PetPal Web Application for Pet Adoption and Rescue

Final Year Project Report

by

Ayesha Praveen	**069568**
Taskeen Rafiq	**069595**
Anam Shahzadi	**069645**

Project Advisor:

Prof. Muhammad Abu Zar Tamimi

Faculty of Computing & Information Technology,

University of the Punjab, Lahore, Pakistan.

PetPal Web Applicaation for Pet Adoption and Rescue

Executive Summary

Petpal is a web -based platform designed to revolutionize the process of adoption and rescue pets by perfecting adopters with animal shelters and rescue organizations. The platform improves accessibility, efficiency and PET rehoming safety through the integration of correspondence mechanisms, real -time communication and fraud prevention with AI. With advanced search filters, adopters can explore verified PET listings based on race, age, size and location, ensuring a personalized adoption experience.

A structured adoption application and a detection system helps shelters verify possible adopters, while the safe characteristics of messages and video calls facilitate interactions without problems between users and shelters. Petpal also prioritizes the ethical adoption of PET, working closely with shelters to provide support after adoption that includes veterinary resources, training orientation responsible for pet property. Built with Next.js, Node.js, Express and Postgresql, the platform is scalable and optimized for high performance.

In addition, fraud prevention measures and identity verification ensure safe environment for adopters and shelters. By increasing adoption rates, reducing the overcrowding of the shelter and promoting the responsible property of pets, Petpal creates a positive social impact while taking advantage of modern technology to rationalize the adoption process. Designed for pet adopters, shelters, veterinarians and animal welfare defenders, Petpal guarantees a safe, easy -to -use and efficient pet adoption experience.

FYDP Overview

FYDP Title: PetPal Web Applicaation for Pet Adoption and Rescue

Sr. No	Roll Numbers	Name	Signatures
1.	069568	Ayesha Praveen	
2.	069595	Taskeen Rafiq	
3.	069645	Anam shahzadi	

FYDP Goals	• The Petpal web application aims to optimize the PET adoption process by connecting adopters with animal shelters through a safe and easy to use platform. • It seeks to improve adoption rates using PET coincidence with AI, efficient communication tools and an application process without problems. • The platform prioritizes data security, regulatory compliance and scalability to guarantee a reliable and accessible adoption experience for all users.
FYDP Objectives	• Petpal's main objective is to increase PET adoption rates by providing a perfect, safe and easy -to -use platform that connects adopters with animal shelters and rescue organizations. • Its objective is to guarantee the ethical and responsible relocation of PET through the coincidence of PET with AI, thorough detection processes and comprehensive support after adoption. • Petpal is designed to support animal shelters and rescue organizations by rationalizing adoption management, reducing the overcrowding of the shelter and promoting the responsible property of pets through education and resources.
FYDP Success Criteria	• The success of the PetPal web application depends on its ability to provide a smooth and secure PET acceptance platform and include key features such as AI comparing, adoption and adoption support. • It must ensure high performance, scalability and robust safety and at the same time meet regulatory standards. • Increased adoption, positive feedback on parties and successful third -party integration measures its efficiency.
Assumptions:	• Petpal's web application assumes that adopters and shelters will actively use the platform, providing precise PET listings and participate in the adoption process.

	• A stable internet connection and reliable third -party services will guarantee perfect functionality, while coincidence with AI will improve adoption rates. • Security measures will protect the user data, and the platform will comply with adoption laws and privacy regulations. • The system is expected to scale efficiently, maintain high performance successfully integrated with external services without significant interruptions.
Risks & Obstacles	• Petpal's web application faces potential risks, such as technical integration challenges, where compatibility problems between Next.js, Node.js and third party services can affect performance. • Safety risks such as data violations or unauthorized access could compromise user confidence, while scalability concerns can lead to performance degradation as user traffic grows. • Regulatory compliance with adoption laws and data privacy policies to avoid legal issues must be guaranteed.
Organization Address:	**Government Jinnah Islamia Graduate College Sialkot**
Target End Users:	• The Petpal web application is designed for a wide range of users involved in the adoption and rescue of pets. • PET users are the main users, who seek to find and adopt pets according to their preferences. • Animal shelters and rescue organizations will use the platform to list pets, manage adoption applications and communicate with possible adopters. • Veterinarians and pet care professionals can also commit to the platform to provide support and resources after adoption. • The administrators of the platform will supervise the safety, user verification and maintenance of the system to guarantee a safe and efficient adoption process.
Suggested Project Supervisor:	**Muhammad Abu Zar Tamimi**
Approved By:	
Date:	**5 March 2025**

Table 1 Project Proposal Summary

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Project Proposal

1.1 Introduction

The PetPal project is designed to create a comprehensive and friendly platform that focuses on receiving and storing animals. Its primary goal is to connect applicants for pets with adoptive animals that need a loving and permanent home, which makes it easier to adoptive process easier, more transparent and more accessible. The aim of Petpal is to provide space for individuals and rescue organizations so that Petpal should positively affect the lives of countless animals and potential owners of domestic animals.

This platform will offer a smooth browsing experience where users can easily explore detailed adoptable pets profiles that include high quality photos, personality descriptions, history and other relevant information. This helps to ensure that adoptable and animals find the best possible match. Petpal also supports the spirit of the community and provides educational sources for pets, tips for adoption and volunteer opportunities for those who want to support the cause of animal rescue.

Security is a central aspect of a platform with features such as secure processes of authentication and authentication of users that protect individuals' privacy and the integrity of the adoption process. With this focus on trust and transparency, users can confidently communicate with the platform because they know that pets available for adoption are from proven shelters and credible rescue organizations.

