information such as personal details, contact information, and other settings.

3. The user clicks on the "My Profile" section to begin editing or viewing their profile.
4. The system shows the profile form, where the user can view and edit their profile details.
5. The user makes changes to their profile information. This may include updating their contact details, name, or other information.
6. After the user makes edits, the system validates the input data to ensure the information is accurate and complete.
7. Once the data is validated, the system sends a confirmation message to the user, indicating that their profile has been updated successfully and is awaiting their approval.
8. The user reviews the confirmation message and approves the changes. This step ensures the user acknowledges the updates made to their profile.
9. The system sends the updated profile data to the database for storage.
10. Finally, the system sends a message to the user confirming that the profile has been updated successfully.

Post-condition:

- The user's profile is successfully updated in the database, and the changes are reflected on the profile page.

3.6.4 User Interface Design

The mechanism of designing user interface (UI) is to create visually appealing, user-friendly interfaces that make the interaction of users with system easy. It covers layout, color scheme, typography, and interactive elements to maintain consistency, accessibility, and usability. In UI design, clear, responsive, and feedback-oriented approaches will improve user satisfaction, enhance efficient task performance, and ensure the appropriateness of the interface to user needs and brand identity. Within this project, the header and footer will be sticky for consistency of layout, while pastel colors have been used for the color theme to give a soft and pleasing look. Consistent typography, icons, pop-ups, and search bars also help to be appealing and user-friendly to the application.

3.6.4.1 Login Page

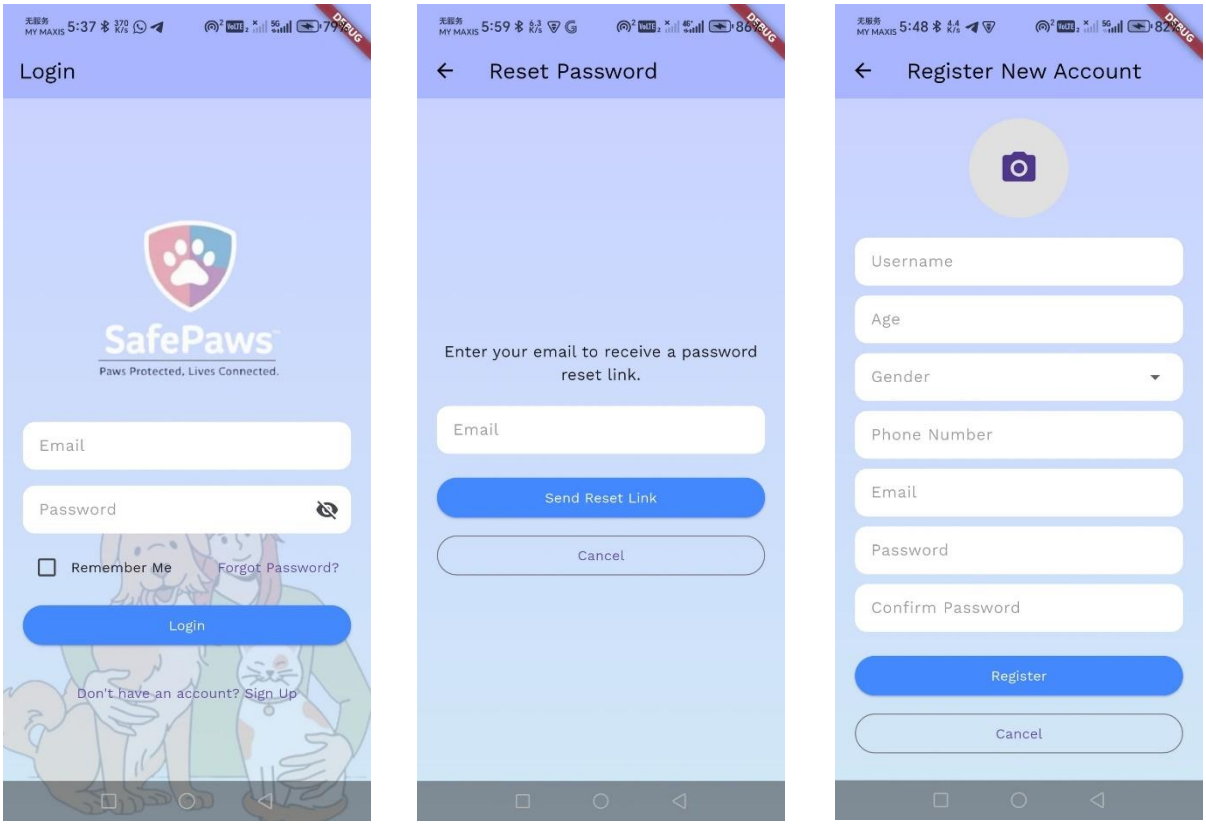


Figure 45: Screenshots for Loin Page

Figure 45 above depict the user interface prototypes of the login page and registration page of the SafePaws application. The login page is displayed when the user first opens the application. New users without an account are required to create one via the registration page. Additionally, if a user forgets their password, they can reset it using the “Forget password” feature.

3.6.4.2 Post Browsing Page

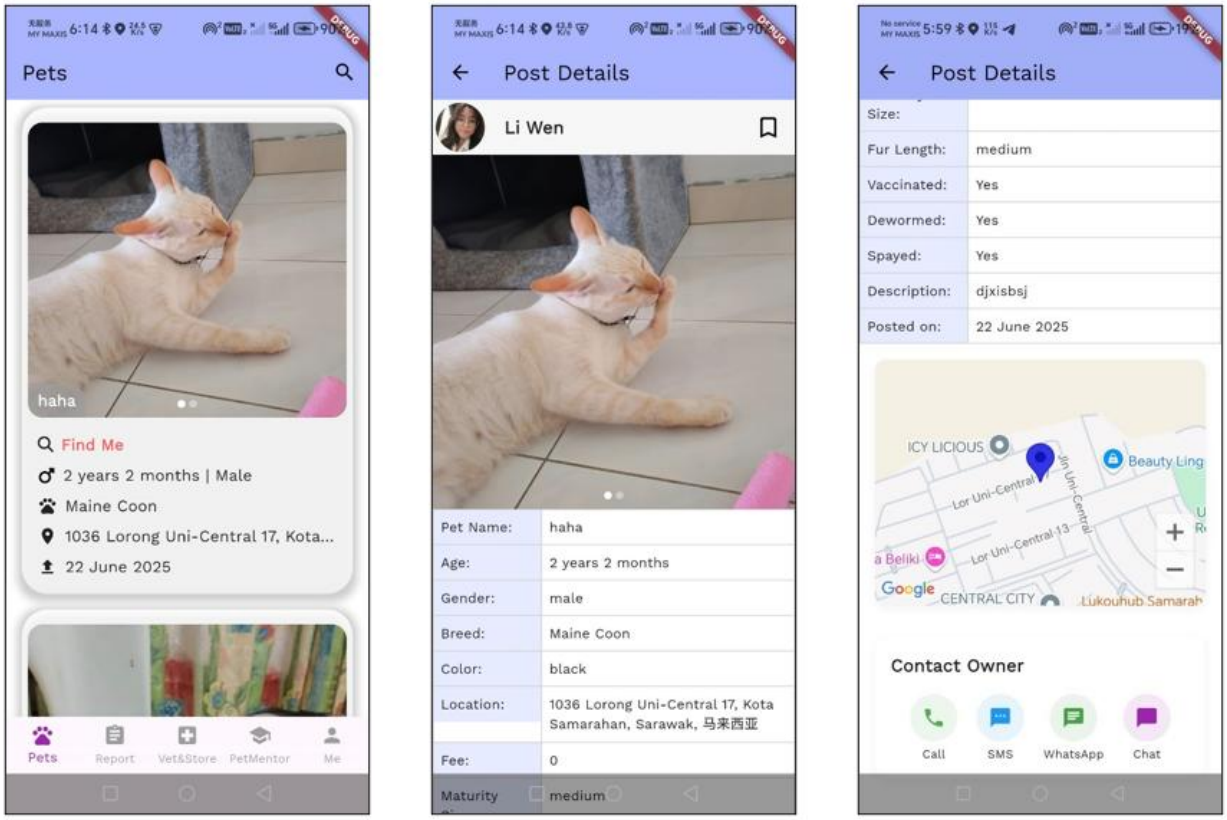


Figure 46: Screenshots for Post Browsing Page

Figures 46 show the prototypes of the pet browsing page. It is displayed to the user immediately after logging into the application. It contains all posts categorized by their purpose, such as “Find Adoption”, “Lost”, “Found” and “Adopted”. Users can view the details of a specific pet by clicking on the corresponding post.

3.6.4.3 Post Management Page

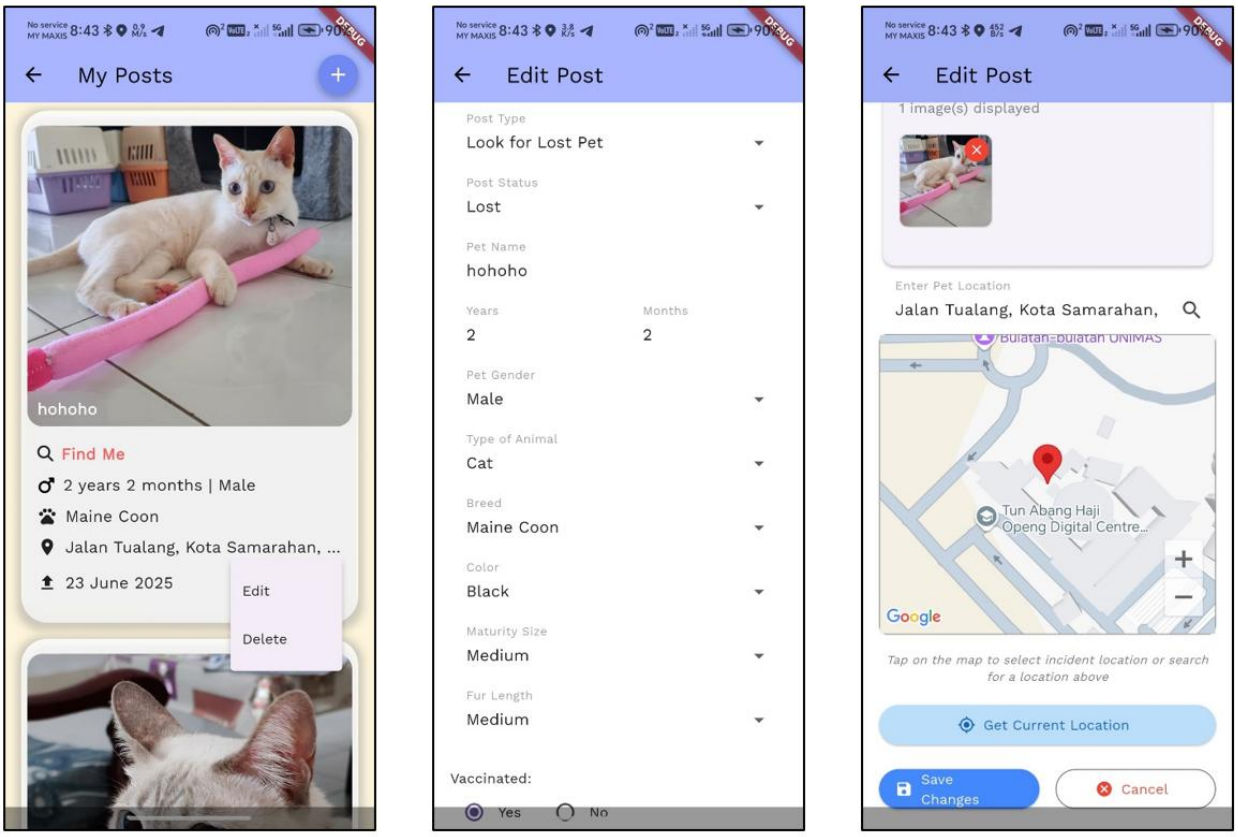


Figure 47: Screenshots for Post Management Page

Figure 47 shows the prototype of the Post Management page. It displays all the posts created by the current user. The post detail is displayed by tapping on the post. This page also allows users to edit or delete their own posts. When editing, the existing data is auto filled to facilitate changes. At this point, the user can also update the status of the post—for example, changing it to "Adopted" or "Found".

3.6.4.4 Incident Reporting Page

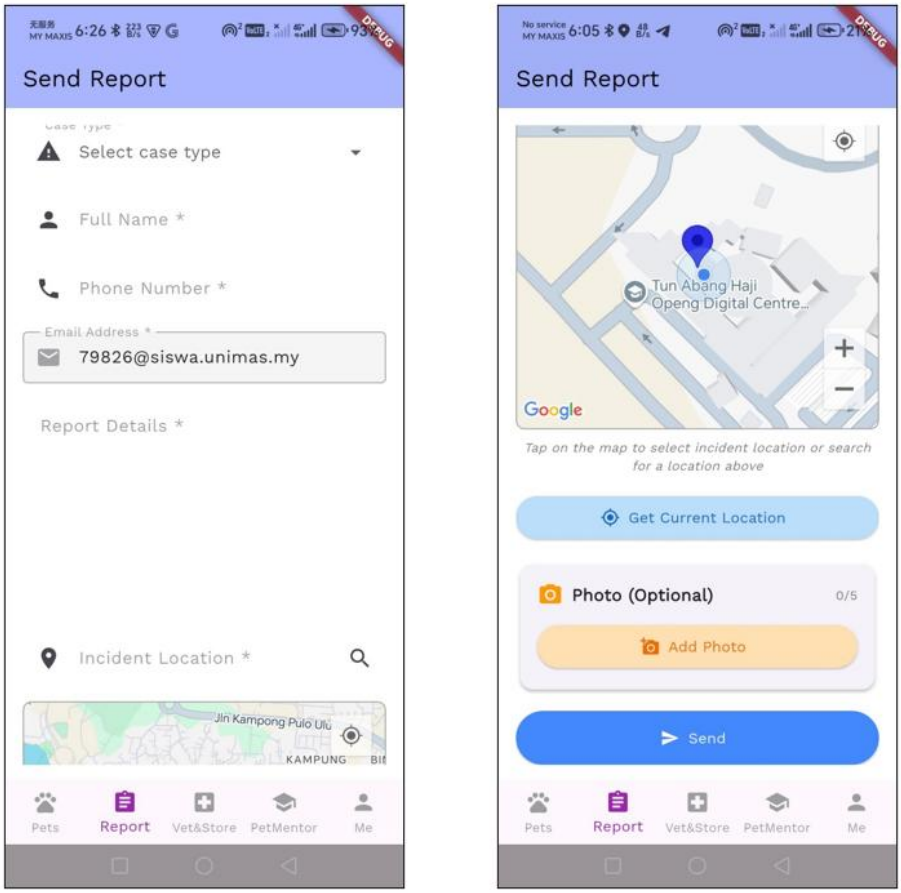


Figure 48: Screenshots for Incident Reporting Page

Figures 48 represent the user interface prototypes of the report page. Users can report incidents by selecting the type of incident, such as a bite case or suspected rabid animals. Once the required information is provided by the user, the report is sent to the relevant local authorities via email. In this project, the local authority's email is a dummy because the actual agency does not provide a public API or official email for testing purposes, and it is not appropriate to send test data to a real government contact during development.

3.6.4.5 Vet and Pet Store Page

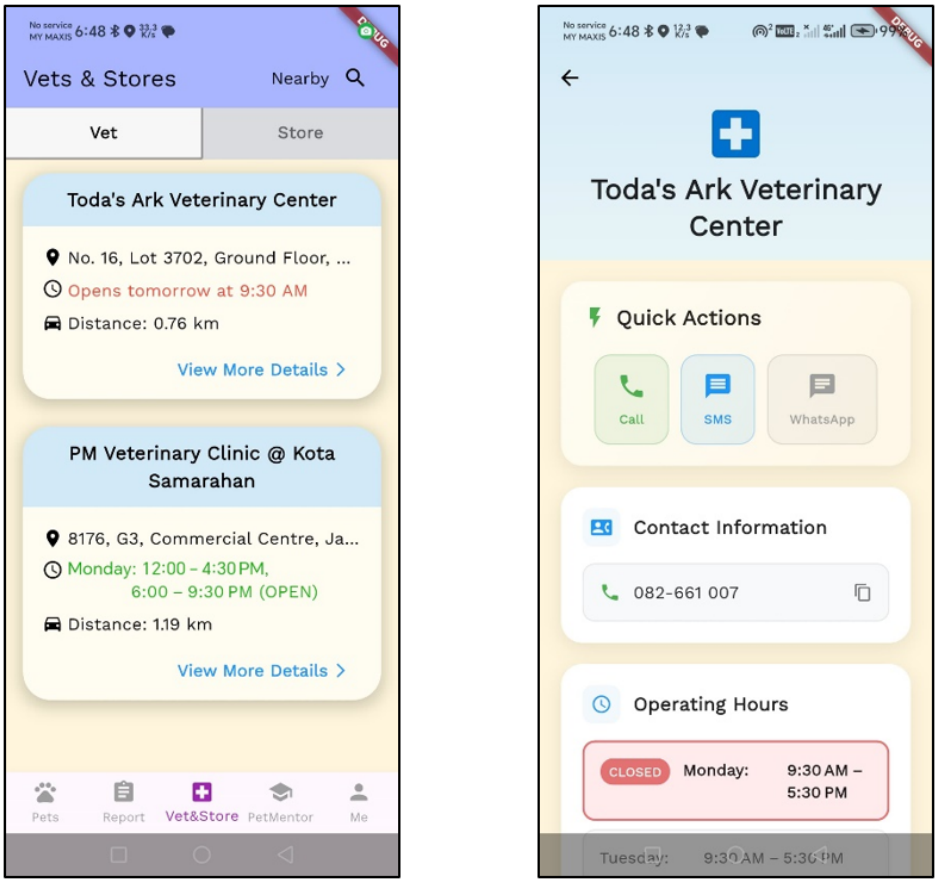


Figure 49: Screenshots for Veterinary Clinic Page

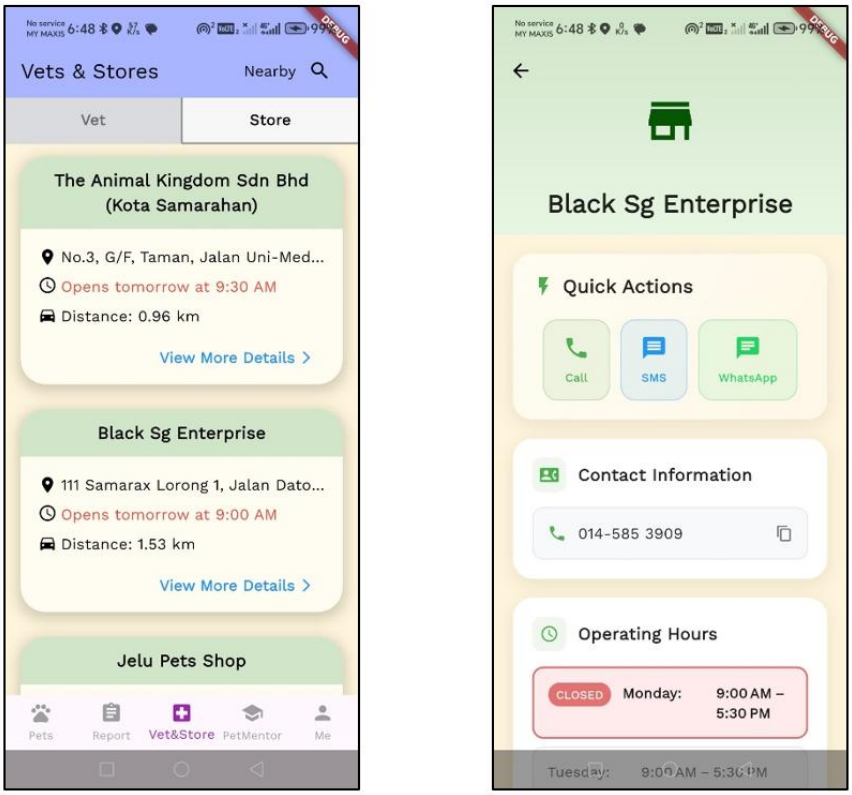


Figure 50: Screenshots for Pet Store Page

Figures 49 and Figure 50 represents the prototypes of vet and pet store page respectively. Users can browse the list of vets or pet stores by selecting wither the “Vet” tab or “Store” tab located at the upper section of the page. When clicking certain vet or store, the detailed information of the vet or store will be displayed to users.

3.6.4.6 AI Chatbot Page

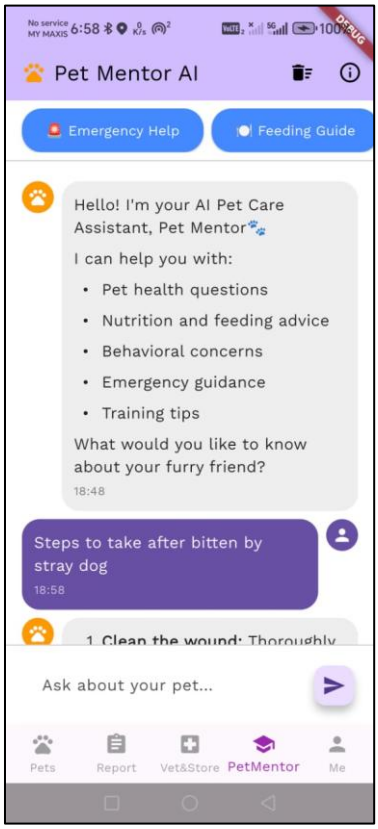


Figure 51: Screenshots for AI Chatbot Page

Figure 51 above shows the user interface of the AI chatbot feature in SafePaws. The interface displays the dialogue exchange between the user and the AI chatbot. Users able to access educational content by asking questions or seeking guidance on various topics related to pet and stray animals.

3.6.4.7 Profile Page

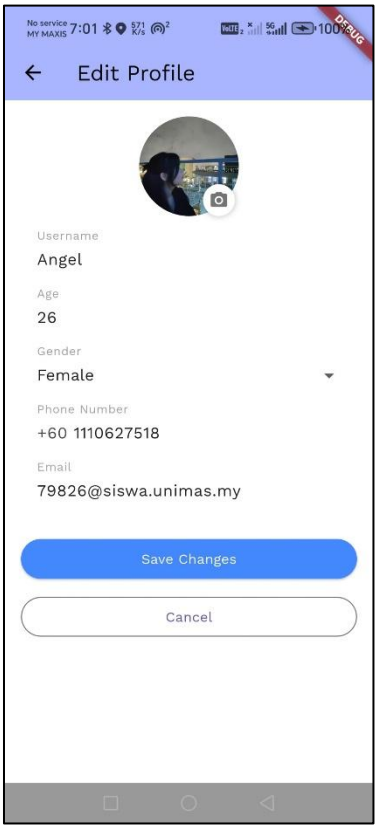


Figure 52: Screenshots for Profile Page

Figure 52 above represent the prototypes of the profile page. On this page, users can manage their profile information and access various features such as their posts, favorite pets, and notifications. By clicking on specific features like profile details or post history, users can view and update their data as needed so that the information is accurate. Additionally, users can seek technical support through the “Contact Us” option.