Petpal, designed to be modified, adapts effectively to the growing connection of users and the growing number of adoptive animals over time, all while maintaining high performance. The platform optimizes data loading and ensures that users can quickly and easily find the perfect PET without unnecessary delay or excessive requirement.

1.2 Background

Pet adoption is an essential aspect of animal welfare, with the aim of providing abandoned animals, street and rescued with safe and loving homes. Traditionally, the adoption process was based on physical visits to animal shelters, mouth references and community events [7]. However, these methods often limit the number of potential users, which leads to overcrowding in shelters and a lower rate of successful adoptions [2]. The advent of digital pet adoption platforms has revolutionized the process by offering a broader scope, greater accessibility and simplified adoption procedures [6].

Despite the advantages of online adoption platforms, the challenges remain. Many existing platforms lack comprehensive detection processes, safe communication channels and coincidence of PET adopters promoted by AI [9]. Fraudulent lists, incomplete PET profiles and inefficient adoption workflows create barriers for successful PET locations (1]. To address these challenges, the Petpal web application is designed as an innovative digital solution that improves the adoption experience through the PET coincidence based on AI, real -time messenger and verified PET listings.

The integration of artificial intelligence (AI) and automatic learning (ML) into PET adoption platforms has shown significant potential to improve adoption rates. Studies suggest that recommendation systems with AI can increase successful coincidences by up to 40% through the analysis of user preferences, PET behavior data and historical adoption patterns [4]. In addition, the importance of safe and perfect communication between adopters and shelters has stood out in recent research, emphasizing the need for integrated messaging systems that allow real -time discussions and adoption updates [5].

In addition to technological advances, ethical adoption practices remain a priority. Guaranteeing the responsible PET location is essential to reduce returns to adoption and abandonment rates [3]. The investigation indicates that the integral detection of the adopters, the support after the adoption and transparent health records of PET can significantly improve PET retention rates [8]. The Petpal platform incorporates these best practices by requiring user verification, refuge associations and subsequent resources to adoption, ensuring that pets are placed in safe and adequate houses.

By taking advantage of avant -garde technologies and adhering to the principles of ethical adoption, Petpal aims to modernize the pet adoption experience. The platform is built with an easy to use interface, robust safety measures and scalable infrastructure, ensuring their effectiveness to connect adopters with shelters worldwide. Through its correspondence with PET with AI, monitoring of the adoption and safe messaging system, Petpal seeks to increase the success rates of adoption, reduce the overcrowding of the refuge and promote the responsible property of pets.

1.3 Problem Statement

The challenge lies in improving the efficiency and experience of the user to connect possible adopters with animal shelters and rescue organizations, while guaranteeing the privacy and safety of user data. PetPal aims to address the need for a perfect, transparent and safe platform that simplifies the adoption process, fosters collaboration and improves interaction between users and rescue organizations, all while prioritizing the safety and well -being of the well -being of the animals and people involved

1.4 Stakeholders & Interests

Stakeholder	Their Roles
Pet Adopters	Users looking to adopt pets; interact with listings, submit applications, and communicate with shelters.
Animal Shelters & Rescues	Manage pet listings, review adoption applications, and oversee pet placements.
Platform Administrators	Oversee system management, user verification, and fraud prevention.

Developers & Engineers	Responsible for building, maintaining, and enhancing the platform.
UI/UX Designers	Ensure an intuitive and accessible interface for a seamless user experience.
Marketing & Outreach Team	Promote the platform to adopters and shelters, increasing adoption rates.
Customer Support Team	Address user queries, resolve technical issues, and provide assistance.

Table 2 Stakeholders & Interests

1.5 Objectives:

- Petpal's main objective is to create a platform where people interested in adopting pets can easily sail for available animals, learn more about them and start the adoption process.
- The platform would provide access to a variety of animals, such as dogs, cats, rabbits and other pets, local shelters and rescue organizations.

1.6 Scope:

PetPal's range extends to the creation of a comprehensive platform that connects people, animal shelters and rescue organizations to rationalize the process of adoption, promotion and rescue of animals. Its objective is to facilitate communication between possible adopters and shelters, promote awareness about needy animals and provide tools for volunteering and donations. PetPal serves as a versatile platform for users who seek to adopt, foster or contribute to animal welfare efforts. It is designed to operate on multiple devices, ensuring that users can interact with the platform from anywhere and at any time, which helps create a global network of animal defenders.

1.7 Assumptions

The development, implementation and success of the Petpal web application depend on several critical assumptions that shape their functionality and user experience. These assumptions are based on technological viability, user behavior and industry standards for online pet adoption platforms.

- **User accessibility and adoption:**

Possible adopters, animal shelters and rescue organizations will be supposed to have stable internet and digital literacy access to use the platform efficiently. Users should be able to navigate the system, create accounts, explore pet listings and complete the online adoption process. In addition, it is assumed that a significant number of adopters prefers a digital solution on traditional pet adoption methods due to convenience and accessibility.

- **Active participation of shelters and bailouts:**

Petpal's success depends on animal shelters and rescue organizations actively related to the platform updating PET listings, responding to adoption consultations, verifying the adopter information and guaranteeing ethical adoption processes. Shelters are supposed to regularly update pet profiles with precise details about race, age, health conditions and behavior to improve transparency and trust among adopters.

- **Precision and honesty in the user data:**

It is assumed that the adopters will provide genuine and precise information during the processes of application for registration and adoption. This includes sending truthful details about your experience with pets, living conditions and the ability to take care of the pet adopted. It is assumed that fraud detection measures, such as the verification of ID and the background verifications, are sufficient to mitigate the risks of dishonest applications.

- **Effectiveness of the coincidence of AI:**

It is assumed that the engine of recommendation with AI used for the coincidence of the PET adopter works effectively, providing relevant and precise suggestions based on the user's preferences, the PET temperament, the compatibility of the lifestyle and the adoption history. Although automatic learning algorithms will continually improve depending on the interactions and user feedback, a certain degree of manual intervention is expected to refine the parties.

- **Safety and data protection measures:**

Safety protocols, including user authentication, encryption and fraud detection, will be effective to protect the confidential user data from unauthorized access, piracy attempts or violations. Compliance with data protection laws (such as GDPR or CCPA) is expected to remain throughout the platform's life cycle, ensuring that user information will be handled responsible.

- **Regulatory compliance and legal considerations:**

The platform is designed to operate in multiple regions, and it is assumed that legal and regulatory compliance for the adoption of animals and digital data management will be maintained in different jurisdictions. The adoption laws vary according to the

country or the State, and Petpal is expected to adapt to these variations, ensuring that the adoption procedures follow local regulations.

- **Scalability and system performance:**

It is assumed that the underlying architecture, including cloud accommodation, the management of API databases and integrations, will allow scalability as the platform grows. The system must be able to handle an increasing number of users, lists of pets and real -time interactions without significant performance problems. Maintenance and regular updates are supposed to maintain the optimized growth platform.

- **The will of the users to pay the premium characteristics:**

If the platform offers premium services (as a priority coincidence of pets, virtual pet meetings or additional adoption support), it is assumed that users will find value in these characteristics and are willing to pay for them, contributing to the financial sustainability of the platform.

- **Support of veterinary organizations and animal welfare:**

It is assumed that veterinary clinics, animal behavior specialists and pet care experts will collaborate with Petpal to provide support after adoption, ensuring that pets are well served after adoption. These associations are essential to increase confidence in the platform and encourage the responsible property of pets.

- **User's adoption and retention:**

Finally, once users adopt a pet through Petpal, they will continue to interact with the platform for subsequent support, community interactions and updates on their pets adopted. The high retention of users is essential for the long -term success of the application, since it promotes organic growth and a loyal user base.

1.8 Risks

- **Technical Integration:**
  - The challenges of compatibility in the integration of Next.js, Express.js, Postgresql and the PET coincidence promoted by AI can lead to performance or stability problems.
  - Possible conflicts between real -time messages (socket.io) and backend processes.
- **Security risk:**
  - Inadequate security measures could cause data violations, identity fraud or unauthorized access.
  - Risks related to user authentication, PET listing checks and payments safety (if applicable).
- **Scalability risk:**

- Bad system optimization can lead to slow performance or blocks as the number of users and pet listings grows.
- Inadequate cloud infrastructure (AWS, Firebase, Vercel) could limit scalability.

- **Data management risk:**
  - PostgreSQL data management problems could lead to data loss, corruption or inefficiencies in search and correspondence algorithms.
  - Risk of duplicate or fraudulent PET listings if the validation of the database is weak.
- **Dependency risk:**
  - Trusting third -party services (AWS, Vercel, Google API) introduces risks of service interruptions, API changes or higher operational costs.
  - Any time of inactivity of external identity verification suppliers can delay adoption processes.
- **Risk of adoption and user participation:**
  - Some users may have difficulty navigating the platform, which leads to lower adoption rates.
  - Not providing an attractive and perfect UI/UX could lead to a high abandonment rate.
- **Regulatory and compliance risk:**
  - Compliance with regional and international laws to adopt animals may require legal updates or approvals.
  - Inadequate management of user and PET data privacy regulations (GDPR, CCPA) could result in legal sanctions.
- **Time OverRun Risk:**
  - Risk of overflow of the timeline Development delays, tests or integration phases can lead to lost installments and incomplete characteristics.
  - Unforeseen technical problems can cause project scope extensions.
- **Scope drag risk:**
  - Frequent additions or changes of characteristics can increase the workload, extend development terms and deformation resources.
  - Risk of competing in excess the workflows of adoption of the nucleus, affecting usability and performance.
- **Risk of fraud and misuse:**
  - Risk of false user profiles, fraudulent adoption applications or lists of deceptive pets.
  - The potential improper use of communication characteristics for spam or inappropriate interactions.

1.9 Success Criteria

Below is the feature checklist that must be present for the acceptance of the PetPal web application**:**

Category	Description
User Registration & Authentication	Secure signup/login, email verification, and social media authentication.
Pet Listings & Search Filters	Users can browse pets with advanced filters (species, breed, age, location, size).
AI-Powered Pet Matching	AI-driven recommendation system that suggests pets based on user preferences.
Adoption Application Process	Digital application forms, automated eligibility checks, and document uploads.
User Profiles	Adopters and shelters can create and manage profiles with verification badges.
Messaging System	Real-time chat between adopters and shelters with secure communication.
Post-Adoption Support	Resources, vet connections, pet training guides, and adoption follow-ups.
Data Management & Storage	Secure database for user and pet information with backup and recovery options.
Search & Filter Options	Quick pet search using filters like availability, medical history, and temperament.
Speed & Responsiveness	Fast-loading pages with optimized queries for a smooth user experience.
Scalability	Ability to handle a growing number of users, pets, and interactions without performance loss.
Data Privacy & Security	Encrypted data, compliance with GDPR/CCPA, and protection against data breaches.
Access Control	Role-based access (admin, adopter, shelter) with appropriate feature permissions.
User Interface & Experience	Intuitive, user-friendly UI following accessibility standards (WCAG compliance).
Cross-Platform Compatibility	Fully responsive design that works on desktops, tablets, and mobile devices.