3.7 Summary

The SafePaws mobile application is designed based on a thorough analysis of user needs gathered through questionnaires focused on stray animal management, pet adoption, and public health awareness. Using the prototype model, the project identifies key challenges such as fragmented information and difficulty in reporting bite cases or finding adoptable pets. This chapter defines the system's functional and non-functional requirements and proposes a unified solution that combines adoption listings, incident reporting, and pet care education. It also presents the system design through use case diagrams, activity diagrams, sequence diagrams, and user interface mockups to ensure the app is intuitive and efficient for users.

CHAPTER 4: SYSTEM IMPLEMENTATION

4.1 Introduction

This chapter discusses the design and development of the SafePaws mobile apps, including the software and hardware used. It provides a detailed explanation of the installation process for essential tools, such as Android Studio, Flutter, and Firebase to ensure a clear understanding of the setup required for the app's development.

4.2 Hardware and Software Development Tools Requirements

This section outlines the hardware and software tools necessary for the development and testing of the SafePaws mobile apps.

4.2.1 Hardware Setup

A laptop of Acer Swift 3 is used for the development of the SafePaws mobile apps. The table below provides the hardware specification of the device used for development:

Table 11: Hardware Requirements of Laptop to Develop SafePaws

Component	**Specification**
Processor	11th Gen Intel(R) Core (TM) i5-1135G7 @ 2.40GHz
GPU	Intel(R) Iris(R) Xe Graphics
RAM	8.00 GB
Storage	512 SSD

The Acer Swift 3 laptop is equipped with an Intel Core i5 processor which running at 2.40GHz. It provides enough power to run Android Studio and Flutter smoothly. It has 8 GB of RAM for efficient multitasking and 512 GB of SSD storage which can ensure fast access to files

and applications. The laptop also features integrated Intel Iris Xe Graphics, which can handle the visual requirements of the development environment.

In addition to the laptop, a HONOR 200 mobile phone is used for testing to ensure that the SafePaws mobile app performs well on an actual mobile device. The table below provides the specifications of the mobile phone used for testing:

Table 12: Hardware Requirements of Laptop to Develop SafePaws

Component	**Specification**
CPU	Qualcomm Snapdragon 7 Gen 3 (4 nm)
Graphic (GPU)	Adreno 720
RAM	12GB
Storage	256GB
Display	6.7-inch OLED, 120Hz refresh rate

The HONOR 200 is powered by a Qualcomm Snapdragon 7 Gen 3 processor (4 nm), paired with an Adreno 720 GPU for smooth graphics performance. It comes with 12GB of RAM, ensuring seamless multitasking and efficient app performance. The device offers 256GB of storage, providing ample space for apps, media, and data. The 6.7-inch OLED display features a 120Hz refresh rate, delivering vibrant visuals and a smooth user experience.

4.2.2 Software Setup

This table below presents the software setup for developing the SafePaws, including key development tools such as Android Studio, Flutter, and Firebase.

Table 13: Software Requirements to Develop SafePaws

Component	**Specification**

Laptop's Operating System	Windows 11
System Type	64-bit operating system, x64-based processor
Software	Android Studio, Flutter
Programming Language	Dart
Database	Firebase

The laptop used for developing the SafePaws mobile app runs on Windows 11 with a 64-bit operating system and an x64-based processor. The main software tools installed include Android Studio for app development and Flutter for creating a cross-platform mobile app using the Dart programming language. Firebase is used as the database to manage user data, images, and other app-related information.

4.2.2.1 Implementation of Integrated Development Environment (IDE)

The integrated development environment (IDE) used for SafePaws is Android Studio. Android Studio is chosen as the primary IDE due to its comprehensive features, seamless integration with Flutter, and support for efficient mobile app development. The following are the steps to install Android Studio for SafePaws:

1. Go to the official Android Studio website at https://developer.android.com/studio.
2. Click the Android Studio Package for window (64-bit) to download and make sure it is .exe file.
3. Once the file is downloaded, open and run the installer. Then the installation wizard will guide you through the setup.
4. Click "Next" to chose the file path for the Android Studio to be installed.

5. During installation, components need to be chosen. By default, the necessary components will be selected, so just proceed with the default settings.
6. Click the “Install” button and the installer download and install the necessary files.
7. Once installed, open Android Studio and the setup wizard will guide you to install the Android SDK (Software Development Kit). Click “Next” to download and install it.
8. After completing the SDK installation, Android Studio will configure the environment and can start to build the Android apps.

4.2.2.2 Implementation of Framework (Flutter)

Flutter, a popular open-source framework by Google, is chosen for its ability to create cross-platform mobile applications with a single codebase. It can ensure efficient development and consistent performance on both Android and iOS devices. To implement Flutter for the SafePaws project, here is the step-by-step instructions:

1. Go to the official Flutter website at https://docs.flutter.dev/get-started/install/windows/mobile.
2. Click download and install to download the installation bundle of the Flutter SDK.
3. Extract the file into the directory file path to store the Flutter SDK.
4. Then need to update the windows path variable by pressing the Windows + Pause to let the system > about dialog displays.
5. Click Advanced System Settings > Advanced > Environment Variables to edit environment variable, type %USERPROFILE%\dev\flutter\bin and click move up until the Flutter entry sits at the top of the list.
6. Then can launch the Android Studio and follow the Android Studio Setup Wizard.

4.2.2.3 Implementation of Database Tool (Firebase)

For the SafePaws app, Firebase is utilized as the database tool to handle user data, authentication, real-time synchronization, chat functionality, and media storage. Firebase provides a robust backend platform with various services, making it an ideal choice for developing a mobile app like SafePaws. Initially, Firebase Authentication is implemented to manage user sign-ups, logins, and password resets securely, ensuring that users can access their accounts and personal data safely.

Firebase Firestore, a NoSQL cloud database, is used to store vital information in the SafePaws app, including user profiles, pet posts data, reports data, and chat messages. This ensures secure data storage and real-time synchronization across devices. Users can add, update, or delete posts about pets, report issues like bite cases or suspected rabid animals, and interact with other users through chat messages.

Additionally, firebase storage is integrated to handle the storage of media files, such as images related to pet posts (pet photos) and user profile images. Firebase storage ensures that images are securely stored in the cloud and are easily accessible within the app. Images used in pet posts and profiles are stored in Firebase Storage and linked via Firestore will provide a smoother loading experience for users. Below are the step-by-step instructions for implementing Firebase in the SafePaws project:

1. Create a Firebase Project:
    - Go to the Firebase Console at https://console.firebase.google.com and click on "Add Project." Follow the prompts to set up a new Firebase project for the SafePaws app.
2. Add Firebase to the SafePaws App:

- In the Firebase Console, after your project is created, click on "Add App" and choose Android. Follow the instructions to download the google-services.json file and add it to your SafePaws app's project.

3. Set Up Firebase Dependencies in Flutter:
   - In your Flutter project, open the pubspec.yaml file and add the necessary Firebase dependencies. For the SafePaws app, you will need packages such as firebase_core, firebase_auth, cloud_firestore, and firebase_messaging for user authentication, data storage, and push notifications.

```
dependencies:
flutter:
sdk: flutter
firebase_core: ^1.10.6
firebase_auth: ^3.3.4
cloud_firestore: ^3.1.5
firebase_messaging: ^10.0.10
```

4. Install Dependencies:
   - Run flutter pub get in the terminal to install the dependencies.
5. Initialize Firebase in Your Flutter App:
   - In your main Flutter app file (usually main.dart), import Firebase and initialize it in the main() function to make sure Firebase services are ready before running the app.

```
import
'package:firebase_core/firebase_core.dart';


void main() async {
 WidgetsFlutterBinding.ensureInitialized();
 await Firebase.initializeApp();
 runApp(MyApp());
```

6. Implement Firebase Authentication:
    - To allow users to sign up, log in, and reset passwords, add the firebase_auth package to your project. Configure methods for sign-up, login, and password reset using Firebase Authentication. These features ensure that only authorized users can access their profiles and post data securely.

```
FirebaseAuth.instance.createUserWithEmailAnd
Password(
  email: email,
  password: password,
```

7. Store and Retrieve Data with Firestore:
    - Firestore will store user-related data, including pet profiles (name, type, age, breed, etc.), reports (case type, reporter details), and chat messages. Add the cloud_firestore package and implement methods to store and retrieve this data. For example,

```
FirebaseFirestore.instance.collection('posts').add
({
  'petName': 'Buddy',
  'petType': 'Dog',
  'age': 3,
  'breed': 'Golden Retriever',
```

8. Set Up Firestore Security Rules:
    - In the Firebase Console, go to the Firestore Database section and configure security rules to ensure that only authenticated users can read and write their own data.

```
service cloud.firestore {
  match /databases/{database}/documents {
    match /posts/{postId} {
      allow read, write: if request.auth != null &&
request.auth.uid == resource.data.userId;
    }
```

9. Implement Firebase Storage for Media Files:
    - Firebase Storage is used to upload and retrieve media files, such as images for pet posts or user profiles. Add the firebase_storage package and implement methods to upload and download images. For example,

```
FirebaseStorage storage =
FirebaseStorage.instance;


// Upload image
storage.ref('post_images/$imageName').putFile(i
```

10. Manage Real-Time Chat Data:
    - Firebase also handles chat functionalities, enabling users to send and receive messages. Messages are stored in a collection, and real-time synchronization ensures that users can chat instantly. The chat data includes participant names, messages, and timestamps.
11. Test Firebase Integration:
    - After setting up Firebase, thoroughly test your app to ensure that Firebase Authentication, Firestore storage, real-time synchronization, and notifications are working correctly. Verify that users can sign up, log in, and add pet posts and reports. Ensure that real-time data updates correctly and that chat functionality operates seamlessly across devices.

4.3 System Architecture

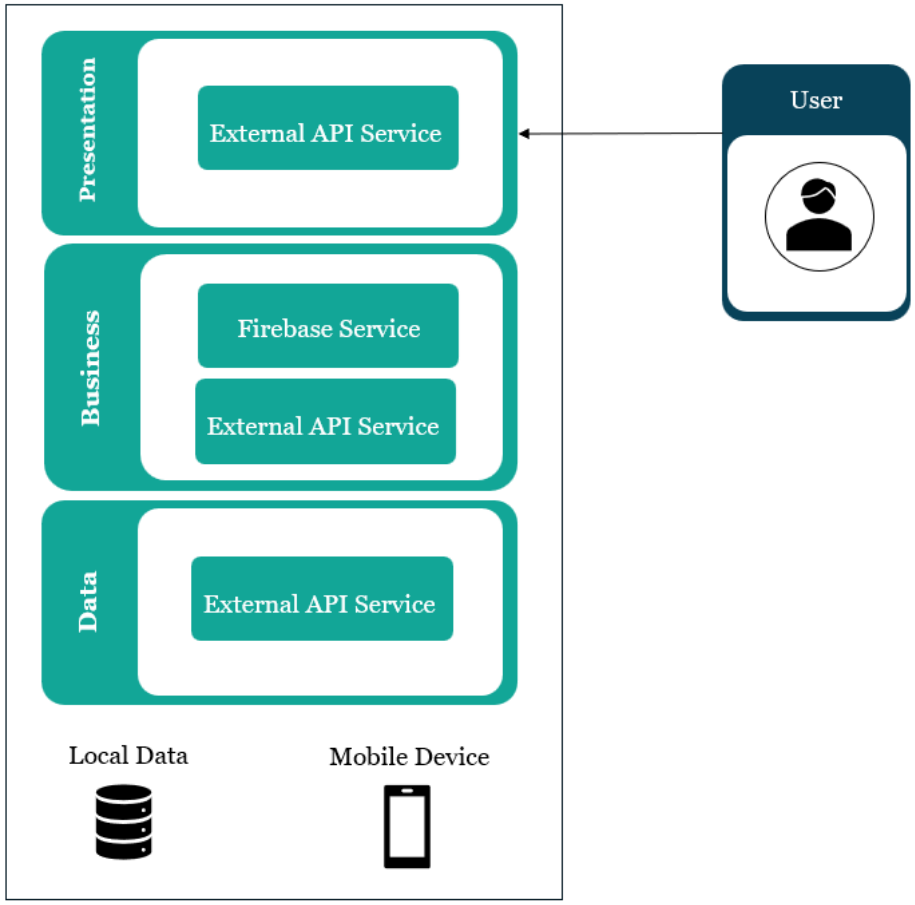


Figure 53: Architecture Diagram of SafePaws Application

Figure 53 illustrates the system architecture of the SafePaws app, organized into three key layers: presentation, business, and data. The presentation layer is the part that users interact with directly, where they can view pet posts, report incidents, chat with others, and access other app functionalities. This layer ensures that users can easily navigate through the app to perform tasks such as creating a post, reporting a bite case. It communicates with the business layer, which handles the core logic of the app's features. This includes Firebase services for user authentication (sign-up, log-in) and managing real-time synchronization of posts, reports, and chat messages.

Additionally, the business layer also interacts with external API Services to fetch data like nearby vets or pet stores.

The data layer stores everything, with Firebase Firestore being the central storage solution. Firestore ensures that user data, pet profiles, reports (like bite cases or suspected rabid animals), chat messages, and posts are securely saved and updated in real-time, making it available across multiple devices. The app runs on a mobile device, where users input their data, whether it is pet details, incident reports, or chat messages, and the data is processed and stored efficiently. This architecture ensures that the SafePaws app provides a seamless and scalable experience, making it easy to manage stray animal-related tasks while keeping the app's features organized and responsive.

4.3.1 Presentation Layer

The presentation layer of the SafePaws app is the part that users directly interact with. It includes all the visual elements and screens of the app, such as the home page which is also pet posts page, incident reporting page, vet & store page and AI chatbot. This layer is responsible for providing an intuitive and engaging user experience, ensuring that the app is not only functional but also easy and enjoyable to use. For example, after a user log in, the presentation layer displays dashboard by showing pet posts and the option to choose report incident types like bite cases or rabid animals. The presentation layer also handles user interactions such as listing the veterinary clinic and pet store based on the user location or area within Sarawak. In addition, it allows user to query about the pet such as emergency procedures, feeding guide, training tips and pet care. In this layer, user is able to message other users within the app. The design of this layer ensures visual consistency through the use of clear icons, readable fonts, and a color scheme that aligns with the

SafePaws brand, making navigation seamless and visually appealing. This layer also ensures that user input, like submitting reports or creating posts, is easily handled with minimal effort. The user-friendly layout and visual elements are tailored to enhance the user experience, making it easy for users to interact with the app and stay engaged with all pet-related activities.

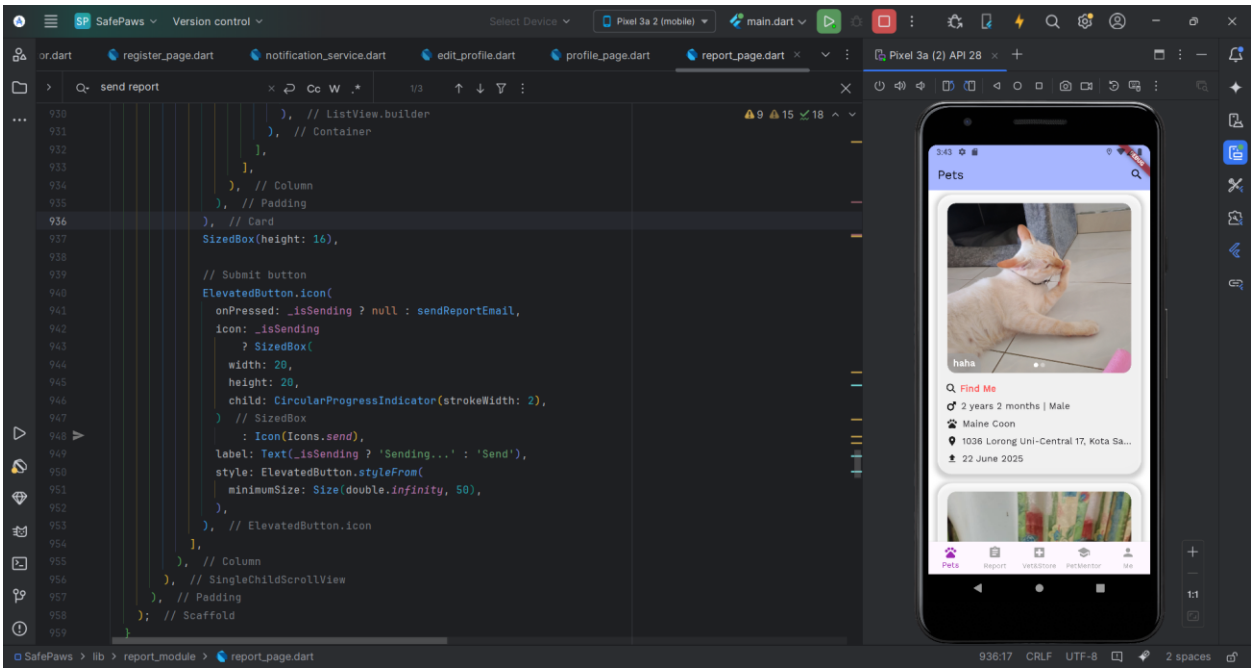


Figure 54: Home page Coding of SafePaws Application

In the presentation layer section, the folder structure defines where the app's UI elements, logic, and resources are stored, which is crucial for how the app looks and functions. By organizing the code and assets in these specific folders, the app's presentation and user interface can be efficiently developed, maintained, and updated, ensuring a smooth and user-friendly experience for SafePaws users. The table below highlights how various components of the app such as visual assets, UI code, and Android-specific configurations are structured and managed in the development process.

Table 14: File Structure of SafePaws

Folder	Description
safepaws/android	This folder contains all the files and configurations specific to the Android version of the app. It includes settings, Android-specific libraries, and permissions needed for the app to run on Android devices.
safepaws/build	This folder stores temporary files created during the app's build process. It includes compiled code and other files generated as part of the app's setup and packaging for distribution.
safepaws/lib	This is the core folder where all the main code for the app lives. It contains Dart files that define the app's functionality, user interface, and logic. It is where the majority of the development work happens.
safepaws/assets	This folder holds non-code files like images, icons, fonts, and other resources that the app uses. These files are essential for the app's appearance and user experience.

4.3.2 Business Logic Layer

The business logic layer of the SafePaws app handles the core functionality that powers the app's features. It acts as the intermediary between the user interface and the data, ensuring that user actions trigger the appropriate business processes. This layer integrates Firebase services for authentication, data management, real-time synchronization, and storage. Firebase Authentication manages user sign-ups, logins, and password resets, ensuring secure access to the app.

In addition to data management through Firebase Firestore, which stores pet posts (lost, found, and adopted pets), incident reports (bite cases, suspected rabid animals), and chat messages,

the Business Logic Layer also manages Firebase Storage. Firebase Storage is used for storing and retrieving media files, such as pet images, user profile pictures, and other related media. For instance, when a user uploads an image related to a pet post or profile, the Business Logic Layer processes the upload and stores the image in Firebase Storage, linking it with the relevant data in Firestore.

The layer also handles interactions with external APIs for additional services, such as retrieving nearby vets or pet stores. By managing user data, media, and real-time communications, the Business Logic Layer ensures that SafePaws operates smoothly, providing users with a secure, efficient, and seamless experience.

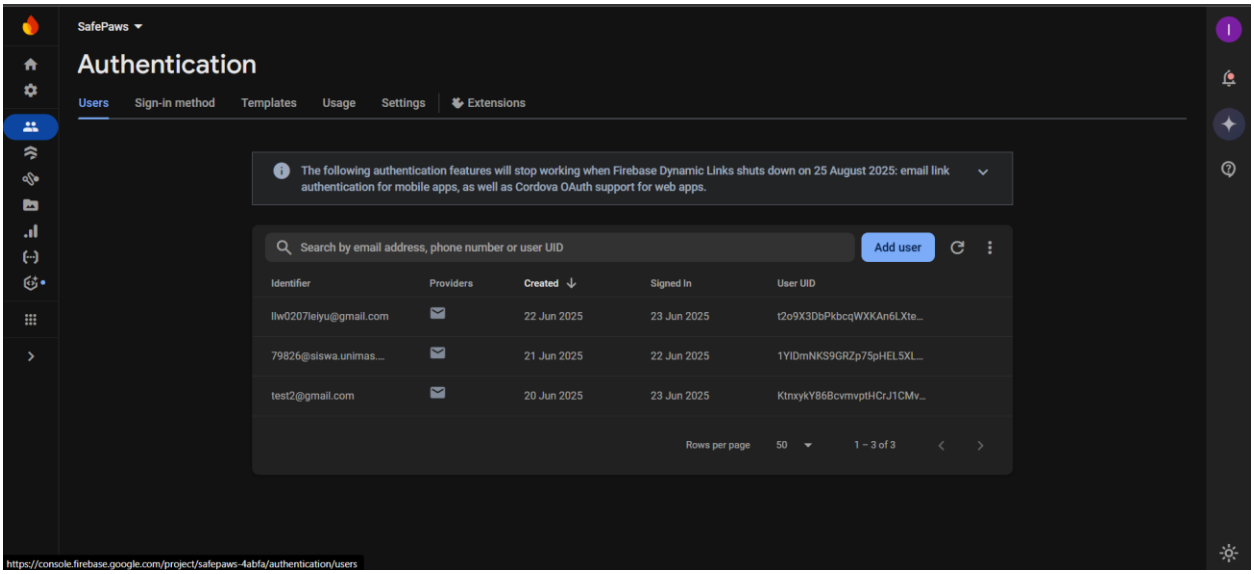


Figure 55: Firebase User Authentication of SafePaws

4.3.3 Data Storage Layer

The data storage layer in the SafePaws app is responsible for securely storing and managing all essential data related to users and pets. This includes user profile details, pet information (such as name, breed, age, and type), incident reports (like bite cases or suspected rabid animals), and chat messages. Firebase Firestore is used to store and synchronize this data in real-time, ensuring that it is accessible across any device the user logs into. Additionally, Firebase storage is integrated into this layer to handle media files, such as images of pets or user profile pictures. These files are securely stored in the cloud and linked to the relevant data in Firestore. By using both Firestore for structured data and Firebase Storage for media content, the Data Storage Layer ensures that all information is securely stored, consistently updated, and accessible, providing a reliable and efficient user experience.