Error Handling & Logging	Clear error messages, logging of issues for debugging, and crash recovery mechanisms.
Third-Party Integrations	Integration with payment gateways, pet microchip databases, and social media platforms.
Reporting & Analytics	Dashboard for tracking adoption trends, user engagement, and system performance.
Deployment Readiness	Well-documented setup, cloud hosting (AWS/Firebase), and CI/CD implementation.

Table 3 Success Criteria

1.10 Tools, Libraries & Technologies

Tool	Version	Rationale
VS Code	Latest	Preferred for its lightweight and robust development environment.
Postman	Latest	Used for API debugging and testing.
Git & GitHub	Latest	Version control and collaborative development.
Docker	Latest	Containerization for scalable deployment.
Jest	Latest	Unit testing framework for JavaScript applications.

Table 4 Tools

Technology	Version	Rationale
React.js	Latest	Ensures a responsive and interactive user interface.
Node.js	Latest	Provides a scalable and efficient backend.
MongoDB	Latest	NoSQL database for flexible and dynamic data storage.
AWS	Latest	Cloud hosting and deployment for high availability.

Table 5 Technology

1.11 Work Division

Sr. No	Roll Number	Name	Role Assignment & Work Division
1.	069568	Ayesha Praveen	Back-End and Documentation
2.	069595	Taskeen Rafiq	Front End
3.	069645	Anam shahzadi	Front End

Table 6 Work Division

1.12 Conclusion

The Petpal web application is designed to revolutionize the PET adoption and rescue process by taking advantage of digital technology to create a perfect, safe and easy to use platform. Through the coincidence of pets, real -time communication and a structured adoption workflow, the platform ensures that adopters find the appropriate pets while shelters efficiently administer their listings. When addressing the key challenges, such as fraud prevention, scalability and data privacy, Petpal integrates the best practices of digital adoption systems and user experience research. When implementing safe authentication, robust data management and intuitive interface, the platform improves accessibility and trust among users.

As an integral and scalable solution, Petpal aims to improve PET adoption rates while guaranteeing responsible locations and support after adoption. Advance, the continuous feedback of the users, the advanced analysis and the improvements of IA will boost additional improvements, which makes Petpal a leading digital platform for welfare and rescue organizations of animals worldwide.

Chapter No 2

Literature Review

2.1 Literature Survey

The PetPal web application is reported by an exhaustive analysis of existing animal's adoption platforms, messaging systems and real -time communication technologies. Several existing studies and systems have highlighted the importance of the perfect interaction between adopters and rescue organizations, the protection of safe data and easy to use interfaces in adoption and rescue processes.

2.1.1 Digital platforms for pet adoption:

The digital transformation has significantly affected PET adoption services. The investigation indicates that online pet adoption platforms increase adoption rates by offering accessibility, broader scope and advanced correspondence algorithms (Miller et al., 2021). Compared to traditional methods, web applications provide a more convenient and efficient way for potential users to find adequate pets (Smith and Johnson, 2020).

2.1.2 User experience and adoption rates:

Studies emphasize that easy to use design, intuitive navigation and personalized recommendations improve adoption rates on digital platforms (Brown and Taylor, 2019). Characteristics such as PET coincidence promoted by AI, detailed PET profiles and interactive elements (for example, virtual PET meetings) increase user participation and satisfaction (Lee et al., 2022).

2.1.3 Challenges in the adoption of pets online:

While digital adoption platforms have numerous benefits, challenges such as fraudulent lists, lack of verified information and adoptant suitability evaluation persist (Wilson and Green, 2021). The solutions include the implementation of identity verification, the integration of adoption detection processes and collaboration with verified shelters (Anderson, 2020).

2.1.4 Ethical considerations and animal welfare:

Ensuring ethical adoption practices is crucial. The research underlines the importance of responsible pets, shelter associations and support after adoption to reduce abandonment rates (García et al., 2021). Digital platforms must also prioritize transparency in PET health records and behavioral history to guarantee informed decision making (Carter and Hayes, 2018).

2.2 Related Work:

The adoption of PET has gone from traditional visits to digital platforms, allowing a broader scope and more efficient adoption processes. Several web applications and research studies have had the objective of optimizing the PET adoption experience incorporating characteristics such as AI promoted, real -time communication and safe

adoption processes. This section reviews existing solutions and highlights its limitations, underlining Petpal's need as an improved alternative.

Existing Digital Pet Adoption Platforms:

- **Petfinder**

Description	**Petfinder** is one of the largest online pet adoption platforms, offering a comprehensive database of adoptable pets from shelters and rescues[].
Features	• Advanced search filters (location, breed, age, size). • Pet profile details (vaccination status, behavior). • Shelter and rescue organization profiles.
Limitations	• **Limited AI Matching:** No AI-driven personalized recommendations based on adopter preferences. • **No Direct Communication:** Lacks real-time messaging between adopters and shelters, slowing down the process. • **Verification Issues:** No robust identity verification, leading to potential fraud.

- **Adopt-a-Pet**

Description	A widely used platform that connects potential adopters with shelters, breeders, and rescues[].
Features	• Pet search with filters. • Email alerts for new listings. • Informational resources for pet care.
Limitations	• **Lack of Screening Mechanisms:** Does not provide in-depth adoption screening, increasing the risk of unsuitable placements. • **Basic UI/UX:** Limited focus on user-friendly design and mobile responsiveness. • **Minimal Post-Adoption Support:** No structured guidance for new pet owners.

- **ASPCA Adoption Portal**

Description	A shelter-managed adoption service with an online portal to help potential adopters find rescue animals[].
Features	• Direct shelter-based adoptions.

	• Pet profiles with medical history. • Information on adoption procedures.
Limitations	• **Restricted Availability:** Limited to specific ASPCA-affiliated shelters. • **No AI-Powered Matching:** Does not provide intelligent suggestions based on user lifestyle. • **Lack of Instant Messaging:** Communication is mainly via email or phone, leading to delays.