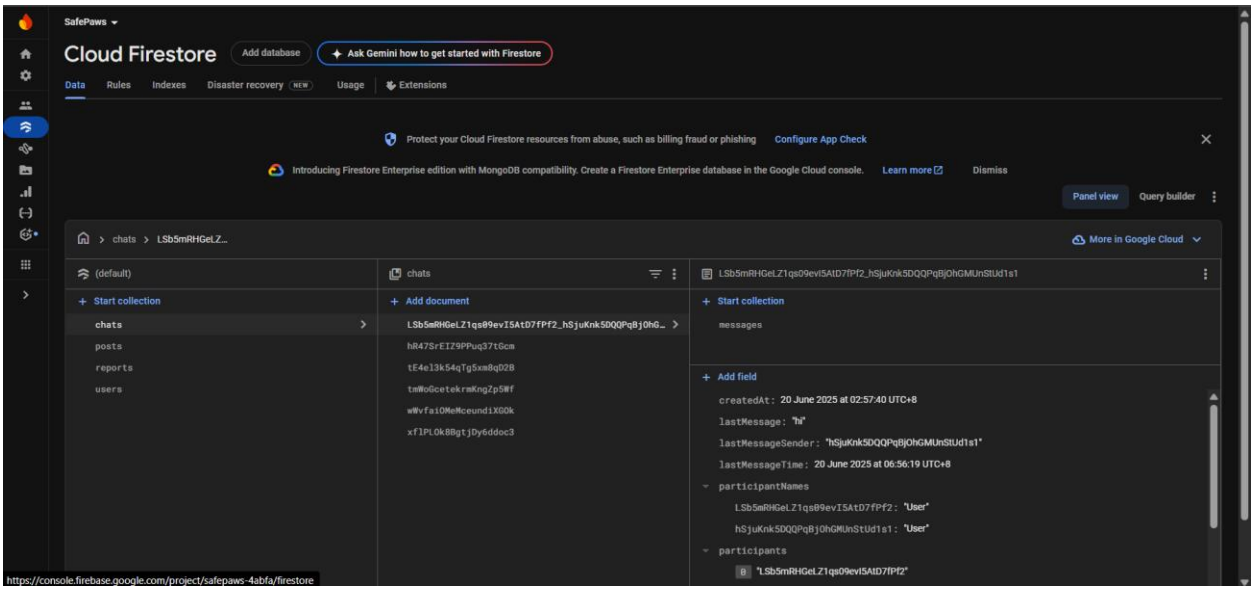


Figure 56: Firebase Firestore Database of SafePaws

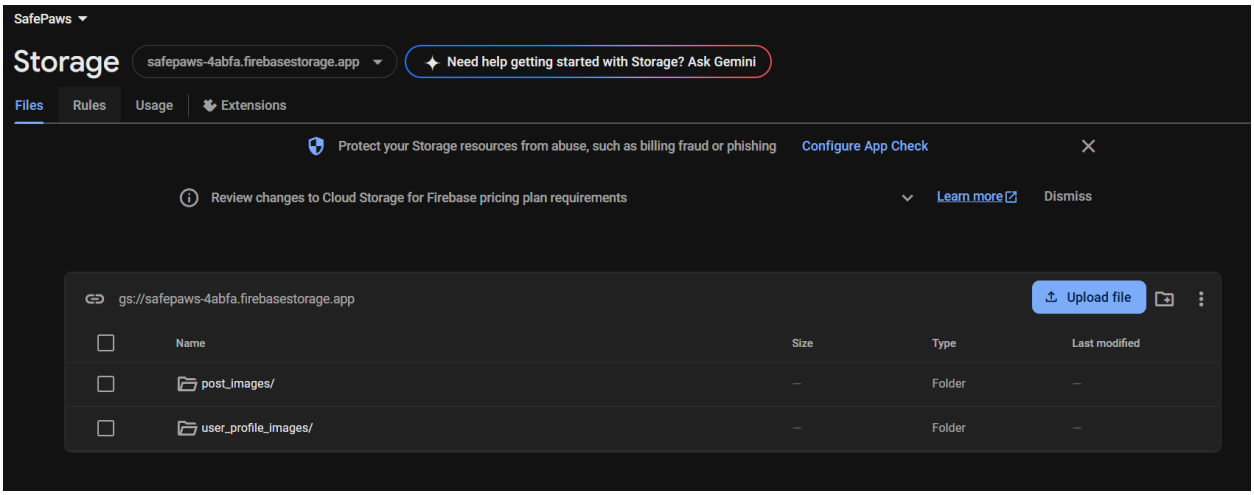


Figure 57: Firebase Storage of SafePaws

4.4 SafePaws User's Description

General Users

Individuals who use the SafePaws app to manage their pet-related activities, including reporting lost pets, adopting new pets, and assisting with stray animal care. These users can create and edit their profiles, post about lost or found pets, report incidents like animal bites or rabies suspicions, and interact with other users through chat. They are typically looking to help the community by supporting lost pets, adopting new ones, and contributing to animal welfare efforts.

4.5 SafePaws Module Implementation

1. User Profile Management

The User Profile Management module allows users to create and manage their profiles. Users input personal details such as their name, contact information, and preferences for pet adoption or lost pet notifications. This information helps personalize their experience, ensuring they receive relevant updates about pet adoption, lost pets, and incident reports. The module ensures

a tailored experience that aligns with the user’s interest in animal welfare and community engagement.

2. **Post Browsing Module**

   The Post Browsing Module lets users browse all pet-related posts made by others, including Find Adoption, Find Lost Pet, Adopted, and Found posts. Each post includes brief details such as the pet's name, age, gender, breed, status, location, and the time it was posted. When users click on a post, they can view expanded information, such as color, fur length, vaccination status, and more. The module also offers the ability to bookmark posts for later viewing, and users can contact the post owner directly based on the current user's role (pet owner or viewer).

3. **Post Management Module**

   The Post Management Module enables users to create, view, edit, and delete their own posts related to lost or found pets or adoption opportunities. Users can easily manage their posts from the "My Posts" section in their profile. When creating a new post, users must fill out fields such as pet name, age, gender, breed, status (lost, found, adoption), location, and images. The module allows users to edit or delete posts, ensuring that their data stays current. Changes to posts are reflected immediately on the UI and in the database.

4. **Incident Report Module**

   The Incident Report Module allows users to send reports related to stray or potentially dangerous animals, such as bite cases or suspected rabid animals, directly to the responsible local authorities via email. Users fill out a form with required fields such as case type, user information (name, phone, email), incident details, and location. The module sends the report to the appropriate local authorities and allows users to view the status of their reports in the "My Reports" section on their profile, ensuring timely follow-ups and accountability.

5. **AI Chatbot Module**

The AI chatbot integrated into the SafePaws mobile application acts as an interactive assistant that provides general pet care advice and safety guidelines. It uses natural language processing (NLP) to understand user queries and respond based on context and intent. Users can ask questions like “What should I do if my dog is choking?” or “How to take care of a newborn kitten?”, and the chatbot replies with helpful information drawn from general pet care knowledge. It also maintains conversational flow, allowing follow-up questions in the same session, making interactions more natural and user-friendly, especially for those unfamiliar with structured inputs.

The chatbot stores the chat history temporarily during the session, which can be cleared manually by the user. Additionally, since it relies on cloud-based processing, the chatbot requires an active internet connection to function. Overall, the AI chatbot plays a supportive role in SafePaws by empowering users to make informed decisions and by supplementing the platform’s goal of improving animal care awareness within the community.

6. **Vet and Pet Store Module**

The Vet and Pet Store Module helps users find nearby vets and pet stores based on their current location. The module offers a toggle feature to switch between vet and store views. It displays business details such as name, address, opening hours, and distance from the user's location. Users can click to view more details, including contact information (phone, SMS, WhatsApp) and navigate to the business on a map or visit their website. This module ensures users can easily access essential pet care services nearby.

4.6 Interfaces of SafePaws

This section presents screenshots of the SafePaws app, each demonstrating how the app addresses specific user needs, including profile management, meal tracking, workout logging, and user interaction with the SafePaws features.

4.6.1 Login Page

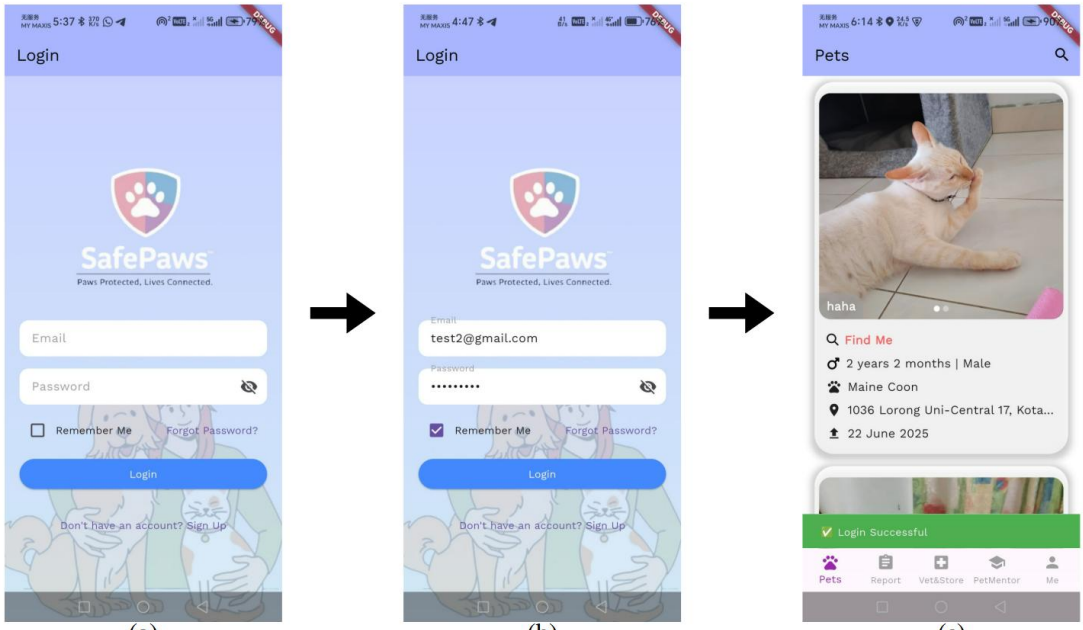


Figure 58: Login Page of SafePaws

Figure 58 shows the SafePaws mobile app login page, which is the first screen users see when opening the app. To access the app, users must enter their email and password. A "Remember Me" feature is available to help users save their login credentials, so they do not have to re-enter them each time they open the app. If a user forgets their password, they can tap "Forgot Password" to reset it. For first-time users who do not have an account yet, tapping "Sign Up" will guide them through the registration process. Once the user logs in successfully, a success message will be displayed, and they will be immediately directed to the home page (Pets page).

4.6.2 Register Page

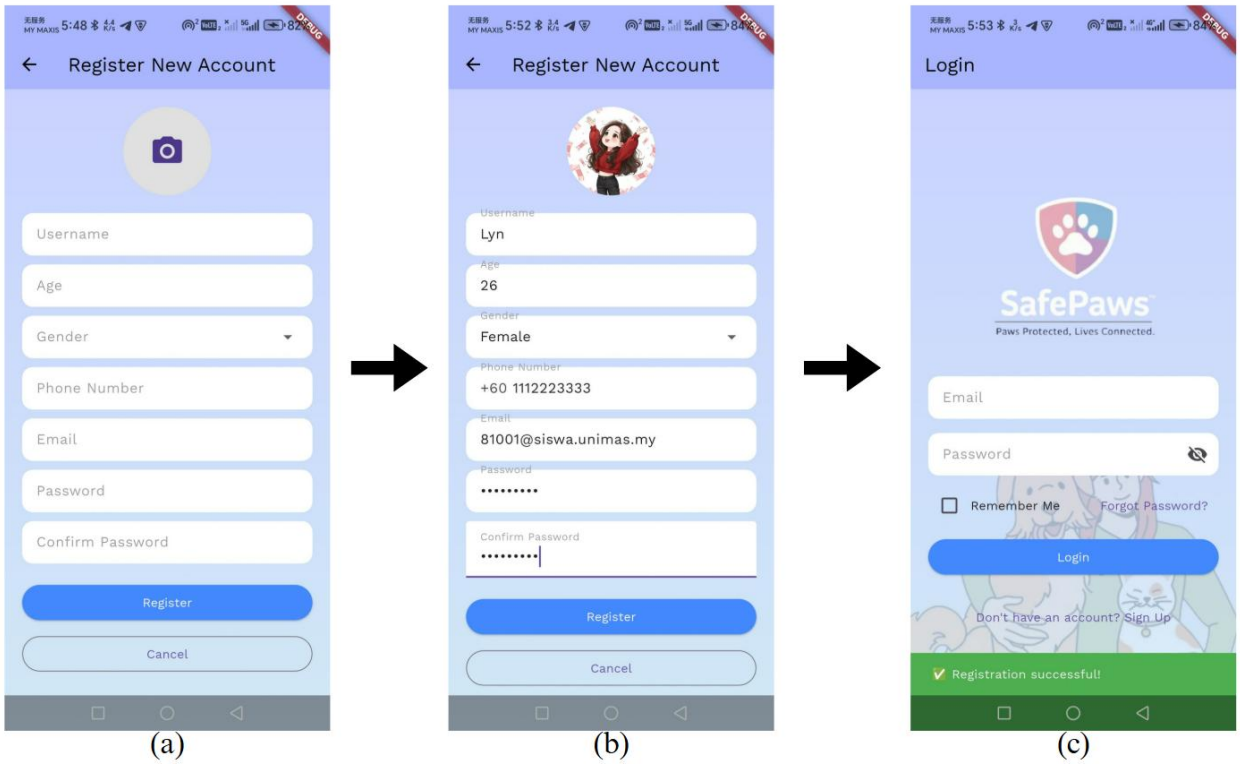


Figure 59: Register Page of SafePaws

Figure 59 shows the registration page of the SafePaws mobile app. Users can access this page by tapping the "Sign Up" button on the login screen. This page allows new users to create an account for the app. After filling in all the required fields and passing validation, the user can tap the "Register" button to proceed to the login page. Once the account is successfully created, a confirmation message will be displayed, and the user can then log in using the email and password they just set up.

4.6.3 Reset Password Page

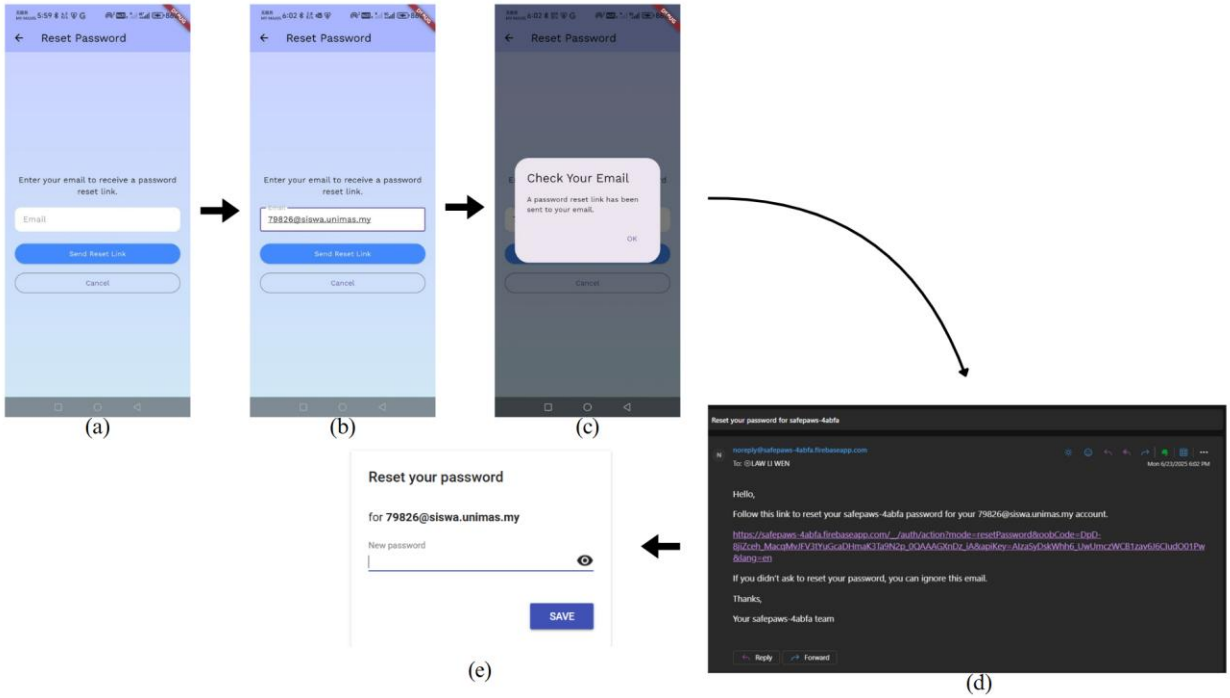


Figure 60: Reset Password Page for SafePaws

Figure 60 shows the Reset Password page of the SafePaws mobile app. When a user taps "Forgot Password" on the login page, they are redirected to this page. To reset their password, the user must enter the email address associated with their account and tap "Send Reset Link." A prompt will then appear, instructing the user to check their email for the reset link. The reset email will arrive shortly in the user's inbox. Upon clicking the link in the email, the user will be guided to a page where they can set a new password. After entering and confirming a valid new password, a confirmation message will appear, indicating the password has been successfully changed. The user can then return to the app and log in using their email and the newly set password.

4.6.4 Home Page/Pets Page

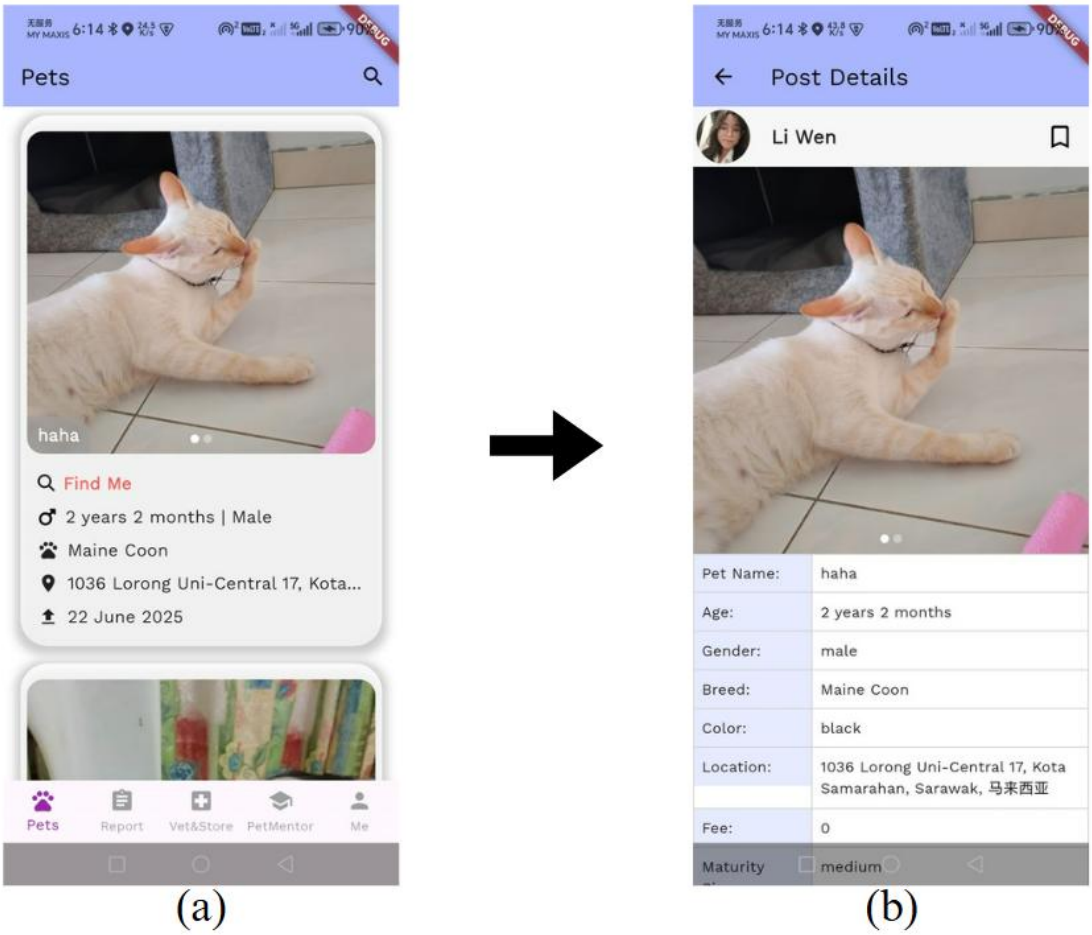


Figure 61: Home Page/Pets Page of SafePaws

Figure 61 shows the home page (Pets page) of the SafePaws mobile app under post browsing module. It appears immediately after the user logs in. This page displays all pet posts in a scrollable feed. Users can scroll down to browse more posts and view brief information about each pet. If a post contains multiple images, users can swipe left or right to view them. By tapping on a post, users are directed to the Pet Details page, where they can view more detailed information, including the exact location of the pet on a map.

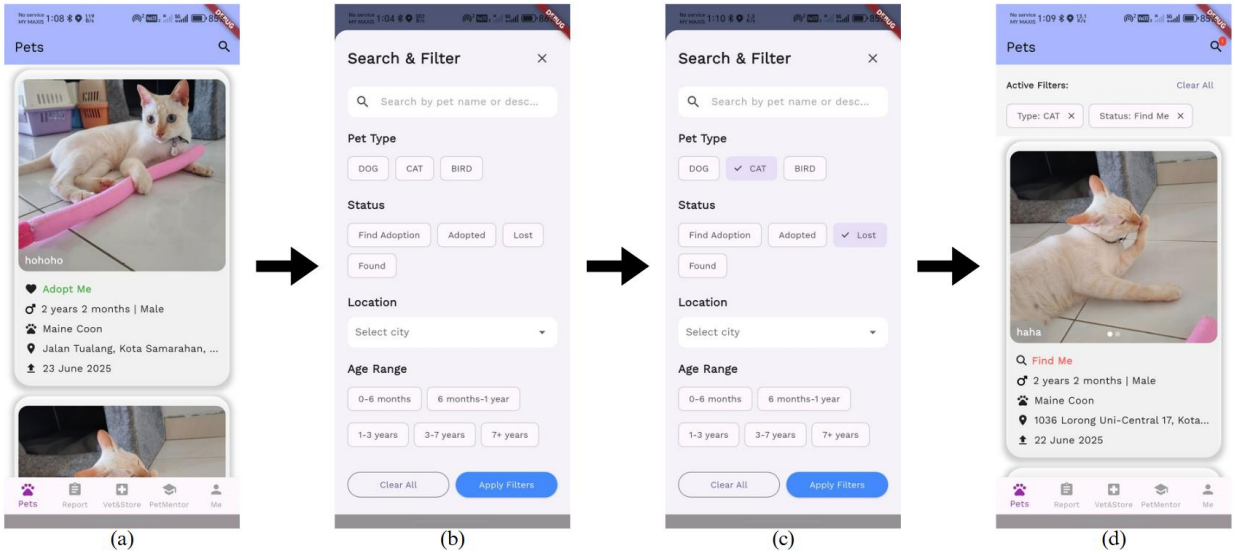


Figure 62: Filter Feature for Pet Post

Figure 62 represents the filter feature for the pet posts. It allows users to narrow down posts based on specific criteria such as pet name, type, status, location, and age range, making it easier to find specific pets of interest. In addition, there is a favorite or bookmark feature in the post detail page.

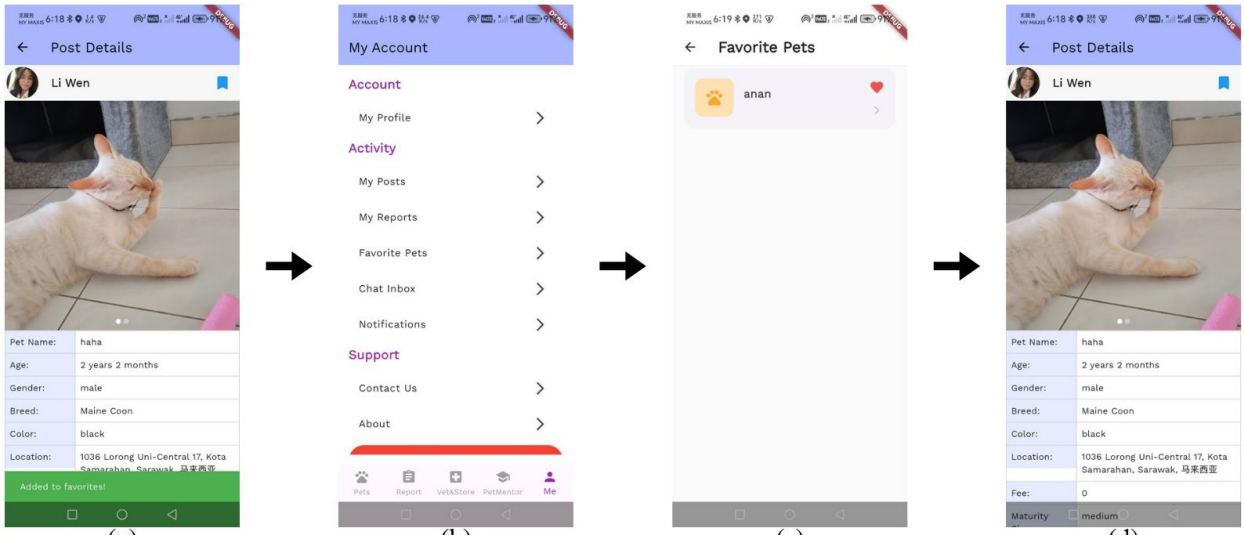


Figure 63: Favorite Feature of Pet Post

Figure 63 shows the favorite pets feature for the post. When a user views a pet's detail page, they can tap the bookmark icon located at the top right corner of the screen to save the post privately. Once tapped, the icon becomes filled to indicate that the post has been bookmarked. To view saved posts, the user can navigate to the **"Me"** section from the bottom navigation bar and select **"**Favorite Pets." The bookmarked post will appear on this page. Users can tap on any post in the Favorite Pets page to view its full details. Tapping the bookmark icon again will unfilled it and remove the pet post from the Favorite Pets list.

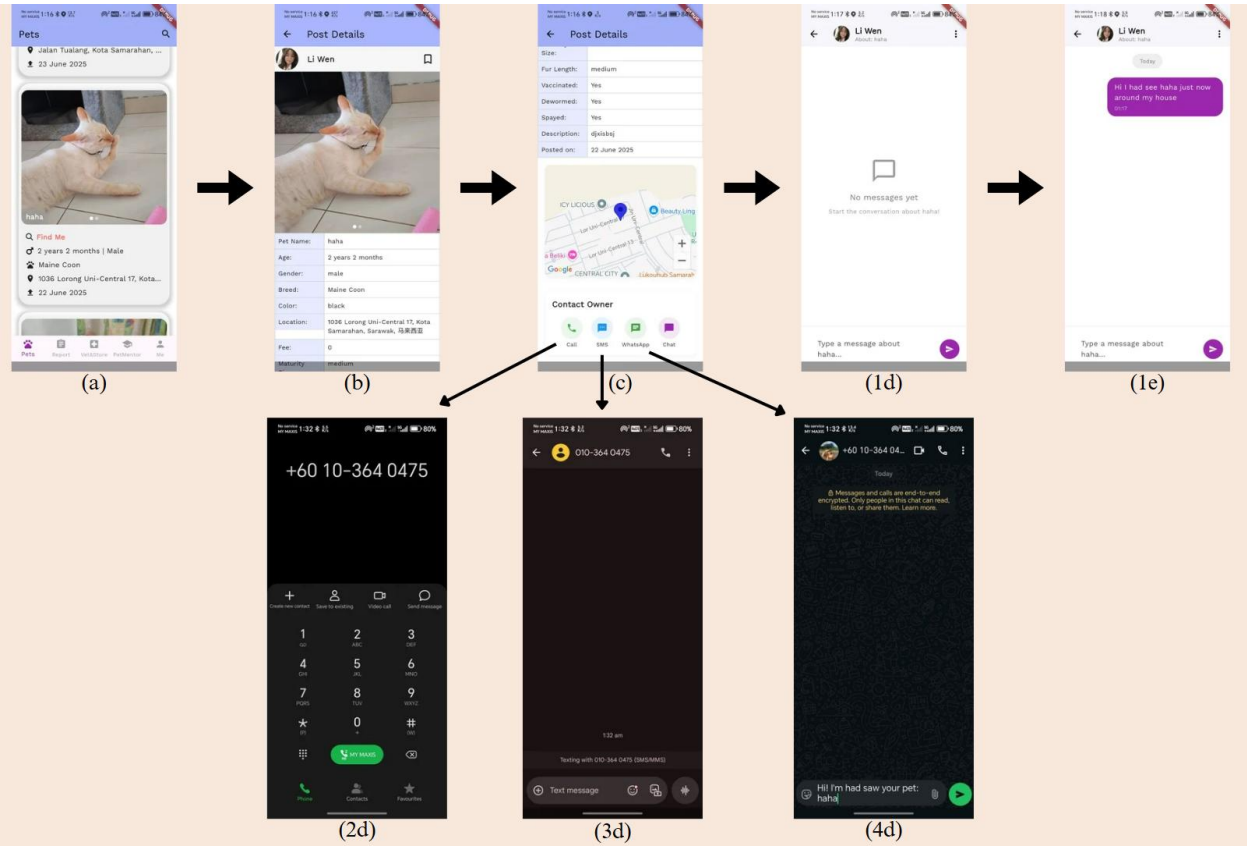


Figure 64: Chat Feature for Post

Figure 64 illustrates the chat feature for a post. On the pet detail page, there is a “Contact Owner” section that provides four contact options: calling via phone, sending a message via SMS, WhatsApp and through the in-app chat. These options allow users to contact the post owner directly.

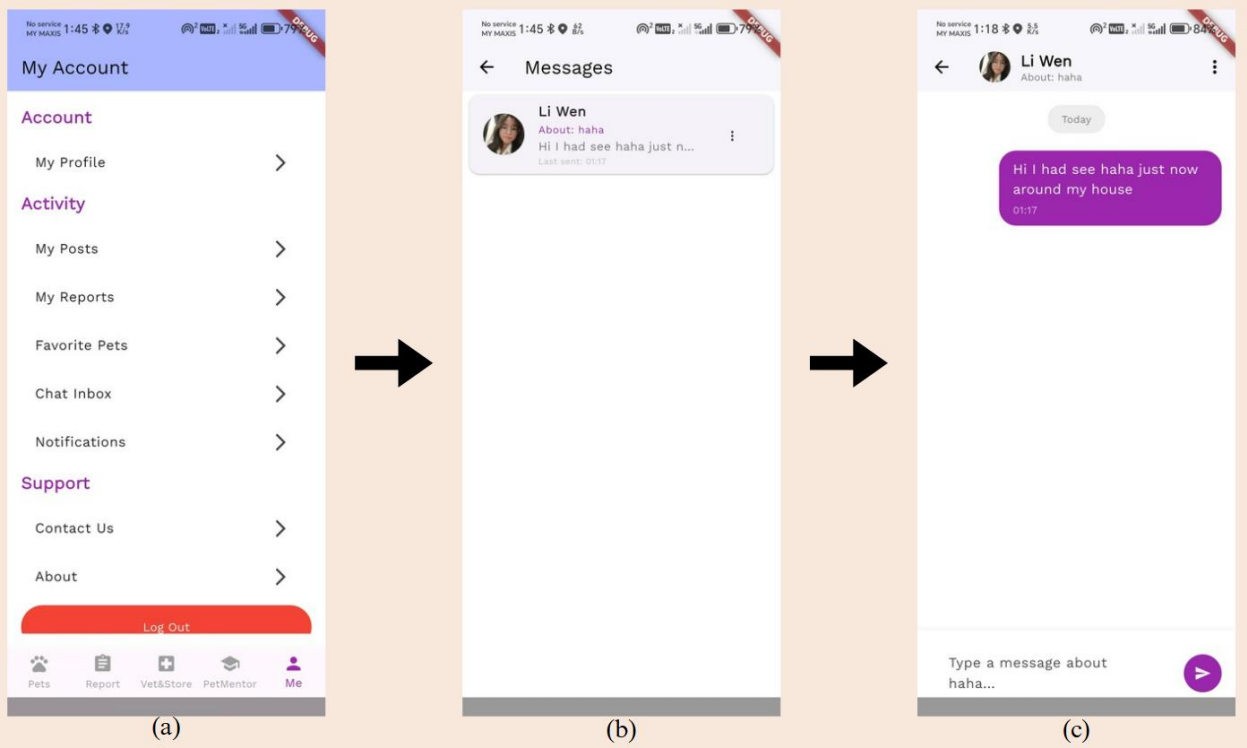


Figure 65: In-app Chat Inbox Feature from Perspective of Non-post Owner User

Figure 65 shows the in-app chat inbox feature for a post from the perspective of a non-post owner user. After sending a message via the in-app chat, the user can view the message history on the "Chat Inbox" page. Users can also delete chat conversations as needed by tapping the vertical ellipsis (⋮) icon.

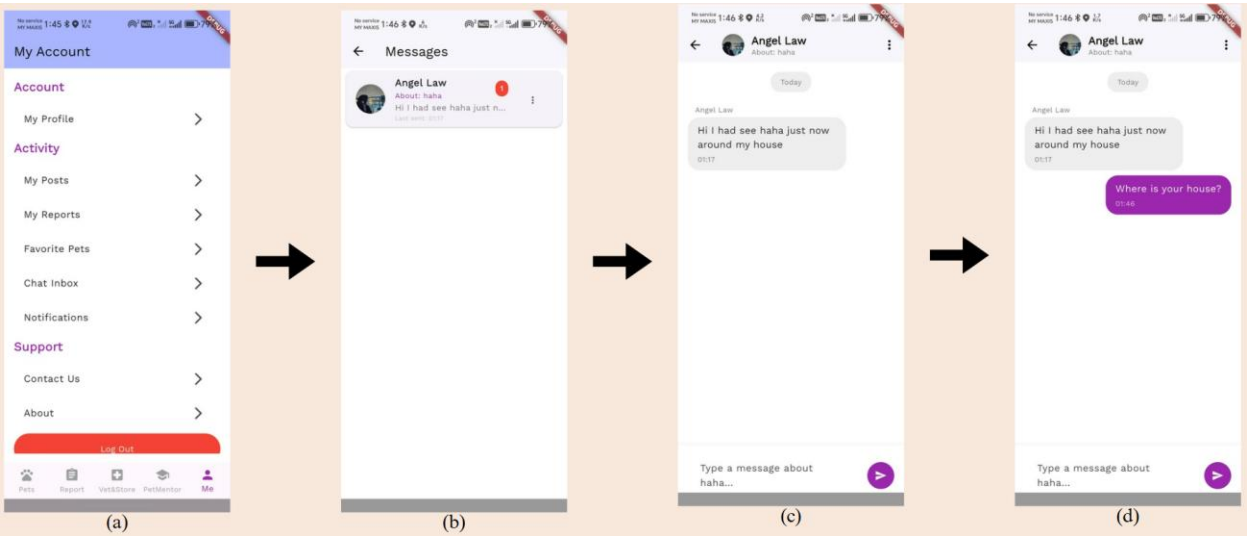


Figure 66: In-app Chat Inbox Feature from Perspective of Post Owner

Figure 66 shows the in-app chat inbox feature from the perspective of the post owner. Once they open the app, they can check messages in the "Chat Inbox." An unread message badge appears on the chat inbox icon to notify the user of new incoming messages.

4.6.5 Incident Report Page

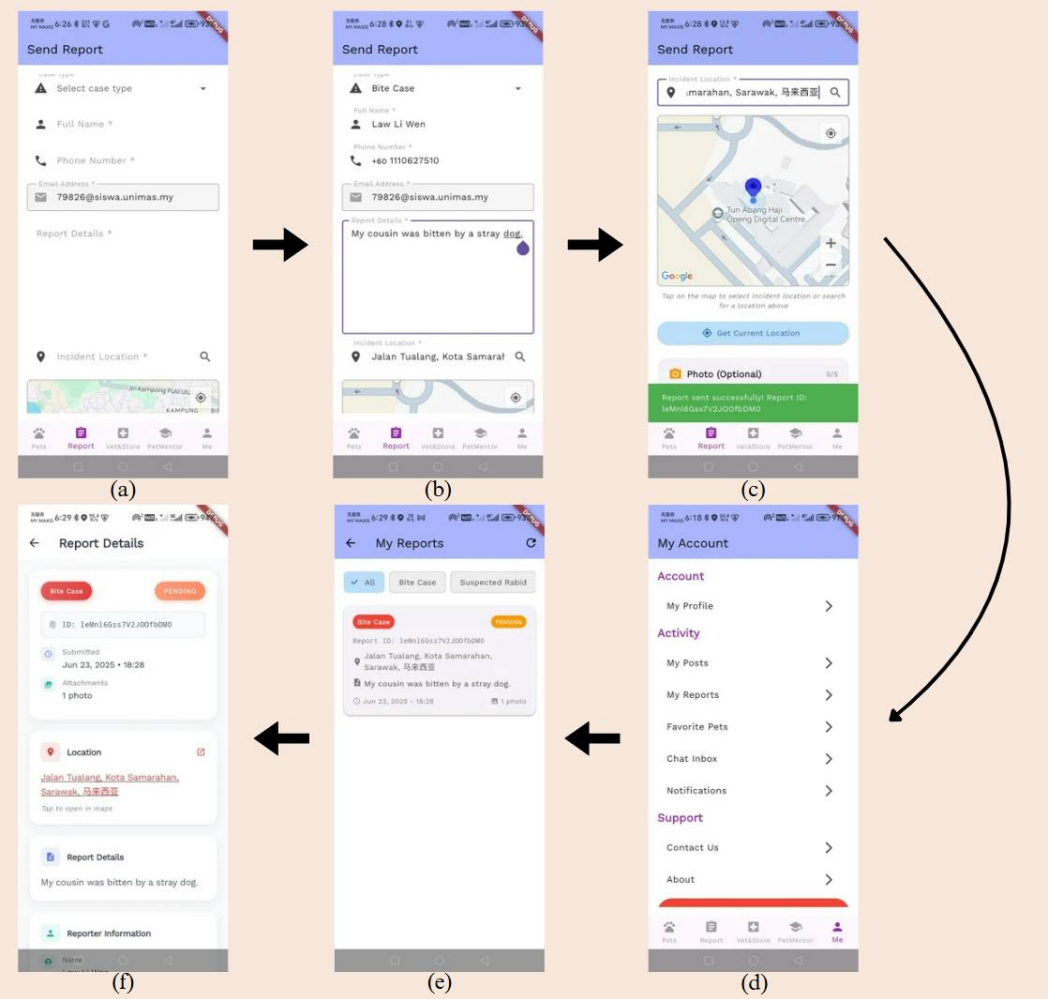


Figure 67: Incident Report Page of SafePaws

Figure 67 shows the incident report page of the SafePaws app. This feature allows users to create and submit reports regarding bite cases or suspected rabid animals. Users are required to fill in all mandatory fields, including case type, full name, phone number, report details, location, and optionally, photos**.** The email field is automatically populated with the user's registered email and is non-editable, as it will be used as the reply-to address when the report is sent via email. Reports are submitted directly to the appropriate local authorities through email. The sender is the app's email address, the recipient is the local authorities s email, and the user's email is set as the reply-

to address for further communication. Once the report is successfully submitted, a confirmation message is displayed. Users can view all the reports they have submitted by navigating to “My Reports” under the “Me” section in the bottom navigation bar. From there, users can tap on any report to view its full details.

4.6.6 Vet & Store Page

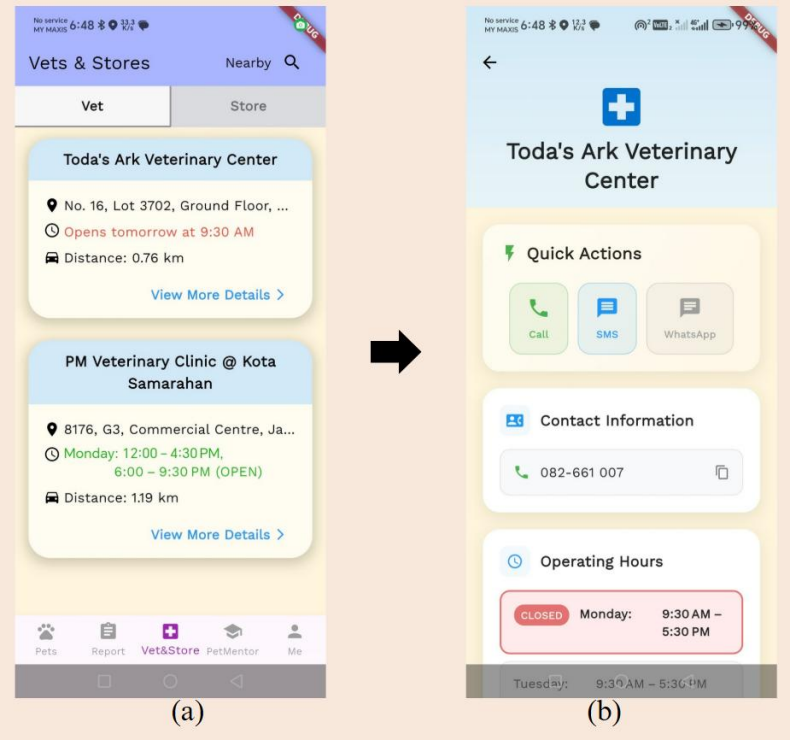


Figure 68: Veterinary Clinic Page of SafePaws

Figure 69: Pet Store Page of SafePaws

Figure 68 and figure 69 show the Veterinary Clinics and Pet Stores pages of the SafePaws app. Information for veterinary clinics and pet stores is displayed on separate views. The list of results is based on the user's current location or areas within Sarawak. Each listing shows brief details, including the address, the current or upcoming opening time, and the distance from the user's location. By tapping "View More Details," users can access additional information about the business. If available, users can contact the clinic or store directly via Call, SMS, or WhatsApp buttons. The details page also displays the phone number, weekly operating hours, clickable address (which opens in a map app), and a website link if provided.

4.6.7 AI Chatbot Page

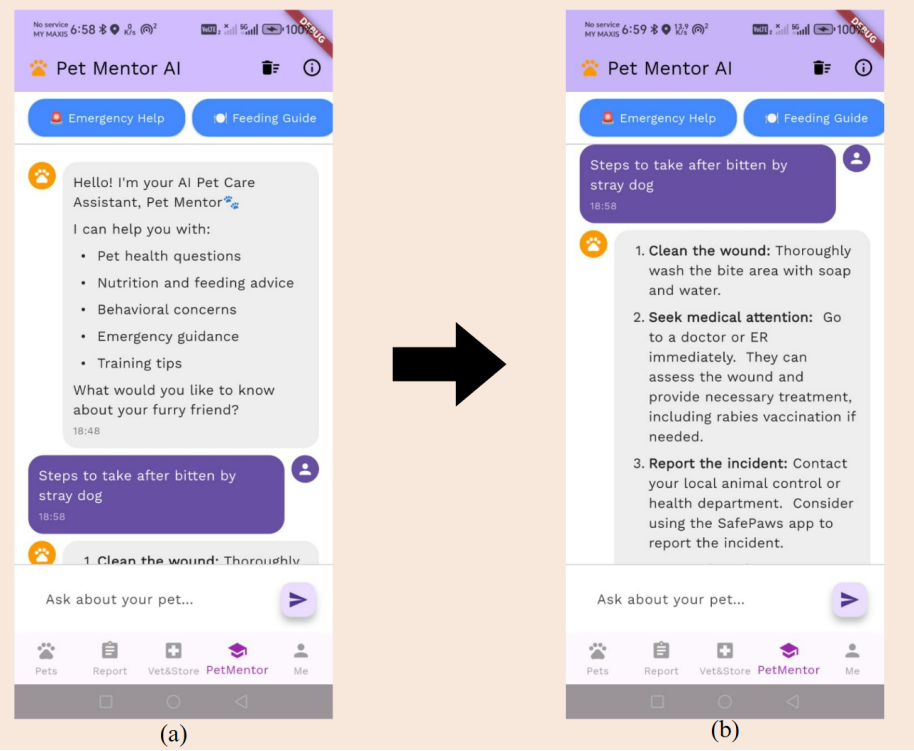


Figure 70: AI Chatbot Page for SafePaws

Figure 70 shows the AI chatbot page of the SafePaws app. The chatbot, named PetMentor, allows users to ask pet-related questions. It can assist with various topics such as emergency procedures, feeding guidelines, training tips, pet care, and more. For example, users can ask questions like "What should I do if I'm bitten by a dog?", "How do I take care of a kitten?", or "What should I do if my cat is choking?" PetMentor is designed specifically for pet-related topics. Questions that are unrelated to pets will be rejected as the chatbot only responds to pet-specific queries.