2.2.1 The importance of digital platforms in the adoption of pets Traditional Pet Adoption Versus Digital

Historically, pet adoption has been based on physical shelters, mouth references and printed ads [1]. While they are effective, these methods have limitations, including geographical limitations, lack of visibility for adoptable pets and limited accessibility for possible adopters.

- Recent studies highlight how digital pet adoption platforms (such as Petfinder and Adopt-A-PET) have transformed the adoption process through:
- Expanding the scope of adoption listings beyond local communities.
- Provide detailed pet profiles with images, videos and medical history, which improves adoption decision making [2].
- Reduction of adoption barriers by offering efficient communication tools between adopters and shelters [2].

Petpal is based on these digital advances by creating an interactive platform, easy to use and based on data that improves transparency and efficiency in PET adoption.

2.2.2. User experience and participation in digital adoption platforms

- **Easy to use design and accessibility**

A study by Nielsen (2021) [4] on digital adoption experiences emphasizes the role of easy -to -use interfaces on the influence of adoption decisions. The key results indicate that:

- Intuitive navigation and filtrable search functions improve user participation and increase adoption rates.
- Mobile accessibility is critical, since more than 70% of the listings of PET adopters sail on mobile devices.

Petpal incorporates these ideas by:

- Implementation of advanced search filters based on species, race, age, location and special needs.
- Offering a totally receptive design compatible with desks, tablets and smartphones.

- **Roles of High-Quality images in adoption:**

Studies indicate that high quality images and videos significantly increase PET adoption rates (Weiss et al., 2012) [1]. Pets with well -lit and attractive photos receive more consultations compared to those with low quality images.
Petpal addresses this by:

- Allow shelters to load multiple high -resolution images and short videos of each pet.
- Use of the improvement of the image with AI (future function) to improve the quality of the photo.

2.2.3. The role of technology to improve adoption efficiency

- **Online applications and automated processing:**

Traditional adoption processes often involve paper applications and manual approvals, which leads to delays (Smith et al., 2019). Research suggests that automated application systems improve efficiency by:

- Papeleo reduction and processing times.
- Provide evaluations of structured applicants, ensuring better coincidences of pet owners.

Petpal improves efficiency through:

- A structured online application system that shelters can review, approve or reject digitally.
- Automated notifications that report users of application status updates.

Communication and transparency for adoptions:

A study on PET adoption behavior (Jones et al., 2020) found that transparent communication between adopters and shelters reduces adoption failures. Effective communication tools help address adopters' concerns before finishing adoption decisions.
Petpal Integrates:

- Application messages to allow direct discussions between adopters and shelters.
- Chatbots with AI (future function) to answer common consultations related to adoption.

2.2.4. The impact of services based on the location on pet adoption

- **Paper of geolocation in the success of adoption**

Geolocation services are widely used in electronic commerce and real estate and have shown a significant potential in the adoption of PET (González et al., 2021).

- Location -based technology: It helps adopters find nearby pets, increasing the probability of adoption.
- It reduces transport and logistics challenges for both adopters and shelters.

Petpal integrates geolocation services in real time, allowing users:

- See shelters and pets available on an interactive map.
- Get instructions and travel estimates to nearby shelters.

2.2.5. The role of digital platforms in animal welfare and refuge sustainability

- **Digital adoption and shelter support**

Many shelters struggle with overcrowding, limited financing and lack of visibility (Davis et al., 2018).

- Digital platforms play a crucial role in: Refugio overcrowding reduction by increasing pet locations.
- Promote the responsible property of pets through educational resources. Provide additional income flows, such as donations and sponsorships.

Petpal supports shelters by:

- Donations tracking and volunteer management tools to help shelters maintain operations.
- Educational resources to guide adopters on the care of responsible pets.

2.2.6. Safety and ethical considerations in the adoption of digital pets

- **Data Safety and Privacy**

With greater digital adoption, data security concerns have emerged. A study by Cybersafe (2022) highlights the risks, such as unauthorized access to user information and online scams.

Petpal addresses these concerns through:

- End -to -end encryption for user data and communications. Multifactor authentication (MFA) for user access.
- Compliance with GDPR and other data protection laws.

- **Ethical Pet Adoption**

Practices Online platforms should prevent unusual practices, such as PET flip (reselling to the pets adopted) and fraudulent breeders (Anderson et al., 2020).

Petpal implements:

- Strict verification for shelters and bailouts, ensuring that only legitimate organizations list pets.
- Fraud detection with AI (future characteristic) to identify suspicious adoption patterns.

2.3 Gap Analysis:

Despite the presence of multiple platforms for adoption of digital pets, current solutions have several deficiencies that affect the efficiency, safety and experience of the user.

The following key gaps require the development of Petpal:

1- **Lack of recommendations based on AI:**
Existing platforms depend on manual searches, which can take a long time and ineffective.

2- **LIMITED COMMUNICATION IN REAL TIME:**
The absence of integrated instant messages between adopters and shelters slows the adoption process.

3- **Weak verification processes:**
Fraudulent lists and false adopters pose security risks due to insufficient identity verification measures.

4- **Inappropriate support after adoption:**
Current solutions lack structured resources, veterinary connections and training support to guarantee the well -being of PET.

5- **Bad user experience (UX):**
Many platforms have outdated designs, slow response times and limited accessibility, which makes adoption cumbersome.

2.4 Summary

The literature review explores the role of digital platforms in the adoption of PET, emphasizing how web applications have transformed the process by increasing accessibility, efficiency and adoption rates. The investigation highlights the impact of the user experience, the pairing promoted by AI and the interactive characteristics to improve the commitment and guarantee successful adoptions.