4.6.8 Profile Page

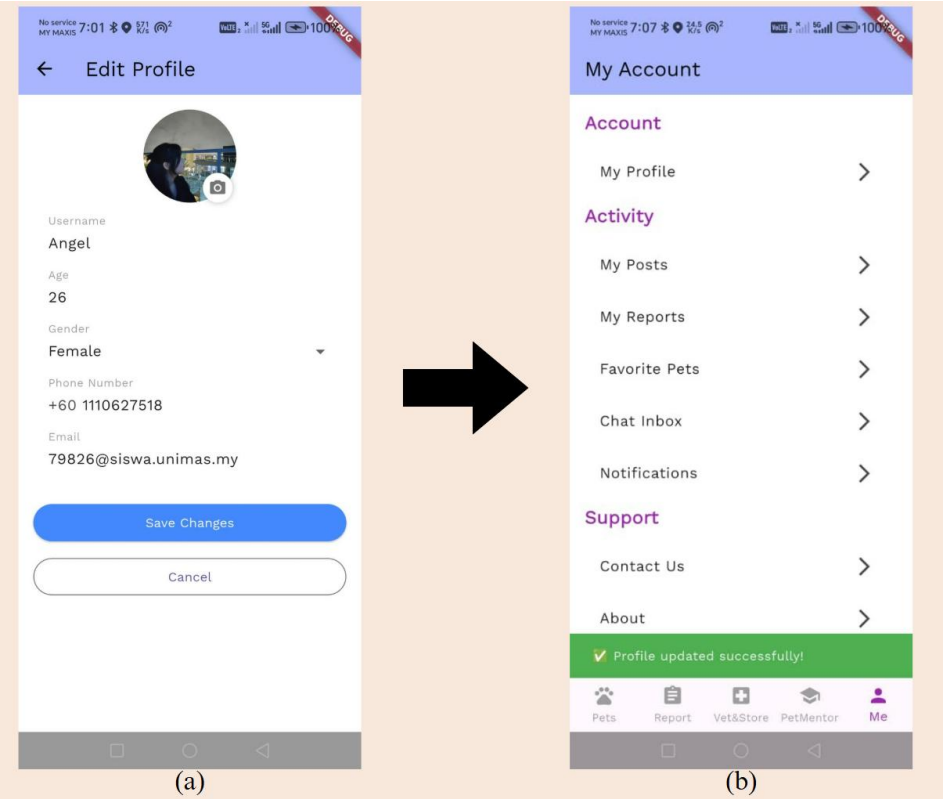


Figure 71: Profile Page for SafePaws

Figure 71 shows the Profile Page of the SafePaws app. By tapping on “My Profile,” users are directed to the Edit Profile page, where they can view and update their personal information. After making changes, tapping the “Save Changes” button will display a confirmation message indicating the profile has been successfully updated.

4.6.9 Post Management Page

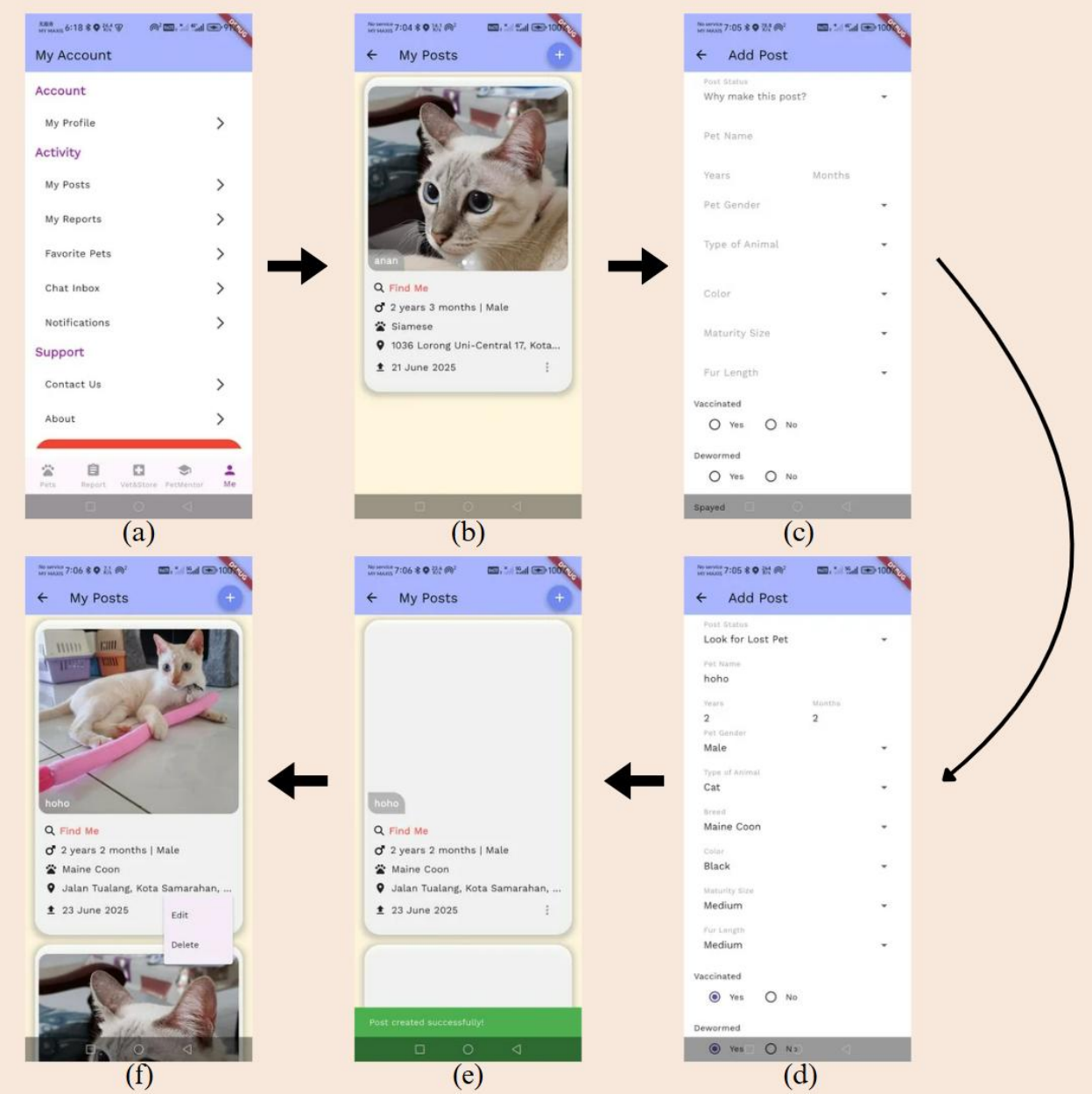


Figure 72: Post Management Page of SafePaws

Figure 72 shows the Post Management page of the SafePaws app. This page allows users to create, view, edit, and delete posts they have made. In the “My Posts” section, users can view all the posts they have submitted. By tapping the add (+) icon at the top right corner of the page, users can create a new post by filling in all the required fields. Once the post is successfully created, a

confirmation message will be displayed. Each post includes a vertical ellipsis icon (⋮) at the bottom right corner. Tapping this icon reveals options to edit or delete the post. If the user selects delete, a confirmation dialog will appear and then tapping Yes will permanently remove the post.

4.7 Summary

The implementation of SafePaws involves using tools like Android Studio, Flutter, and Firebase to build a three-tier architecture comprising the presentation, business logic, and data storage layers. Each module supports essential features such as user authentication, pet post browsing and management, stray animal incident reporting with geolocation, and access to nearby veterinary clinics and pet stores. An AI chatbot is integrated to offer pet care guidance. Screenshots and interface descriptions demonstrate the user experience and confirm that the implementation aligns with the design and requirement specifications.

CHAPTER 5: SYSTEM TESTING

5.1 Introduction

This chapter outlines the system testing conducted to ensure the application functions correctly and meets user expectations. It includes functional testing, which verifies that all features work as intended, and non-functional testing**,** which evaluates performance, usability, and reliability. These tests collectively ensure that the system performs reliably, meets quality standards, and is prepared for deployment.

5.2 Fucntional Testing

Functional testing focuses on verifying that each feature of the application works according to the specified requirements. It ensures that all user inputs, processes, and outputs behave as expected. This includes testing core functions such as data input, user interactions, and system responses to confirm the app performs its intended tasks correctly.

5.2.1 Test Case for Registration

Table 15: Test Case 1 for Registration

Test Scenario ID	TS_REG_01	**Test Case ID**	TC_REG_01
Test Title	Successful User Registration	**Test Module**	Register Page
Test Case Description	Verify that a new user can successfully register with valid credentials in SafePaws	**Test Priority**	High
Pre-Requisite	- SafePaws app is installed - User is not already registered with the same email	**Post-Requisite**	User is registered successfully and can log in using the registered email and password

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open SafePaws app	N/A	SafePaws app launches and shows login page	Login page displayed	Pass	
2	Tap on “Sign Up” button	N/A	Navigates to Registration Page	Registration Page displayed	Pass	

3	Enter valid credentials	Username: Cindy Age: 28 Gender: Female Phone: 1234567890 Email: usertest@email.com Password: Test@1234 Confirm Password: Test@1234	Credentials entered	Fields accepted	Pass	
4	Tap on “Register” button	N/A	Account created, redirected to Login Page	Redirected to Login Page	Pass	
5	Log in using registered credentials	Same email and password	User redirected to Home Page	Home Page displayed	Pass	

Table 16: Test Case 2 for Registration

Test Scenario ID	TS_REG_02	**Test Case ID**	TC_REG_02
Test Title	Registration with Invalid or Incomplete Information	**Test Module**	User Registration Page
Test Case Description	Verify that the registration process fails when the user provides invalid, incomplete, or duplicate input	**Test Priority**	High
Pre-Requisite	- SafePaws app is installed - Registration page is accessible	**Post-Requisite**	User is not registered; proper error messages are displayed; fields remain for correction

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open Register Page	N/A	Registration page opens	Registration page displayed	Pass	UI loads properly

2	Leave all fields empty	N/A	Show validation errors for all fields	Errors shown (e.g., "Email is required")	Pass	Empty input blocked
3	Enter invalid email format	Email: test123	Show “Enter a valid email address” message	Error message displayed	Pass	Email validation works
4	Enter weak password	Password: 123	Show “Password must be at least 6 characters” message	Invalid password message shown	Pass	Password policy enforced
5	Enter phone number with letters	Phone number: 12345	Show “Enter a valid Malaysian Phone Number” message	Error shown for invalid phone	Pass	Phone format validated
6	Use an already registered email	Email: existing@user.com	Show “This email is already registered” message	Duplicate email error shown	Pass	Duplicate account prevented

7	Tap "Register" with only some fields filled	Email: test@email.com only	Show error for missing fields	Incomplete form error shown	Pass	All fields required

5.2.2 Test Case for Login Module

Table 17: Test Case 1 for Login Module

Test Scenario ID	TS_LGN_01	**Test Case ID**	TC_ LGN_01
Test Title	Successful Login	**Test Module**	Login Page
Test Case Description	Verify that the user can successfully log in using valid credentials	**Test Priority**	High
Pre-Requisite	User has a registered account in Firebase Authentication	**Post-Requisite**	User is logged in and redirected to the Home Page

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Open SafePaws application	Tap app icon	Launch SafePaws login page	Login page opened	Pass	App launched successfully
2	Enter valid credentials	Email: safepawsuser@email.com Password: SafePaws@123	Input accepted	Input accepted	Pass	Valid input
3	Tap on "Login" button	-	Redirected to Home Page	Redirected to Home Page	Pass	Login successful

Table 18: Test Case 2 for Login Module

Test Scenario ID	TS_ LGN_02	**Test Case ID**	TS_ LGN_02
Test Title	Invalid user account	**Test Module**	Login Page
Test Case Description	Verify that login fails and an error is shown when an unregistered email is used	**Test Priority**	Medium

Pre-Requisite		User attempts login with an email not registered in the system	**Post-Requisite**		User remains on login screen with appropriate error message shown
Test Execution Steps:					
S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open SafePaws application	N/A	Login page loads	Login page loaded	Pass	App opened
2	Enter unregistered email and password	Email: notexist@email.com Password: Test123	Show error message: "The supplied auth credential is incorrect, malformed or has expired.”	Error message displayed	Pass	Error shown for invalid account
3	Tap “Login”	N/A	User remains on login page	Still on login page	Pass	Properly blocked invalid login

Table 19: Test Case 3 for Login Module

Test Scenario ID	TS_ LGN_03	**Test Case ID**	TC_ LGN_03
Test Title	Incorrect Password	**Test Module**	Login Page
Test Case Description	Verify that login fails when the user enters a correct email but incorrect password	**Test Priority**	Medium
Pre-Requisite	User must be registered with a valid email	**Post-Requisite**	User remains on login page with a visible error message

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open SafePaws application	Tap app icon	Login page loads	Login page opened	Pass	
2	Enter valid email and wrong password	Email: safepawsuser@email.com	Show error message: "Incorrect password" or equivalent	Error message displayed	Pass	

		Password: Wrong123				
3	Tap "Login"	-	Stay on login page	Login blocked	Pass	

5.2.3 Test Case for Reset Password

Table 20: Test Case 1 for Reset Password

Test Scenario ID	TS_ RPW_01	**Test Case ID**	TC_ RPW_01
Test Title	Successful Password Reset Email Sent	**Test Module**	Reset Password Page
Test Case Description	Verify that the user receives a password reset email after entering a registered email address	**Test Priority**	Medium
Pre-Requisite	User must have a registered account	**Post-Requisite**	Password reset email is sent successfully

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Open Reset Password page	Forgot Password hyperlink	Launch SafePaws Reset Password Page	Launch SafePaws Reset Password Page	Pass	Launch successful
2	Enter registered email	Email: 79826@siswa.unimas.com	Email is accepted	Email accepted	Pass	Input accepted
3	Tap "Send Reset Email" button	Send Reset Email button	Go to the page displaying the success of sending email.	Go to the page displaying the success of sending email.	Pass	Email sent successfully
4	Check email inbox	Checks registered email inbox	Password reset email is received	Email received	Pass	Email delivery confirmed

Table 21: Test Case 2 for Reset Password

Test Scenario ID	TS_ RPW_02	**Test Case ID**	TC_ RPW_02
Test Title	Successful Reset Password	**Test Module**	Reset Password Page

Test Case Description	Verify that the user can login using the password that has already been reset	**Test Priority**	Medium
Pre-Requisite	User must have a registered account	**Post-Requisite**	Login successfully by using password that has been reset

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open Reset Password page	Forgot Password hyperlink	Launch SafePaws Reset Password Page	Launch SafePaws Reset Password Page	Pass	Launch successful
2	Enter registered email	Email: 79826@siswa.unimas.com	Email is accepted	Email accepted	Pass	Input accepted

3	Tap "Send Reset Email" button	Send Reset Email button	Go to the page displaying the success of sending email.	Go to the page displaying the success of sending email.	Pass	Email sent successfully
4	Check email inbox	Checks registered email inbox	Password reset email is received	Email received	Pass	Email delivery confirmed
5	Click on the link of reset password in the email	Link of reset password	Go to Reset Password Page from Firebase	Go to Reset Password Page from Firebase	Pass	Go to Reset Password Page from Firebase successfully
6	Key in the new password	New password: Newpassword@123	Reset password successful	Reset password successful	Pass	Password reset successful

7	Proceed to login using new password	New password: Newpassword@123	Login successful	Login successful	Pass	Login successful using new password

5.2.4 Test Case for Post Browsing Module

Table 22: Test Case 1 for Post Browsing Module

Test Scenario ID	TS_PB_01	**Test Case ID**	TC_PB _01
Test Title	Display All Pet Posts on Pets Page	**Test Module**	Post Browsing Module
Test Case Description	Verify that all pet posts with brief information are displayed correctly to the user in the post feed.	**Test Priority**	High
Pre-Requisite	User is logged into the app and has internet connection.	**Post-Requisite**	User remains on the Pets page or can click to view details.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Navigate to “Pets” page	Tap on “Pets” tab on the navigation bar	All posts are displayed.	All posts are displayed.	Pass	
2	View the list of pet posts	N/A	Pet posts displayed with: name, status, age, gender, breed, address, posted date and image.	All expected fields are visible for each post.	Pass	
3	Scroll down the post list	N/A	More posts are loaded dynamically.	Posts loaded as expected.	Pass	
4	Tap on any post	N/A	Post detail page is opened.	Detail page opened correctly.	Pass	

Table 23: Test Case 2 for Post Browsing Module

Test Scenario ID	TS_PB_02	**Test Case ID**	TC_PB _01
Test Title	Search and Filter Posts	**Test Module**	Post Browsing Module

Test Case Description	Ensure that users can filter and search pet posts by pet type, status, location, and age range	**Test Priority**	High
Pre-Requisite	Multiple posts exist in the database with different types, statuses, locations, and ages	**Post-Requisite**	Filtered results are displayed based on selected criteria

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to “Pets” page	Tap "Pets" on navigation bar	Post list is loaded.	As expected	Pass	
2	Tap the magnifying glass icon at the top right corner of the page	N/A	Filter UI is shown.	As expected	Pass	

3	Apply filters	Pet name: Lucky Pet type: Dog Status: Find Adoption Pet location: Kuching Age: 1–3 years	Post list is updated and matching post is shown.	As expected	Pass	
4	Clear filters	Tap "Clear All"	Full post list is shown again.	As expected	Pass	

Table 24: Test Case 3 for Post Browsing Module

Test Scenario ID	TS_PB_03	**Test Case ID**	TC_PB _01
Test Title	Bookmark Post	**Test Module**	Post Browsing Module
Test Case Description	Validate bookmark icon toggles and saves the post to favorites	**Test Priority**	Medium
Pre-Requisite	User is logged in.	**Post-Requisite**	Post is saved in favorites.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Navigate to “Pets” page	Tap "Pets" on navigation bar	Post list is loaded.	As expected	Pass	
2	Tap on any post	N/A	Post detail page is opened.	As expected	Pass	
3	Tap bookmark icon on post	N/A	Icon changes to filled as bookmarked.	As expected	Pass	The icon stays filled until tapped again, then it becomes unfilled.
4	Navigate to “Me” page	Tap "Me" on navigation bar	A list of user-related features is shown on the page.	As expected	Pass	
5	Tap “Favorite Pets” under activity category and view list of posts	N/A	Bookmarked posts are shown only.	As expected	Pass	
6	Tap on post	N/A	Details of the bookmarked post are displayed.	As expected	Pass	

Table 25: Test Case 4 for Post Browsing Module

Test Scenario ID	TS_PB_04	**Test Case ID**	TC_PB _01
Test Title	Post Owner Conditional View for Contact Section of Post	**Test Module**	Post Browsing Module
Test Case Description	Ensure that when the post owner views their own post, they see a message instead of contact buttons.	**Test Priority**	High
Pre-Requisite	User is logged in and has created at least one post.	**Post-Requisite**	The post owner can go to in-app chat to see if anyone contact him/her.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to “Pets” page	Tap on “Pets” tab on the navigation bar	List of posts are loaded.	As expected.	Pass	

2	Tap on the post created by the current logged-in user	User post ID	Post details are displayed.	As expected.	Pass	If no post, go to TC_PM_01 to create a post.
3	View contact owner section	N/A	• Message shown: “This is your post. Check your call, SMS, WhatsApp or in-app chat to see if someone has contacted you.” • No contact buttons are displayed. • Prompt the post owner to open the chat inbox via a button	As expected.	Pass	

Table 26: Test Case 5 for Post Browsing Module

Test Scenario ID	TS_PB_05	**Test Case ID**	TC_PB _01
Test Title	Other User Contact Buttons on Contact Section of Post.	**Test Module**	Post Browsing Module
Test Case Description	Verify contact buttons are displayed for non-owners.	**Test Priority**	High
Pre-Requisite	A post created by another user exist.	**Post-Requisite**	User able to contact the post owner.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Login as different user	Email: 79826@siswa.unimas.my Password: Llw@12345	Logged in successfully.	As expected	Pass	
2	Navigate to “Pets” page	Tap "Pets" on navigation bar	Post list is loaded.	As expected	Pass	

3	Tap on another user's post	N/A	Details of the post are displayed.	As expected	Pass	
4	Scroll down and check contact section	N/A	Call, SMS, WhatsApp, and Chat buttons are visible.	As expected	Pass	
5	Tap "Call" icon	Post owner’s phone number	User is redirected to dialer page of phone with post owner’s number pre-filled.	As expected	Pass	
6	Tap “SMS” icon	Post owner’s phone number	User is redirected to SMS page to message to the post owner	As expected	Pass	
7	Tap “WhatsApp” icon	Post owner’s phone number	User is redirected to WhatsApp with a pre-filled message to the post owner: 'Hi, I want to	As expected	Pass	

			contact you about [pet name]			
8	Tap “Chat” icon	“Hi, I am Lasly”	User is redirected to the in-app chat page to message the post owner.	As expected	Pass	

Table 27: Test Case 6 for Post Browsing Module

Test Scenario ID	TS_PB_06	**Test Case ID**	TC_PB _01
Test Title	Start a chat with post owner	**Test Module**	Post Browsing Module
Test Case Description	To verify that the user can successfully initiate a chat with the post owner from the pet detail page and that the chat session is properly created and accessible through the Chat Inbox.	**Test Priority**	Medium
Pre-Requisite	User is logged in.	**Post-Requisite**	Chat session is created between user and post owner.

Test Execution Steps:						
S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Tap on a post that created by other users	N/A	Post detail page is opened.	As expected	Pass	
2	Scroll down and tap on “Chat” button	N/A	Chat page with post owner is navigated.	As expected	Pass	
3	Type a message	“Is this pet still available?”	Text is displayed in input box.	As expected	Pass	
4	Tap Send icon	N/A	Message is sent and appears in chat history	As expected	Pass	
5	Navigate to “Me” page	Tap "Me" on navigation bar	A list of user-related features is shown on the page.	As expected	Pass	

6	Tap on “Chat Inbox” under activity category	N/A	Chat list with other users is shown.	As expected	Pass	
7	Tap on a chat thread	N/A	Chat history with all past message is displayed.	As expected	Pass	

Table 28: Test Case 7 for Post Browsing Module

Test Scenario ID	TS_PB_07	**Test Case ID**	TC_PB_07
Test Title	Delete chat conversation	**Test Module**	Post Browsing
Test Case Description	Verify that when either user deletes a chat, the conversation is removed from both users’ chat inboxes	**Test Priority**	High
Pre-Requisite	Active chat exists	**Post-Requisite**	Chat is removed from both inboxes

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Navigate to “Me” page	Tap "Me" on navigation bar	A list of user-related features is shown on the page.	As expected	Pass	
2	Tap on “Chat Inbox” under activity category	N/A	Chat list with other users is shown.	As expected	Pass	
3	Tap on the vertical “…” on the tight side of a chat thread	N/A	A button of delete chat is shown.	As expected	Pass	
4	Tap delete chat	Confirm deletion	Confirmation message is displayed.	As expected	Pass	
5	Click Yes to confirm deletion	N/A	Chat removed from current user's inbox and Firebase. Chat no longer appears in another user's inbox.	As expected	Pass	

Table 29: Test Case 8 for Post Browsing Module

Test Scenario ID	TS_PB_08	**Test Case ID**	TC_PB _01
Test Title	Display Message When No Posts Exist	**Test Module**	Post Browsing Module
Test Case Description	Simulate an empty post collection in Firebase and verify that the user is informed properly	**Test Priority**	Medium
Pre-Requisite	Firebase posts collection is empty or filtered query returns no documents.	**Post-Requisite**	Restore original posts data if needed.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Open the app and navigate to “Pets” page	Tap on “Pets” tab on the navigation bar	App is open and post list page is opened.	App opened and page opened.	Pass	
2	Simulate empty collection	No documents in “posts” collection in the Firebase	A message: “No posts available” is displayed.	Message displayed correctly.	Pass	

5.2.5 Test Case for Post Management Module

Table 30: Test Case 1 for Post Management Module

Test Scenario ID	TS_PM_01	**Test Case ID**	TC_PM_01
Test Title	Create a new post	**Test Module**	Post Management Module
Test Case Description	Verify that a user can successfully create a new post with all required fields filled	**Test Priority**	High
Pre-Requisite	User is logged in.	**Post-Requisite**	New post appears in the "My Posts" and “Pets” page and be stored in Firebase

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to “Me” page	Tap on “Me” tab on the navigation bar	A list of user-related features is shown on the page.	As expected	Pass	

2	Tap “My Posts” under activity category	N/A	Message shown: “No Post Available”	As expected	Pass	This message is shown when the currently logged-in user does not make any post yet.
3	Click "+" icon to fill all required fields	Pet status: Find adoption Pet name: Lucky Age: 2 years 3 months Pet gender: Male Type of animal: Dog Breed: Labrador Color: Black Maturity size: Big	Required field are filled and validated.	As expected	Pass	

		Fur length: Medium Vaccinated: Yes Dewormed: Yes Spayed: Yes Description: He is a good dog. Adoption fee/reward: 0 Pet Images: [use camera/upload from gallery] Location: Jalan Tabuan				
4	Click Save to submit form	N/A	Post is created and shown in "My Posts"	As expected	Pass	

Table 31: Test Case 2 for Post Management Module

Test Scenario ID	TS_PM_02	**Test Case ID**	TC_PM_02
Test Title	Edit a post	**Test Module**	Post Management Module

Test Case Description	Verify that a user can edit their post and changes are updated in both UI and Firebase	**Test Priority**	High
Pre-Requisite	At least one post exists in "My Posts"	**Post-Requisite**	Edited post is updated in the UI and Firebase

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Tap the vertical "..." icon on a post	N/A	Edit/Delete menu is displayed.	As expected	Pass	
2	Select "Edit"	N/A	The edit post page is opened with the original data pre-filled.	As expected	Pass	
3	Modify some fields and click Save Changes	Original data Pet name: Lucky	The post is updated in both UI and Firebase.	As expected	Pass	

		Age: 2 years 3 months <u>Modified data</u> Pet name: Money Age: 1 years 3 months				

Table 32: Test Case 3 for Post Management Module

Test Scenario ID	TS_PM_03	**Test Case ID**	TC_PM_03
Test Title	Delete a post	**Test Module**	Post Management Module
Test Case Description	Verify that a user can delete their post after confirmation	**Test Priority**	High
Pre-Requisite	At least one post exists in "My Posts"	**Post-Requisite**	Deleted post is removed from UI and Firebase
Test Execution Steps:			

S.No	Action	Inputs	Expected Output	Actual Output	Test Result	Test Comments
1	Tap the vertical "..." icon on a post	N/A	Edit/Delete menu is displayed.	As expected	Pass	
2	Select "Delete"	N/A	Confirmation message is displayed.			
3	Click Yes to confirm deletion	N/A	Post is removed from list on “My Posts”, “Pets” page and Firebase.	As expected	Pass	

Table 33: Test Case 4 for Post Management Module

Test Scenario ID	TS_PM_04	Test Case ID	TC_PM_04
Test Title	View user’s own posts	Test Module	Post Management Module
Test Case Description	Verify that the "My Posts" page correctly displays all posts created by the user	Test Priority	Medium

Pre-Requisite		User has created at least one post.		**Post-Requisite**	User's own posts are displayed with correct data.	
Test Execution Steps:						
S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to "Me" page	Tap on "Me" tab on the navigation bar	A list of user-related features is shown on the page.	As expected	Pass	
2	Tap "My Posts" under activity category	N/A	Posts of the current logged-in user are listed.	As expected	Pass	

5.2.6 Test Case for Incident Reporting Module

Table 34: Test Case 1 for Incident Reporting Module

Test Scenario ID	TS_IR_01	**Test Case ID**	TC_IR_01
Test Title	Submit Valid Incident Report	**Test Module**	Incident Report Module
Test Case Description	To verify that a user can submit a complete report with all required fields filled correctly	**Test Priority**	High
Pre-Requisite	User is logged in.	**Post-Requisite**	Email is sent to dedicated local authority and report is saved to user's report history

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to "Report" page	Tap on "Report" tab on the navigation bar	Empty report form is shown.	As expected	Pass	

2	Enter all required details	Case Type: "Bite Case" Full Name: Siti Binti Mohamad Phone Number: 1112223333 Email: (auto filled) Report Detail: I was bitten by a big black dog. Incident Location: Jalan Tabuan Image: Optional	Form is filled completely	As expected	Pass	
3	Click Send button	N/A	Email sent to the local authority. Confirmation message is shown. Report is saved to both UI and Firebase.	As expected	Pass	

Table 35: Test Case 2 for Incident Reporting Module

Test Scenario ID	TS_IR_02	**Test Case ID**	TC_IR_02
Test Title	Submission with Empty Required Fields	**Test Module**	Incident Report Module
Test Case Description	To verify that submission is blocked when required fields are not filled	**Test Priority**	High
Pre-Requisite	User is logged in and on the incident report submission page	**Post-Requisite**	No email is sent, and report form remains on screen with validation errors

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to “Report” page	Tap on “Report” tab on the navigation bar	Empty report form is shown.	As expected	Pass	
2	Leave full name and report details blank	Case Type: "Bite Case" Full Name: (blank) Phone Number: 1112223333	Validation error is shown on the “Full	As expected	Pass	

		Email: (auto filled) Report Detail: (blank) Incident Location: Jalan Tabuan Image: Optional	name" and "Report details" fields.			

Table 36: Test Case 3 for Incident Reporting Module

Test Scenario ID	TS_IR_03	**Test Case ID**	TC_IR_03
Test Title	View My Submitted Reports	**Test Module**	Incident Report Module
Test Case Description	To verify that a user can view their submitted reports from the "Me" section	**Test Priority**	Medium
Pre-Requisite	User has submitted at least one report and is logged in	**Post-Requisite**	User is able to view details and progress of previous reports

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Navigate to “Me” page	Tap on “Me” tab on the navigation bar	A list of user-related features is shown on the page.	As expected	Pass	
2	Tap “My Reports” under activity category	N/A	List of submitted reports is shown.	As expected	Pass	

5.2.7 Test Case for AI Chatbot Module

Table 37: Test Case for AI Chatbot Module

Test Scenario ID	TS_CB_01	**Test Case ID**	TC_CB_01
Test Title	Ask a General Pet-related Question	**Test Module**	AI Chatbot
Test Case Description	Verify that the chatbot responds correctly to a general pet care	**Test Priority**	High
Pre-Requisite	User is logged in.	**Post-Requisite**	Chat history remains available until the user closes the app or clears the history.

Test Execution Steps:						
S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Navigate to “PetMentor” page	Tap on “PetMentor” tab on the navigation bar	Chat interface is displayed and a greeting message is displayed from the chatbot.	As expected	Pass	
2	Enter a query into the chat input box	"What should I do if my cat is choking?"	Chatbot provides relevant steps.	As expected	Pass	
3	Enter a follow-up question	"Can I give it water?"	Chatbot understands the context and gives appropriate follow-up answer	As expected	Pass	
4	Tap delete icon on top right to clear chat	N/A	Chat history is cleared and a blank chat interface is shown	As expected	Pass	

5.2.8 Test Case for Vet and Pet Store Module

Table 38: Test Case for Vet and Pet Store Module

Test Scenario ID	TS_VPS_01	**Test Case ID**	TC_VPS_01
Test Title	View List of Veterinary Clinics and Pet Stores and Navigate to Detail Page	**Test Module**	Vet and Pet Store
Test Case Description	To verify that the default vet list based on user's location is displayed correctly with basic information, and that user can switch between vet and store view, then view more details of selected business.	**Test Priority**	High
Pre-Requisite	Location permission is granted. App is connected to the internet. At least one nearby vet and one pet store exists in the system database.	**Post-Requisite**	User can return back from details page to vet/store list.

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Navigate to “Vet & Store” page	Tap on “Vet & Store” tab on the navigation bar	Nearby vet list based on user location is displayed.	As expected	Pass	
2	Verify basic information shown for each vet	N/A	All expected info: name, address, current operating time/next opening time, distance is correctly shown for each vet.	As expected	Pass	
3	Tap on "Store" tab to switch view	N/A	Nearby vet list based on user location is displayed. All expected info: name, address, current operating time/next opening time, distance is correctly shown for each pet store. If the business is open, the current operating time is shown	As expected	Pass	

			in green. Otherwise, the next opening time is shown in red.			
4	Tap “View More Details” on one store	N/A	Store detail page is shown with: phone number, full address, opening hours (weekly), website link, clickable icons for call, SMS, WhatsApp, address and website.	As expected	Pass	
5	Tap one of the contact methods	Tap "Call" icon	User is redirected to phone dialer with business phone number pre-filled.	As expected	Pass	
6		Tap “SMS” icon	User is redirected to the SMS app with the business phone number pre-filled to message the business owner.	As expected	Pass	

7		Tap “WhatsApp” icon	User is redirected to the business's WhatsApp contact page.	As expected	Pass	
8	Tap address link	Business location	User is redirected to map application with destination pin.	As expected	Pass	
9	Tap website link	Business website URL	User is redirected to external browser to open the website URL correctly.	As expected	Pass	

5.2.9 Test Case for Profile Module

Table 39: Test Case for Profile Module

Test Scenario ID	TS_PRF_01	**Test Case ID**	TC_ PRF_01
Test Title	Verify the Profile Page Displays Correct User Information	**Test Module**	Profile Module
Test Case Description	Ensure the profile page displays the correct user details such as name, phone number, email, and	**Test Priority**	High

	profile picture, and provides access to profile-related features		
Pre-Requisite	- User must be logged in - User's data must exist in Firestore (name, phone number, email, profile picture) - Navigation bar is visible	**Post-Requisite**	User details are accurately shown, and profile options are functional.

Test Execution Steps:

S.No	Action	Inputs	Expected Output	Actual Output	Test Result	Test Comments
1	Tap on "Me" in the bottom navigation bar and "My Profile" under account category	N/A	Profile page opens	Profile page opened	Pass	

2	Verify displayed profile details	Firestore user data	Correct name, phone number, and email are shown	Data displayed correctly	Pass	
3	Check profile image	User's profile image exists	Profile image is shown in profile section	Image displayed	Pass	
4	Tap "My Posts" under activity category	N/A	Navigates to list of user-created posts	Posts displayed	Pass	
5	Tap "My Reports" under activity category	N/A	Navigates to user's report history	Reports displayed	Pass	

5.3 Non-functional Testing

Non-functional testing evaluates aspects of the system that are not related to specific user actions or features but are crucial to overall performance, reliability, and user experience. This type of testing ensures the system meets quality standards such as speed, scalability, usability, compatibility, and security. In this section, non-functional tests are conducted to verify that the mobile app performs well under expected conditions, responds promptly, maintains stability, and offers a smooth user experience across devices.

5.3.1 Performance

Table 40: Test Case for Performance of SafePaws

Test Scenario ID	TS_Performance_01	**Test Case ID**	TC_Performance_01
Test Title	System Performance Under Load	**Test Module**	Overall System
Test Case Description	Testing the performance and responsiveness of the system under different load conditions including post creation, chat, browsing, and report submission	**Test Priority**	High
Pre-Requisite	- Main modules (Post Browsing, Post Management, Incident Report, Chat, Vet & Store, Chatbot) are fully implemented - Test users and sample data are available	**Post-Requisite**	Performance test report with system responsiveness results under load
Test Execution Steps:			

S.No	Action	Inputs	Expected Output	Actual Output	Test Result	Test Comments
1	Load Testing	Simulate 10 users creating posts, sending messages, browsing listings	All operations should complete with acceptable response times (< 3s)	App handled load without slowdown	Pass	
2	Stress Testing	Simulate peak load with 20+ users using all modules simultaneously	System remains responsive, with no crash or timeout	No crash, minor delays under peak load	Pass	
3	Endurance Testing	Run system continuously for 12+ hours with background traffic	No memory leaks, app remains stable	No performance degradation	Pass	
4	Response Time	Measure response for posting, messaging, report submission	All responses < 5 seconds	Posting: 2s Messaging: 1s Report: 2.8s	Pass	

5	UI Responsiveness	Switch rapidly between modules and features	UI should remain responsive and fluid	UI was responsive	Pass	
6	Scalability	Gradually increase users from 5 → 20	System should handle increased user base without errors	App adapted and maintained response time	Pass	
7	Database Performance	Test queries on posts, reports, bookmarks	Queries return in <3s	All queries completed in <2.5s	Pass	

5.3.2 Usability

Table 41: Test Case for Usability for SafePaws

Test Scenario ID	TS_Usablility_01	**Test Case ID**	TC_Usablility_01
Test Title	Usability Evaluation of Core Modules	**Test Module**	Overall System
Test Case Description	Evaluate ease of navigation, clarity, and user satisfaction when interacting with all app modules	**Test Priority**	High

Pre-Requisite		All modules are accessible from the navigation bar; test user account is available	**Post-Requisite**		Feedback and usability score for improvements	
Test Execution Steps:						
S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**
1	Ease of Navigation	Move between tabs: Post → Report → Chatbot → Vet & Store	Pages load smoothly, user understands where they are	All pages accessible via bottom nav bar	Pass	
2	Design Consistency	To verify consistent styling and placement of UI elements across all screens and modules (buttons,	The UI design remains uniform and coherent throughout the app, ensuring a seamless and intuitive user experience.	All interface elements followed a consistent style guide across pages, including the "Me", "Post Browsing",	Pass	

		icons, typography, colors, layout).		"Vet & Store", and "Chat" screens.		
3	Accessibility	Tap buttons (e.g., "Chat", "Send", "Call")	All tappable elements are usable and readable	Buttons sized correctly and reachable	Pass	
4	Error Handling Test	Ensure that the system provides error messages when invalid data is entered.	Users are informed of errors through descriptive messages that help them correct their input.	The system displayed meaningful and accurate error messages when required fields were left empty or incorrect data formats were used.	Pass	

5.3.3 Reliability

Table 42: Test Case for Reliability of SafePaws

Test Scenario ID	TS_Reliability_01	**Test Case ID**	TC_Reliability_01
Test Title	Reliability of System Features Over Time and Conditions	**Test Module**	Overall System
Test Case Description	Evaluate how reliably the system performs key functions under normal and extreme conditions (crash, reconnect, restart)	**Test Priority**	High
Pre-Requisite	All modules and services are working normally	**Post-Requisite**	App continues to perform consistently across multiple sessions

Test Execution Steps:

S.No	**Action**	**Inputs**	**Expected Output**	**Actual Output**	**Test Result**	**Test Comments**

1	Concurrent Access	Two users edit their own data simultaneously	No data conflict or overwrite	No conflict observed	Pass	
2	API Response Time Validation	Check the response time from external APIs like Google Places API, Geocoding Api, Maps SDK for Andriod	API response times should consistently fall within acceptable performance thresholds (e.g., < 3 seconds) during location-based operations	All API responses were received promptly without noticeable delays	Pass	
3	Network Interruption	Disconnect during chat or report submission	Show error message, no crash	Proper error message displayed	Pass	
4	Crash Recovery	Force closes the app during post creation	App should not save incomplete data; no corruption	Unsaved data lost, app restarted cleanly	Pass	

5	Long Usage Session	Use app for 2+ hours switching modules	No crash, lag, or slowdown	No memory issues observed	Pass	

5.4 User Acceptance Testing (UAT)

User Acceptance Testing (UAT) is carried out to ensure that the system meets the expectations of end users and satisfies the project's functional requirements. This phase validates whether the application is ready for deployment in a real-world environment. There are 25 respondents carried out the questionnaire. The questions can be referred to Appendix C.

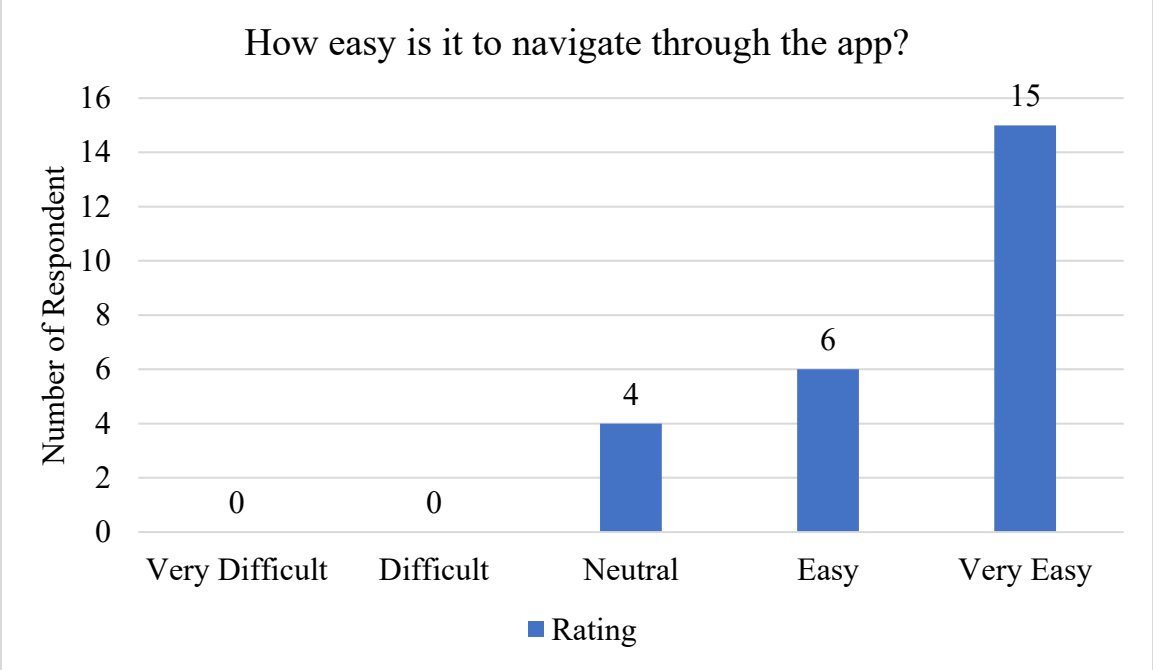


Figure 73: The Questionnaires - How easy is it to navigate through the app?

Figure 73 presents the results of a UAT question focused on the ease of navigation through SafePaws. Based on the data, the majority of respondents found the app to be very easy to navigate, with 15 out of 25 participants selecting the "Very Easy" option. Additionally, 6 respondents considered it as "Easy," while 4 respondents remained neutral regarding the ease of use. Notably, no respondents reported the app as being "Difficult" or "Very Difficult" to navigate, indicating a high level of satisfaction with the user interface. This positive feedback suggests that the app's navigation is user-friendly and aligns well with the expectations of the users, confirming its readiness for deployment.

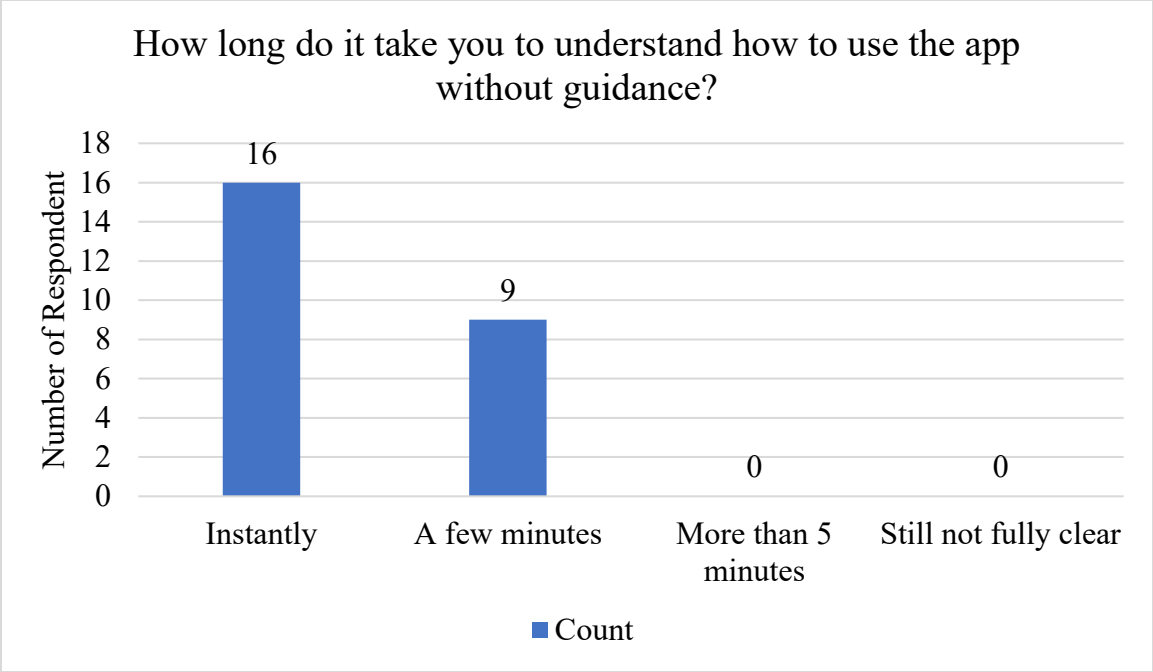


Figure 74: The Questionnaires - How long do it take you to understand how to use the app without guidance?

Figure 74 depicts the result of the duration taken for users to understand how to use the app without any guidance. Among the 25 respondents, the majority (16 respondents) were able to instantly understand how to use the app, indicating that the app's interface is highly intuitive and easy to navigate. A smaller group of 9 respondents took "A few minutes" to understand how to use the app, which still suggests a relatively smooth learning curve. There were no respondents who took "More than 5 minutes" or found themselves "Still not fully clear" about using the app, highlighting its user-friendly design. This feedback reflects positively on the app's ease of use and its capacity to allow users to quickly get accustomed to its features without needing additional guidance.

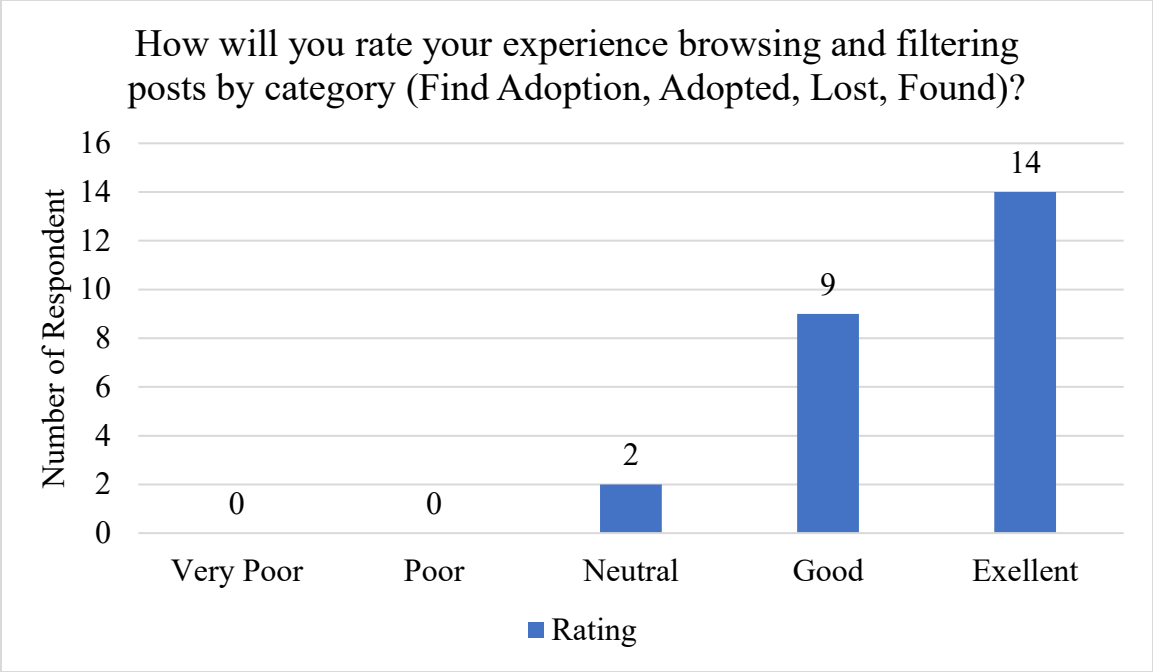


Figure 75: The Questionnaires - How will you rate your experience browsing and filtering posts by category (Find Adoption, Adopted, Lost, Found)?