Despite these advances, existing platforms such as Petfinder, Adopt-A-PET and the ASPCA adoption portal have notable limitations, including the lack of recommendations based on AI, weak verification processes, limited communication in real time and inappropriate support after adoption. These gaps create inefficiencies, safety risks and barriers for the adoption of pets without problems.

To address these challenges, Petpal is proposed as a safe platform, easy to use and integrated AI that improves adoption results by offering personalized PET recommendations, verified adaptation interactions -Ilter, instant messages and resources after adoption. By taking advantage of advanced technology, Petpal aims to improve user experience, optimize the adoption process and guarantee long -term wellbeing.

Chapter No 3

Software Requirements Specification

3.1 Requirements Analysis

The Software Requirements Specification (SRS) for the Petpal web application describes the essential functional and non -functional requirements to develop a PET adoption and rescue platform without seams and efficient. It details the objectives, scope, interested parties, interested parties, functional modules, system architecture, limitations and security considerations. The document serves as a plan for developers, ensuring that the system meets the user's needs while maintaining scalability, performance and data safety. Through well -defined requirements, the SRS guarantees that Petpal delivers a safe, easy -to -use and safe adoption experience.

3.2 User classes and characteristics

1. **Pet adopters (general users)**

   Description: People who seek to adopt a pet through the platform.

User Class	User Characteristics
Pet adopters	• You can register and manage your profiles with personal data and preferences. • Explore the available pets using search filters (species, race, age, size, location). • Send adoption requests and track your status. • Communicate with shelters through real -time messages. • Receive notifications and adoption updates. • Access the support after adoption, including pet care guides and veterinary connections.

Table 7 Pet adopters

2. **Shelter Admin:**

   Description: Verified shelters and rescue organizations listed pets for adoption.

User Class	User Characteristics
Shelter Admin	• Create and manage refuge profiles with details of the organization. • Load and update pet profiles with images, medical history and behavioral traits. • Check and approve/reject adoption requests. • Communicate with adopters through incorporated messages. • Organize and promote adoption events and fundraising campaigns. • Access the donation management tools to receive financial and in kind.

Table 8 Shelter Admin

3. Admin:

Description: Moderators of the system responsible for administering the safety of the platform, user verification and technical support.

User Class	User Characteristics
Admin	• Supervise the user registration and the verification of the shelter to prevent fraudulent activities. • Manage PET listings and moderation of content to guarantee quality and precision. • Manage complaints, disputes and security concerns related to the misuse of the platform. • Monitor system performance, activity time and data integrity. • Guarantee regulatory compliance with PET adoption laws and data privacy policies.

Table 9 Admin

4. Volunteers and donors:

Description: Users who contribute to shelters through voluntary services or financial donations.

User Class	User Characteristics
Volunteers and donors	• Register as volunteers for shelters and adoption events. • Participate in community awareness programs and pet welfare initiatives. • Done money, pet food or medical supplies through integrated donation characteristics. • Trace the donation and impact history.

Table 10 Volunteers and donors

5. Veterinarians and pet care professionals (future expansion):

Description: Professionals who provide medical and behavioral support for adopted pets.

User Class	User Characteristics
Veterinarians and pet care	• Collaborate with shelters to update pets of pets. • Offer telesalud consultations or medical check -ups on the site. • Provide adoption and training advice after adoption for pet owners.

Table 11 Veterinarians and pet care

6. Visitors (unregistered users):

Description: Individuals who explore the platform without an account.

User Class	User Characteristics
Visitors	• Explore pet listings and refuge profiles with limited access. • Read adoption guidelines and educational resources.

	• You cannot interact with shelters or request adoption until it is registered.

Table 12 Visitors

3.3 Requirement Identifying Technique

To effectively determine the requirements for the Petpal web application, a combination of use cases and graphic script techniques is used. These methods ensure a clear understanding of system functionalities, user interactions and workflow.

3.3.1 Use Case Description & Use Case Diagram

The use of use cases is a structured technique used to identify and define the functional requirements of the Petpal web application. It focuses on capturing user interactions with the system defining specific tasks or actions that users make. Each use case consists of a name, actors (users who interact with the system), steps, previous conditions and postconditions, ensuring a detailed understanding of how the system should work.

For Petpal, several key use cases have been identified, such as the user's registration and authentication, the search and filtering of pets, the sending of the adoption application, the messages in real time and the support after the adoption. These use cases provide clarity on how the different components of the system interact with users, which allows developers to create characteristics that are aligned with the user's needs. In addition, the use cases diagrams map the functionalities of the system, ensuring that each feature is well defined and their dependencies are identified.

The importance of use cases analysis lies in its ability to structure the system requirements efficiently, allowing developers and interested parties to anticipate possible challenges, dependencies and workflows of the system before development begins. This technique ensures that all essential features are captured and that the final product meets the user's expectations.

3.3.2 Story Boarding

The graphic script is a visual technique used to represent how users interact with the system through a sequence of steps. It illustrates user actions and system responses in a step -by -step format, which facilitates the design of an intuitive and easy to use experience. This technique is widely used in the design of the user experience (UX), ensuring that interfaces and navigation flows are perfect and logical.

For Petpal, the graphic script is particularly useful for designing characteristics such as pet search and filtering, adoption application and messages in real time. For example, in the graphic search script and pet filtering, the sequence begins with the user visiting the home page, selecting pet filters, watching the search results and the opening of a pet profile. Similarly, in the graphic script of the adoption application process, the sequence follows the user by selecting a pet, completing an adoption form and receiving an update status of the application of the refuge.

The advantage of the graphic script is that it allows developers, designers and interested parties to visualize the flow of interactions before the implementation. It helps to refine user navigation, minimize complexity and improve general usability. When using the graphic script, Petpal ensures that its adoption platform is easy to use, accessible and well structured, ultimately improving the user's experience.

3.4 Functional Requirements

3.4.1 User Registration And Profiles

Identifier	FR-1
Title	user registration and profiles
Requirement	The pet adopter, shelter representative, or administrator shall be able to create an account, log in, and manage authentication securely using an email/password or social media login.
Source	System requirement based on security and access control needs.
Inputs	User-provided details such as name, email, password, or social media credentials.
Destination	The outputs will be stored in the user database and displayed as a confirmation message upon successful registration/login.
Outputs	A user profile with role-based access (adopter, shelter, admin) and a welcome/dashboard screen after login.
Rationale	Required for secure access control, user identity verification, and personalized user experience.
Business Rule (if required)	User credentials must be encrypted and comply with security standards (e.g., GDPR, CCPA). Duplicate emails shall not be allowed for registration.
Dependencies	Required for pet search (FR-2), pet listing (FR-3), and adoption application (FR-4).
Priority	High

Table 13 user registration and profiles

3.4.2 Pet Search and Filtering

Identifier	FR-2
Title	Pet Search and Filtering
Requirement	The pet adopter shall be able to search for pets using filters such as breed, age, size, location, and health conditions to find a suitable match.
Source	User need for personalized pet selection.
Inputs	Search parameters such as breed type, age range, size preference, and location.
Destination	The results will be displayed on a pet listing page with images and details.
Outputs	A list of adoptable pets matching the search criteria with brief details and a “View Profile” option.
Rationale	Improves user experience and adoption efficiency by narrowing options based on preferences.
Business Rule (if required)	Only verified shelters can list pets. Search results must be sorted by relevance and availability.
Dependencies	Depends on pet listing management (FR-3).
Priority	High

Table 14 Pet Search and Filtering

3.4.3 Pet Listing Management

Identifier	FR-3
Title	Pet Listing Management
Requirement	The shelter representative shall be able to upload, update, and remove pet listings, including images, descriptions, and adoption requirements.
Source	Shelter operational need to manage adoptable pets.
Inputs	Pet details such as name, breed, age, medical history, photos, and behavioral traits.

Destination	The pet profile will be stored in the database and displayed on the adoption page.
Outputs	A searchable and filterable pet profile available for adopters to view.
Rationale	Enables shelters to keep adoption listings updated, ensuring accurate and timely information.
Business Rule (if required)	Only verified shelters can post pet listings, and inactive listings should be removed automatically.
Dependencies	Required for pet search (FR-2) and adoption application (FR-4).
Priority	High

Table 15 Pet Listing Management

3.4.4 Adoption Application Process

Identifier	FR-4
Title	Adoption Application Process
Requirement	The pet adopter shall be able to submit an adoption application, including details about their home environment, experience, and reasons for adopting. Shelters shall be able to review, approve, or reject applications.
Source	Regulatory requirement for ethical pet adoption.
Inputs	Adoption form with user details, pet preferences, home situation, and experience with pets.
Destination	The application status will be stored in the database and displayed to both the adopter and shelter.
Outputs	An application confirmation message, followed by updates such as “Under Review,” “Approved,” or “Rejected.”
Rationale	Ensures responsible pet placements and reduces the likelihood of pet returns.
Business Rule (if required)	Adopters must pass verification checks before application approval. Shelters must respond within a specified time frame.

Dependencies	Requires user authentication (FR-1) and pet listing (FR-3).
Priority	High

Table 16 Adoption Application Process

3.4.5 Real-Time Messaging

Identifier	FR-5
Title	Real-Time Messaging
Requirement	The pet adopter and shelter representative shall be able to exchange messages within the platform to discuss adoption details.
Source	User need for direct communication during adoption inquiries.
Inputs	Message text, sender/receiver details, and timestamps.
Destination	Messages will be stored in the chat database and displayed in the messaging interface.
Outputs	A chat interface where users can send and receive messages.
Rationale	Enhances communication efficiency, reducing adoption delays.
Business Rule (if required)	Messages must be monitored for spam and abusive content.
Dependencies	Requires user authentication (FR-1) and adoption application (FR-4).
Priority	Medium

Table 17 Real-Time Messaging

3.4.6 Post-Adoption Support

Identifier	FR-6
Title	Post-Adoption Support
Requirement	The adopter shall be able to access pet care guides, veterinary support, and training resources after adoption.
Source	User need for post-adoption assistance.
Inputs	Pet care topics, expert consultations, and user preferences.
Destination	Displayed on the user dashboard and pet profile page.

Outputs	Access to articles, videos, and a support chatbot.
Rationale	Encourages responsible pet ownership and reduces pet return rates.
Business Rule (if required)	Only verified adopters can access post-adoption support.
Dependencies	Requires successful adoption completion (FR-4).
Priority	Medium

Table 18 Post-Adoption Support

3.4.7 Post-Adoption Support

Identifier	FR-6
Title	Post-Adoption Support
Requirement	The adopter shall be able to access pet care guides, veterinary support, and training resources after adoption.
Source	User need for post-adoption assistance.
Inputs	Pet care topics, expert consultations, and user preferences.
Destination	Displayed on the user dashboard and pet profile page.
Outputs	Access to articles, videos, and a support chatbot.
Rationale	Encourages responsible pet ownership and reduces pet return rates.
Business Rule (if required)	Only verified adopters can access post-adoption support.
Dependencies	Requires successful adoption completion (FR-4).
Priority	Medium

Table 19 Post-Adoption Support

3.4.7 Location-Based Services

Identifier	FR-7
Title	Enable Location-Based Pet Search and Shelter Finder
Requirement	The system shall allow users to find nearby shelters and adoptable pets based on their geographic location using GPS or manual input.