Figure 75 shows the rating results of users' experiences with browsing and filtering posts by category, such as Find Adoption, Adopted, Lost, and Found. Among the 25 respondents, the majority rated their experience positively. A significant portion of users (14 respondents) rated the experience as "Excellent," while 9 respondents found it to be "Good." Only 2 respondents remained neutral, indicating neither satisfaction nor dissatisfaction with the browsing and filtering features. Notably, there were no respondents who rated the experience as "Poor" or "Very Poor," suggesting that the feature for browsing and filtering posts is effective and well-received by users. Overall, the feedback indicates that users are satisfied with the app's functionality for browsing and filtering posts, which contributes to its overall usability.

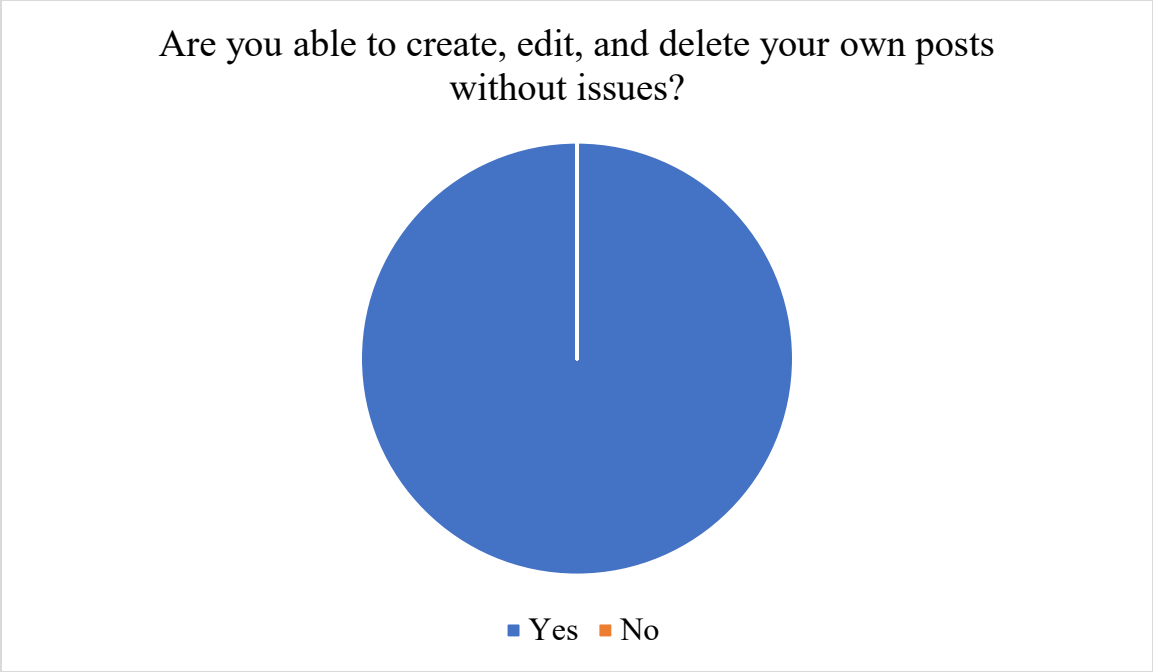


Figure 76: The Questionnaires - Are you able to create, edit, and delete your own posts without issues?

Figure 76 depicts the result of users' ability to create, edit, and delete their own posts without issues. The responses overwhelmingly show that 100% of the respondents (represented by the blue section) were able to perform these tasks without any difficulties. This suggests that the post management functionality of the app is working as intended, providing users with a seamless and intuitive experience when managing their posts. There were no respondents who reported issues with creating, editing, or deleting posts, indicating that the feature is efficient and user-friendly.

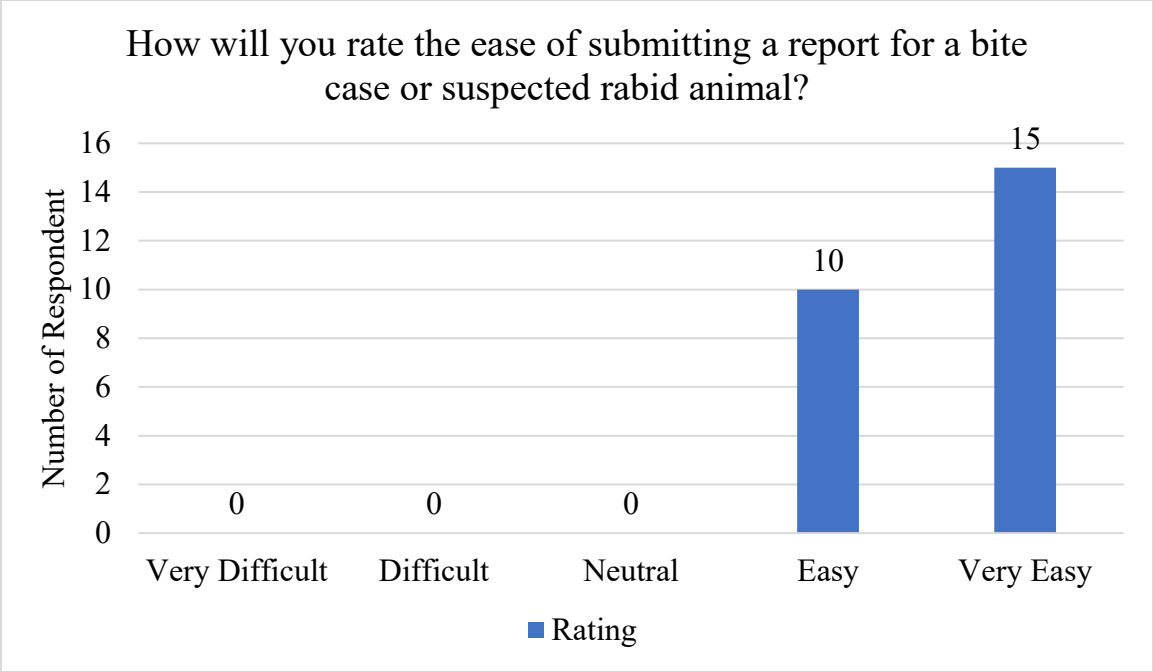


Figure 77: The Questionnaires - How will you rate the ease of submitting a report for a bite case or suspected rabid animal?

Figure 77 depicts the result of the ease of submitting a report for a bite case or suspected rabid animal. The majority of respondents rated the process as either "Easy" or "Very Easy," with 15 respondents selecting "Very Easy" and 10 respondents selecting "Easy." This indicates that the majority of users found submitting a report to be straightforward and simple. Notably, there were no respondents who rated the process as "Difficult" or "Very Difficult," and no respondents were neutral about the ease of submission. These results suggest that the app's reporting feature is efficient and user-friendly, enabling users to report critical issues with minimal effort.

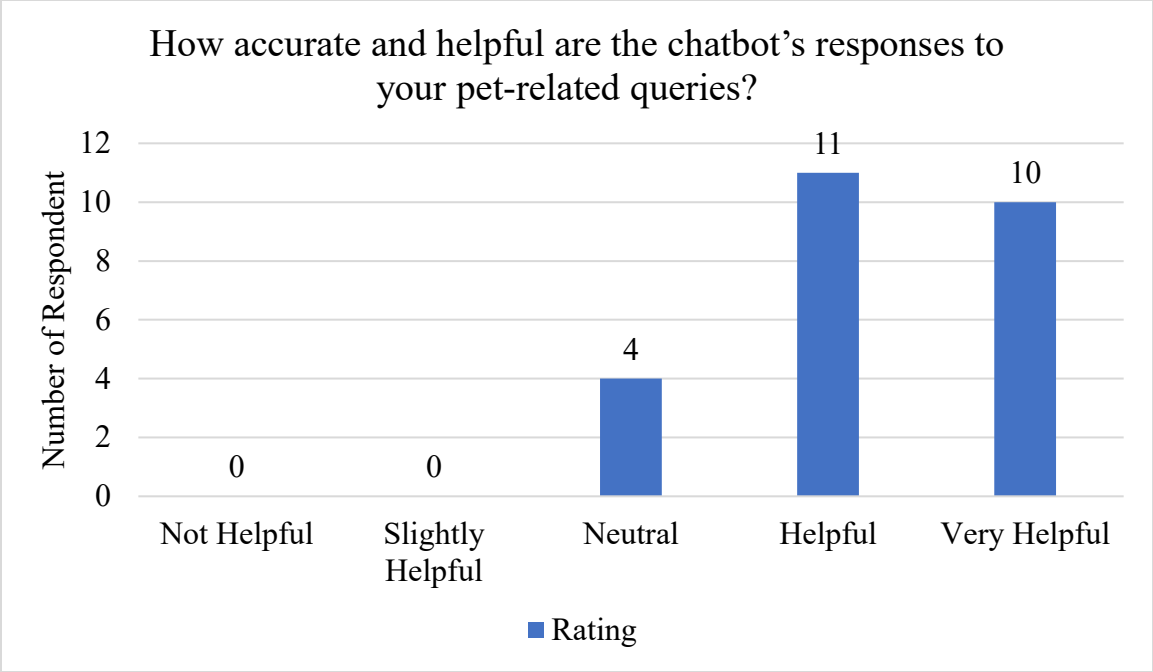


Figure 78: The Questionnaires - How accurate and helpful are the chatbot's responses to your pet-related queries?

Figure 78 depicts the result of the accuracy and helpfulness of the chatbot's responses to users' pet-related queries. The majority of respondents found the chatbot's responses to be either "Helpful" or "Very Helpful," with 11 users selecting "Helpful" and 10 users selecting "Very Helpful." This shows that the chatbot is perceived as a valuable tool for answering pet-related queries. A smaller group of 4 respondents chose "Neutral," suggesting that while the chatbot was generally seen as helpful, there was some variation in user experience. Importantly, there were no respondents who found the chatbot's responses to be "Not Helpful" or "Slightly Helpful," indicating overall satisfaction with the chatbot's performance. This feedback highlights the chatbot's effectiveness in assisting users with pet-related questions.

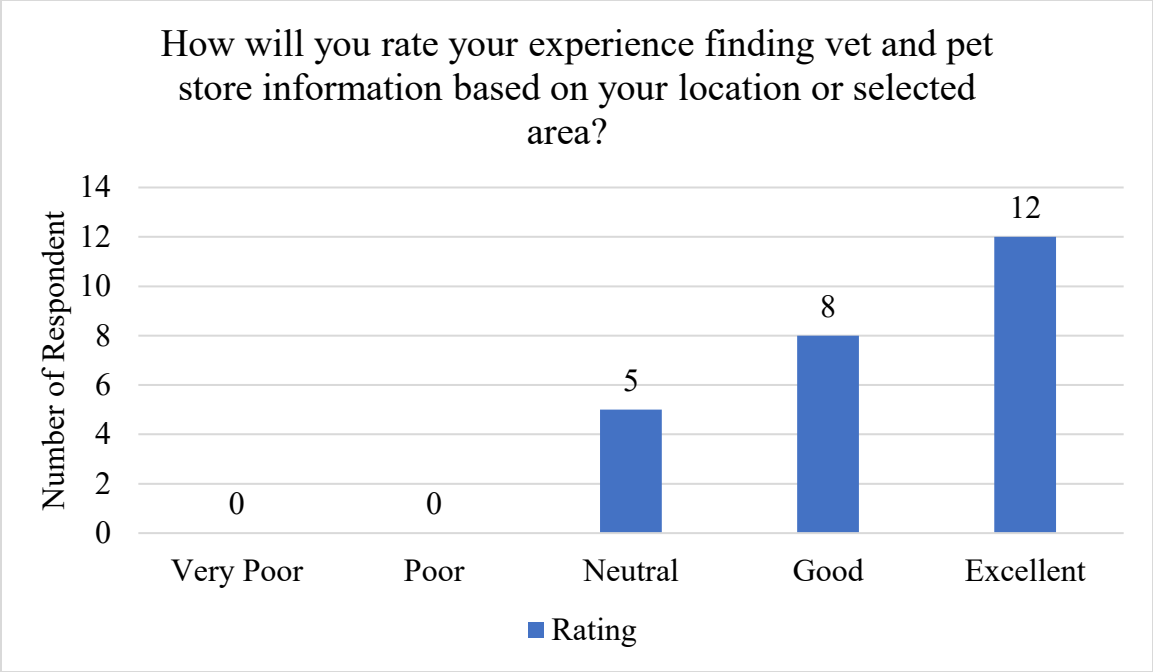


Figure 79: The Questionnaires - How will you rate your experience finding vet and pet store information based on your location or selected area?

Figure 79 depicts the result of users' experience in finding vet and pet store information based on their location or selected area. The majority of respondents rated their experience positively, with 12 users selecting "Excellent" and 8 users rating it as "Good." This suggests that most users found the app's functionality for locating vet and pet store information based on their area to be effective and satisfactory. A smaller group of 5 respondents chose "Neutral," indicating that while the feature worked well for most, there may have been some variability in experience. Importantly, no users rated the experience as "Poor" or "Very Poor," which indicates that the feature is generally well-received and performs effectively.

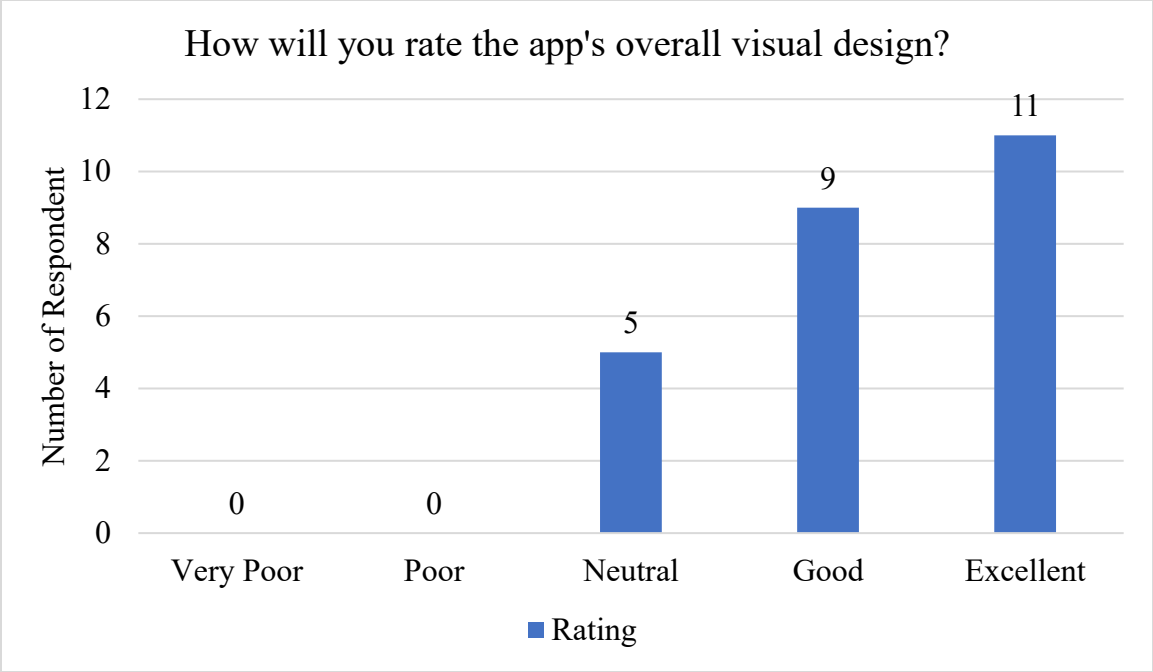


Figure 80: The Questionnaires - How will you rate the app's overall visual design?

Figure 80 depicts the result of users' rating of the app's overall visual design. A majority of respondents rated the visual design positively, with 11 users selecting "Excellent" and 9 users rating it as "Good." This suggests that the visual appeal of the app is generally well-received, with most users finding it aesthetically pleasing and user-friendly. A smaller group of 5 respondents selected "Neutral," indicating that some users felt indifferent or neutral about the design, while no respondents rated the design as "Poor" or "Very Poor." These results indicate that the app's visual design meets the expectations of the users, with minimal negative feedback.

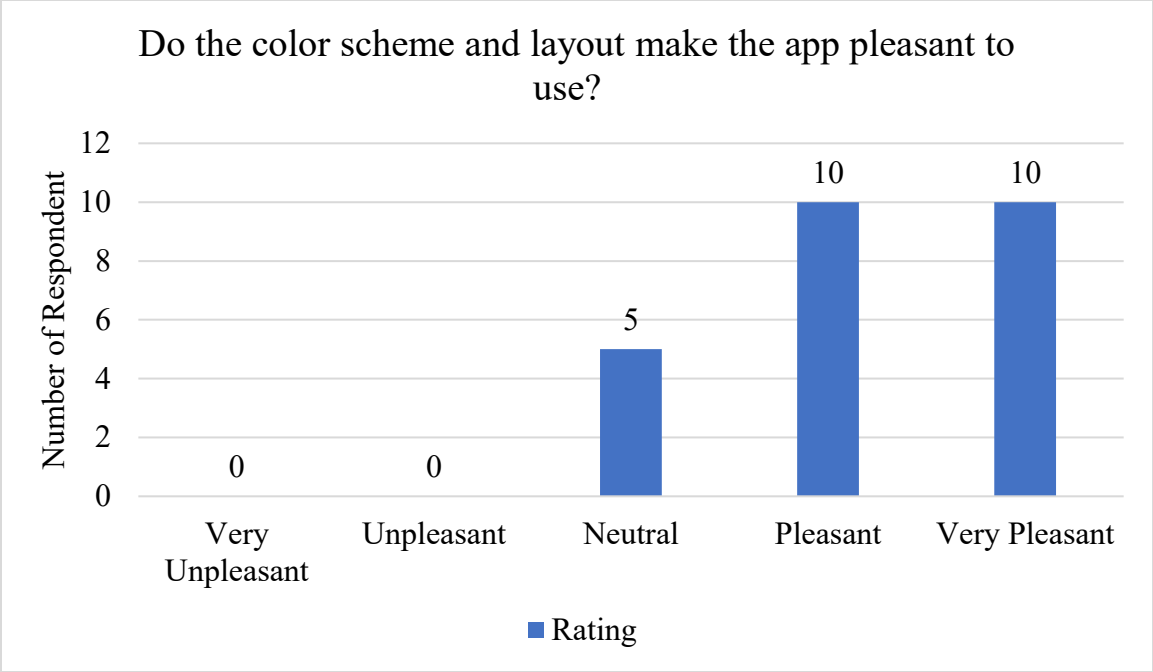


Figure 81: The Questionnaires - Do the color scheme and layout make the app pleasant to use?

Figure 81 depicts the result of users' ratings of the color scheme and layout's impact on the app's overall pleasantness to use. The majority of respondents found the app's design to be either "Pleasant" or "Very Pleasant," with 10 users rating it as "Pleasant" and 10 users rating it as "Very Pleasant." This indicates that the color scheme and layout were well-received, contributing to a positive user experience. A smaller group of 5 respondents selected "Neutral," showing that while the design may have been functional, it did not evoke strong feelings either way. Importantly, no respondents rated the design as "Unpleasant" or "Very Unpleasant," suggesting that the app's visual appeal and layout meet the expectations of most users.

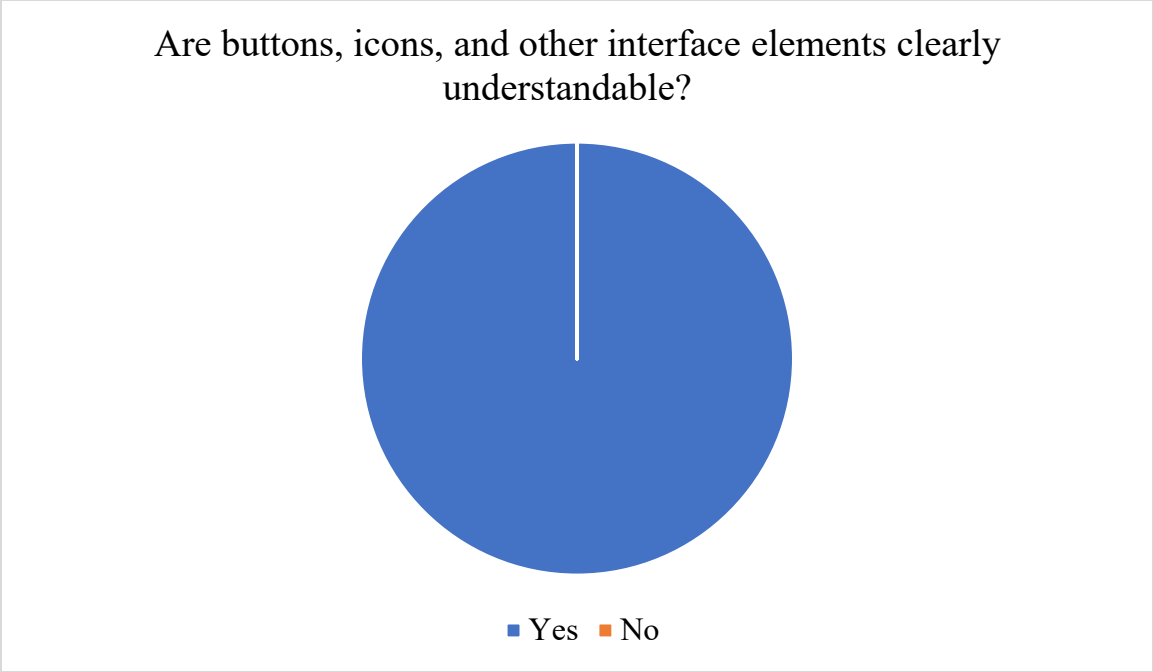


Figure 82: The Questionnaires - Are buttons, icons, and other interface elements clearly understandable?

Figure 82 depicts the result of users' understanding of the app's buttons, icons, and other interface elements. The overwhelming majority of respondents (represented by the blue section) confirmed that the buttons and icons were clearly understandable, with 100% selecting "Yes." This indicates that the app's interface is intuitive, and users had no trouble identifying and using the app's interactive elements. There were no respondents who found the interface elements unclear, highlighting the effectiveness of the app's design in providing a smooth and user-friendly experience.

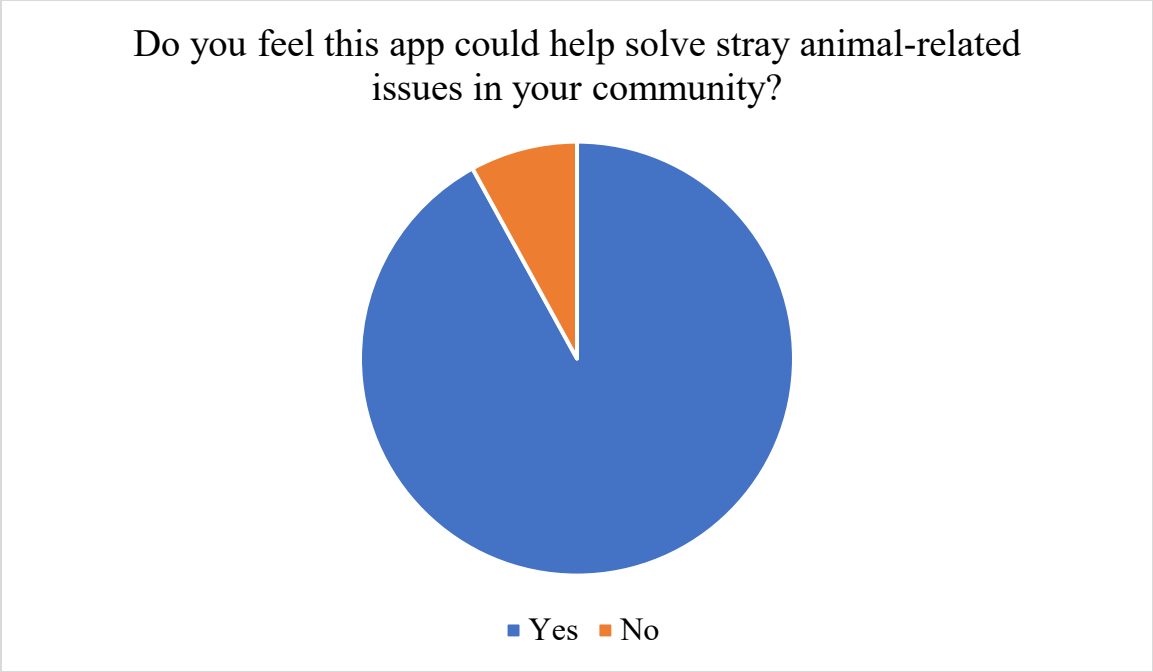


Figure 83: The Questionnaires - Do you feel this app could help solve stray animal-related issues in your community?

Figure 83 depicts the result of users' opinions on whether the app could help solve stray animal-related issues in their community. The vast majority of respondents (represented by the blue section) agreed that the app could make a positive impact, with almost all of them selecting "Yes." Only a small portion of respondents (represented by the orange section) disagreed, selecting "No." This overwhelming support indicates that the app is seen as a valuable tool for addressing stray animal concerns, highlighting its potential to improve community engagement and animal welfare efforts.

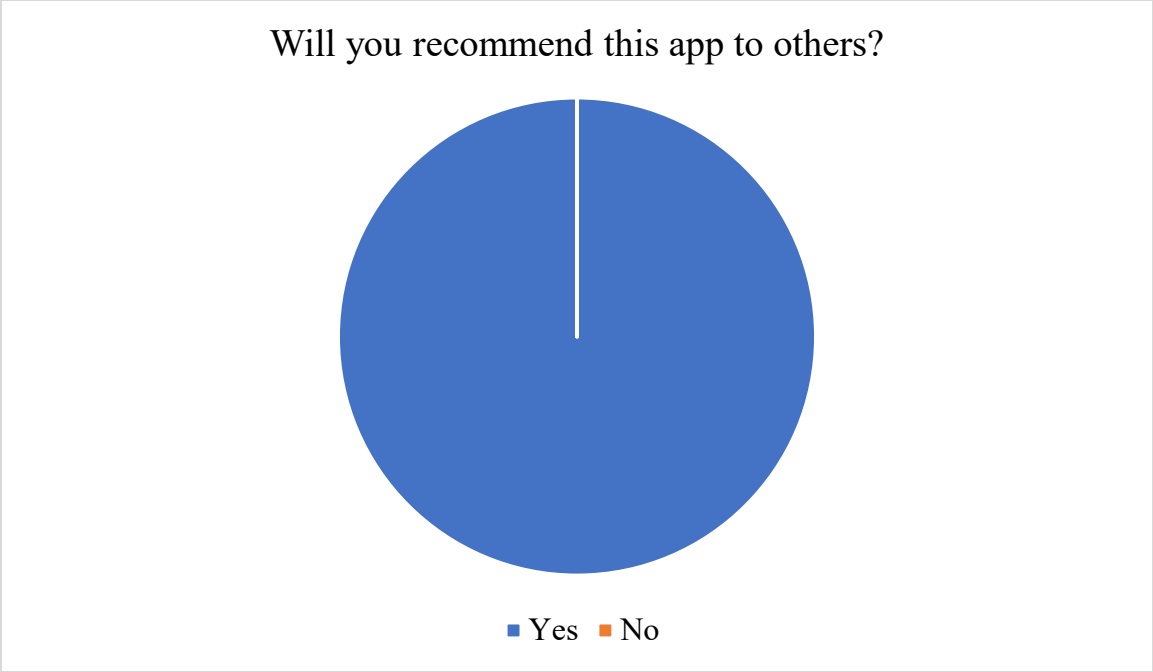


Figure 84: The Questionnaires - Will you recommend this app to others?

Figure 84 depicts the result of users' willingness to recommend the app to others. The overwhelming majority of respondents (represented by the blue section) indicated that they would recommend the app, with 100% selecting "Yes." This suggests that the app has made a positive impression on its users, as all respondents felt confident enough in its functionality and usefulness to suggest it to others. There were no respondents who chose "No," highlighting the app's strong approval rate among users.

5.5 Summary

SafePaws undergoes a comprehensive testing process to ensure its features function correctly and meet user expectations. Functional testing is carried out on key modules such as registration, login, post management, incident reporting, and the AI chatbot to verify that each operates as intended. Non-functional testing assesses performance, usability, and reliability, ensuring the app loads quickly, is easy to use, and remains stable during interaction. User Acceptance Testing (UAT) involves collecting feedback from actual users through structured questionnaires, confirming that the system is intuitive and effectively addresses their needs. The testing results indicate that SafePaws performs reliably and delivers a smooth and satisfactory user experience.

CHAPTER 6: CONCLUSION AND FUTURE WORK

6.1 Conclusion

The "SafePaws" mobile application provides an innovative digital solution to address the growing concerns surrounding stray animal management and public health issues in Sarawak. By centralizing the management of pet adoption, lost pet posts, and stray animal incident reporting, SafePaws creates an accessible and efficient platform that empowers the community and local authorities to respond swiftly to animal welfare issues. The integration of AI-driven pet care support, a user-friendly interface, and real-time access to veterinary services and pet stores further enhances the app's value in promoting responsible pet ownership and public safety. Through iterative development using the prototype model, SafePaws has successfully met its core objectives, contributing to a more coordinated approach to handling stray animals, preventing zoonotic diseases like rabies, and fostering community involvement in animal welfare.

6.2 Achievement

Throughout the project development cycle, several important milestones were achieved. The application was successfully built with seven integrated modules, covering core features such as post browsing, reporting, chatbot communication, and pet service directories. The below are the key achievements:

1. Facilitating pet adoption and helping owners find lost pets

   The application allows users to create and browse pet posts categorized as “Find Adoption,” “Adopted,” “Lost,” and “Found.” Each post includes details such as breed, age, color, and location, along with photo uploads. Users can filter posts based on criteria like pet type and

area, making it easier to match potential adopters with available pets and assist in reuniting lost pets with their owners.

2. Minimizing the risk of zoonotic diseases such as rabies

   SafePaws includes a reporting feature for bite cases and suspected rabid animals. Users can submit reports with images and geolocation, which are sent automatically to local authorities via email. This supports faster response times and improves coordination between the public and health agencies in managing stray animal-related risks.

3. Providing pet care and safety guidance through an AI chatbot

   An integrated AI chatbot enables users to ask pet-related questions on topics such as emergency procedures, feeding, training, and general care. The chatbot uses natural language processing to provide accurate, helpful responses, encouraging responsible pet ownership and quick access to reliable information.

4. Delivering a user-friendly and reliable mobile solution

   Built using Flutter and integrated with Firebase, SafePaws offers cross-platform support, real-time database interaction, secure authentication, and image storage. Usability testing and User Acceptance Testing (UAT) show high satisfaction rates, confirming that the app is responsive, intuitive, and effectively meets user needs.

6.3 Limitation and Constraints

The SafePaws application has several limitations and constraints that may affect its current functionality and real-world deployment. Firstly, the app does not feature a real-time tracking or verification system for submitted reports, making it difficult for users to follow up on the status of their cases after submission. Additionally, since most local authorities do not provide public APIs

for report intake, the app simulates the reporting process by sending emails to a developer-managed address that represents the authority. This limits actual authority involvement and follow-up, especially in real deployment scenarios.

Apart from that, the system is fully dependent on internet connectivity. Users must be online to browse posts, submit reports, view locations, and interact with the AI chatbot. This restricts accessibility in rural or low-connectivity areas, where reliable internet may not be available.

Another significant constraint is the absence of a backend admin panel for shelters or local authorities. As a result, there is no dedicated interface for organizations to manage, verify, or respond to user-submitted posts or reports within the system.

Security and privacy features such as two-factor authentication, email verification, and robust data encryption have not been fully implemented due to time and resource limitations during development. Lastly, the app is currently available only in English, which may limit accessibility for users who are not proficient in the language, particularly in a multilingual region like Sarawak.

6.4 Future Work

To enhance the system's capabilities and improve user experience, several areas are identified for future development. One of the main priorities is the creation of an admin dashboard for dedicated local authorities and animal shelters. This will allow authorized personnel to manage and respond to incident reports, validate adoption posts, and monitor community engagement. Another important improvement will be the integration of push notifications to keep users informed about lost pets, bite case reports in their vicinity and responses to their submitted reports.

The addition of AI-based image recognition can greatly improve lost-and-found pet matching, using photos to detect possible matches between posts. Multi-language support,

particularly in Malay and Chinese, should be implemented to ensure inclusivity for all user groups in Sarawak. The chatbot can also be enhanced with more advanced natural language processing and broader knowledge coverage. Offline capabilities will be beneficial, allowing users to draft posts or reports without internet access and have them automatically submitted once connectivity is restored.

Future enhancements should also include stronger security features such as encrypted data handling, user verification processes, and secure authentication. Lastly, integration with external systems such as veterinary records, animal shelter databases, or public health campaign APIs can help further streamline information sharing and improve the app's overall effectiveness. By addressing these areas, the application can evolve into a powerful and sustainable platform that supports stray animal management and public health efforts across wider regions.

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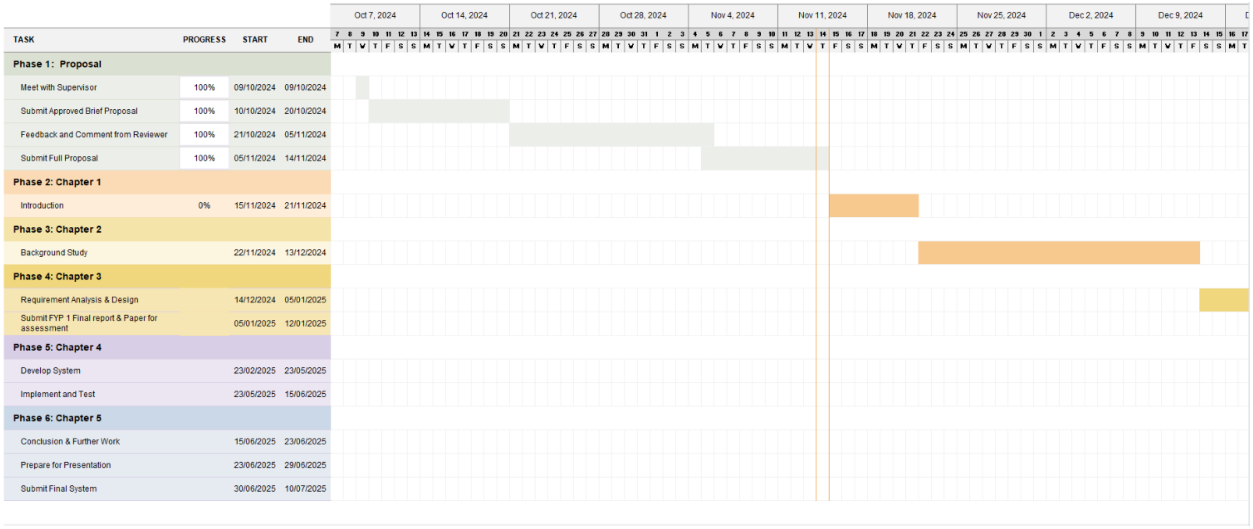
APPENDICES

Appendix A - Gantt Chart



TASK	PROGRESS	START	END
Phase 1: Proposal			
Meet with Supervisor	100%	09/10/2024	09/10/2024
Submit Approved Brief Proposal	100%	10/10/2024	20/10/2024
Feedback and Comment from Reviewer	100%	21/10/2024	05/11/2024
Submit Full Proposal	100%	05/11/2024	14/11/2024
Phase 2: Chapter 1			
Introduction	0%	15/11/2024	21/11/2024
Phase 3: Chapter 2			
Background Study		22/11/2024	13/12/2024
Phase 4: Chapter 3			
Requirement Analysis & Design		14/12/2024	05/01/2025
Submit FYP 1 Final report & Paper for assessment		05/01/2025	12/01/2025
Phase 5: Chapter 4			
Develop System		23/02/2025	23/05/2025
Implement and Test		23/05/2025	15/06/2025
Phase 6: Chapter 5			
Conclusion & Further Work		15/06/2025	23/06/2025
Prepare for Presentation		23/06/2025	29/05/2025
Submit Final System		30/06/2025	10/07/2025

Appendix B - Questionnaire

Community Survey on Pet and Stray Animal Management System

Hey everyone! 👋

I am Law Li Wen, a final-year student from Bachelor of Software Engineering at UNIMAS. I am currently working on my final-year project (FYP), titled **'Digital Solutions for Stray Animal Care and Public Health Initiatives.'** This project involves developing a mobile app called '**SafePaws**' for pet adoption, reporting lost pets and promoting stray animal health welfare.

This questionnaire aims to collect feedback from the community to help me design and improve the features of this mobile app. Your feedback will help ensure the app meets user needs in order to promotes better stray animal care and public health initiatives.

It consists of 4 parts:

Part 1: Demographics Information

Part 2: Awareness of Community

Part 3: App Feature an Expectation

Part 4: Overall Feedback

The survey will take about **5–10 minutes** to finish. Your personal information and responses will remain **confidential** and will only be used for the purpose of this survey.

If you have any questions, please do not hesitate to reach out to me at 79826@siswa.unimas.my.

Thanks a ton for taking the time to fill out this survey! Your thoughts and feedback are super valuable and I truly appreciate your input! 😊

* Indicates required question

Part 1: Demographics Information

1. What is your age group? *

   Mark only one oval.

   - Under 18
   - 19-25
   - 26-35
   - 36-45
   - 46 and above

2. Where do you live? *

   Mark only one oval.

   - Urban
   - Suburban
   - Rural

3. Do you own a pet? *

   Mark only one oval.

   - Yes
   - No

4. Have you ever adopted a pet from a shelter? *

   Mark only one oval.

   - Yes

- No

Part 2: Awareness of Community

5. Do you know any existing apps in Malaysia for finding adoptable animals or reporting lost pets? *

   Mark only one oval.

   - Yes *Skip to question 6*
   - No *Skip to question 7*

6. If yes, please state the platform's name. *

   _____

7. How would you rate the accessibility of the following services in your area? *

   Is it easy to get such service?

   Mark only one oval per row.

	Very Difficult	Difficult	Neutral	Easy	Very Easy
Adopt a pet	•	•	•	•	•
Find lost pet	•	•	•	•	•
Report stray animal (e.g., suspected rabies, bite case)	•	•	•	•	•
Provide information on responsible pet ownership (e.g., steps to take	•	•	•	•	•

when bitten by a stray animal, ways

to prevent rabies)

---

8. How do you usually report stray animals or incidents (e.g., bite case or suspected rabid animals)? *

   Mark only one oval.

   - Posting in social media (Facebook, Instagram, etc.) *Skip to question 11*
   - Directly report to local shelters/authorities *Skip to question 9*
   - No, I don't report *Skip to question 10*

9. Please name the local shelters/authorities. *

   _____ *Skip to question 11*

10. What is the main reason you choose not to report such cases? *

    Mark only one oval.

    - I don't know how to report such cases.
    - I don't know the appropriate authority or platform to report to.
    - I'm concerned about potential costs or involvement required.
    - I'm unsure if the situation warrants reporting.
    - I don't feel it's my responsibility.
    - Other: _____

11. Have you follow any public health activities or information on responsible pet ownership online? *

Mark only one oval.

- Yes
- No

12. What are the biggest barriers you encounter when you are willing and able to adopt a pet from the internet? *

Tick all that apply.

- Information about adoptable pets is scattered across social media platform
- Unable to filter adoptable pets based on specific features (species, gender, location, ...)
- Lack of information about adoption processes
- Lengthy or complicated adoption procedures
- Fear of adopting a pet without meeting it in person
- Other:_____

Part 3: App Feature and Expectation

13. Which of the following features would you find the most useful in a pet management app? *

Mark only one oval.

- Finding pets available for adoption and lost pets
- Reporting bite case/suspected rabid animals
- Finding a nearby veterinary hospital and pet store
- Receiving educational content about pet care, rabies prevention and etc.

- Receiving notifications about nearby animal-related events
- Other:_____

14. What information do you expect to see about pets available for adoption? *

Tick all that apply.

- Name, age, gender
- Breed
- Health status (e.g., vaccinated, sterilized, any existing conditions)
- Photo, video and location of the pet
- Temperament (e.g., friendly, shy, energetic)
- Adoption fee or costs
- Compatibility with children or other pets
- Contact details for adoption inquiries
- Other:_____

15. How important is it for the app to provide real-time updates on your reported cases (e.g., suspected rabid animal reports)? *

Mark only one oval.

	1	2	3	4	5	
Not Important At All	•	•	•	•	•	Very Important

16. If the app includes AI chatbot, what services would you expect it to offer? *

Tick all that apply.

- Answering questions about pet care and health
- Providing information on responsible pet ownership
- Offering advice on handling pet-related emergencies
- Helping report lost or stray animals
- Assisting with finding nearby veterinary services or pet stores
- Other: _____

17. Would you trust an AI chatbot for advice on pet care and welfare? Why or why not? *

_____

18. What design elements would make the app easier for you to use? *

- Simple and intuitive navigation
- Large, easy-to-click and intuitive icons
- Search bar with filters (e.g., by pet type, location)
- Step-by-step guidance for key actions
- Visually appealing and uncluttered layout
- Multilingual support
- Feedback or suggestion button
- Other: _____

Part 4: Overall Feedback

19. Would you use a mobile app to adopt pets, find lost pets or report suspected rabid animals? *

Mark only one oval.

- Yes
- No

20. How much do you agree that this app could help improve community involvement in animal welfare? *

Mark only one oval.

	1	2	3	4	5	
Stringly Agree	•	•	•	•	•	Strongly Disagree

21. What potential challenges or concerns do you foresee when using this app? *

Tick all that apply.

- Privacy and data security issues
- Difficulty navigating or using the app
- Inaccurate or outdated information
- Accuracy of AI chatbot responses
- Slow app performance
- Other: _____

22. Do you have any other suggestions for SafePaws's functionality or design?

_____

Appendix C – UAT Questionnaire

User Accrptance Testing (UAT) Questionnair of SafePaws Mobile Application

Hey everyone! 👋
I am Law Li Wen, a final-year student from Bachelor of Software Engineering at UNIMAS. I am currently working on my final-year project (FYP), titled **'Digital Solutions for Stray Animal Care and Public Health Initiatives.'** This project involves developing a mobile app called '**SafePaws**' for pet adoption, reporting lost pets and promoting stray animal health welfare.

This questionnaire is designed to gather your feedback on the usability, functionality, design, and overall performance of a mobile application developed to assist with stray animal care, pet adoption, and public health initiatives in Sarawak.

It consists of 4 parts:
Part 1: General Usability
Part 2: Functionality
Part 3: Design & User Interface
Part 4: Overall Suggestion

The survey will take about **5–10 minutes** to finish. Your personal information and responses will remain **confidential** and will only be used for the purpose of this survey.

If you have any questions, please do not hesitate to reach out to me at **79826@siswa.unimas.my**.
Thanks a ton for taking the time to fill out this survey! Your thoughts and feedback are super valuable and I truly appreciate your input! 😊

llw0207leiyu@gmail.com Switch accounts

Not shared

Section A: General Usability

How easy is it to navigate through the app?

	1	2	3	4	5	
Very Difficult	○	○	○	○	○	Very Easy

How long do it take you to understand how to use the app without guidance?

- ○ Instantly
- ○ A few minutes
- ○ More than 5 minutes
- ○ Still not fully clear

Section B: Functionality

How will you rate your experience browsing and filtering posts by category (Find Adoption, Adopted, Lost, Found)?

	1	2	3	4	5	
Very Poor	○	○	○	○	○	Excellent

Are you able to create, edit, and delete your own posts without issues?

- ○ Yes
- ○ No
- ○ Other: _____

If No, specify the problem:

Your answer

How will you rate the ease of submitting a report for a bite case or suspected rabid animal?

	1	2	3	4	5	
Very Difficult	○	○	○	○	○	Very Easy

How accurate and helpful are the chatbot's responses to your pet-related queries?

	1	2	3	4	5	
Not Helpful	○	○	○	○	○	Very Helpful

How will you rate your experience finding vet and pet store information based on your location or selected area?

	1	2	3	4	5	
Very Poor	○	○	○	○	○	Excellent

Section C: Design & User Interface

How will you rate the app's overall visual design?

	1	2	3	4	5	
Very Poor	○	○	○	○	○	Excellent

Do the color scheme and layout make the app pleasant to use?

	1	2	3	4	5	
Very Unpleasant	○	○	○	○	○	Very Pleasant

Are buttons, icons, and other interface elements clearly understandable?

- ○ Yes
- ○ No

If No, describe issue:

Your answer

Section D: Overall Suggestions

Do you feel this app could help solve stray animal-related issues in your community?

- ◯ Yes
- ◯ No

Will you recommend this app to others?

- ◯ Yes
- ◯ No

What improvements or new features will you suggest for future versions?

Your answer