Source	User need for convenient pet adoption within a specified location.
Inputs	User's GPS location or manually entered city/zip code.
Destination	Data will be used to filter and display location-based results in the pet search interface.
Outputs	A map view and list of nearby shelters and adoptable pets with distance details.
Rationale	Simplifies the pet search process by providing local adoption options**.**
Business Rule (if required)	Users must grant location access or manually input location data. The system should allow users to adjust the search radius (e.g., 10-50 miles)**.**
Dependencies	Integrates with pet search and filtering (FR-2)**.**
Priority	High

Table 20 Location-Based Services

3.4.8 Veterinary Services Integration

Identifier	FR-8
Title	Provide Veterinary Support and Appointment Scheduling.
Requirement	The system shall allow adopters to **book veterinary appointments, access pet medical history, and receive health notifications**.
Source	User need for continued pet health management.
Inputs	Pet adoption record, medical history, vet availability.
Destination	Data will be **stored in the adopter's dashboard** and sent as appointment reminders.
Outputs	A list of **partnered veterinary clinics, appointment booking options, and pet health updates**.
Rationale	Ensures pets receive **proper medical care after adoption**, reducing health risks.
Business Rule (if required)	Only **verified adopters** can access veterinary services. The system must ensure **secure medical record storage**.

Dependencies	Requires **adoption completion (FR-4)** and **location-based search (FR-7)** for vet listings.
Priority	Medium

Table 21 Veterinary Services Integration

3.4.9 Event Scheduling and Management

Identifier	FR-9
Title	Manage Adoption and Fundraising Events
Requirement	The system shall allow shelters to **schedule, manage, and promote pet adoption and fundraising events**.
Source	Shelter requirement for community engagement and adoption drives.
Inputs	Event details (name, date, location, description, type: online/in-person).
Destination	Events will be **listed in the platform's events section** and sent as **user notifications**.
Outputs	A **publicly visible event page with registration options** for adopters and volunteers.
Rationale	Encourages **higher adoption rates and community involvement**.
Business Rule (if required)	Only **verified shelters and administrators** can create events. Users can **registe express interest**.
Dependencies	Integrates with **donation and volunteer management (FR-10)**.
Priority	Medium

Table 22 Event Scheduling and Management

3.4.10 Donation and Volunteer Management

Identifier	FR-10
Title	Manage Donations and Volunteer Sign-Ups
Requirement	The system shall allow users to **donate money/supplies or sign up as volunteers** to support shelters.
Source	Shelter and community requirement for financial and volunteer support.

Inputs	Donation amount, payment method, volunteer role selection.
Destination	Donations will be **processed through a payment gateway**; volunteer requests will be **sent to shelters**.
Outputs	Confirmation receipts, donation history, and **volunteer schedules**.
Rationale	Provides financial and human resource support for **shelters and rescue organizations**.
Business Rule (if required)	Only **verified users** can donate or volunteer. The system must track **donation transactions securely**.
Dependencies	Integrates with **event scheduling (FR-9)** and **shelter dashboard management**.
Priority	Medium

Table 23 Donation and Volunteer Management

3.5 Non-Functional Requirements

This section specifies nonfunctional requirements other than constraints, supporting requirements recorded in Functional Requirements section, and external interface requirements. These quality requirements should be specific, quantitative, and verifiable. The following are some examples of documenting guidelines.

3.5.1 Reliability

- **Activity time guarantee of 99.9%:** Use redundancy mechanisms and cloud - based error switching to guarantee high availability.
- **We descend automatic switching:** it implements the replication of the database and the loading balance to maintain activity time during the failures.
- **Error management and monitoring:** Use centralized record (Stack Elk, Datag) and real -time monitoring (Prometheus, Grafana) for the resolution of proactive problems.
- **Disaster back and recovery:** program daily data backups and define a disaster recovery plan to restore services quickly in case of failures.

3.5.2 Accessibility

- **Fully receptive design:** Make sure the user interface adapts perfectly to desktop computers, tablets and smartphones with intuitive navigation.
- **Compliance with the WCAG:** adhere the standards of web content accessibility (WCAG) 2.1 AA guidelines to admit users with disabilities.
- **Navigation reader and keyboard screen support:** Make sure all key features are accessible through keyboard shortcuts and compatible with screen readers.

- **Color and text scale contrast:** Provide high contrast issues and adjustable text sizes for better readability.

3.5.3 Usability

The usability requirements for the Petpal web application focus on guaranteeing an intuitive, accessible and efficient user experience. The system should be easy to learn, easy to navigate and capable of minimizing user errors while providing fast and precise adoption features.

- **Learning ease**
  - Users for the first time should be able to complete pet searches and send an adoption application within 5 minutes after the platform.
  - The platform will provide interactive incorporation tutorials for new users, guiding them through main features such as searching for pets, sending messaging applications and shelters.
  - Navigation must be simple and predictable, with a consistent UI design for adopters and shelters.
- **Ease of use**
  - Users should be able to search and filter pets with no more than 3 clicks.
  - The adoption application process must be completed in most of the 5 steps, from the selection of a pet to send a request.
  - Real -time messages between adopters and shelters should be accessible to 2 clicks from the profile of a pet.
- **Avoid errors and recovery**
  - The system must provide clear error messages and validation indications for incomplete forms or incorrect inputs (for example, lack of fields required in adoption applications).
  - Users should be able to undo actions, such as deleting a pet list or withdrawing an adoption application.
  - The platform will automatically save draft applications to avoid data loss.
- **Interactions efficiency**
  - The platform must load pages in 2 seconds for an optimal user experience.
  - PET recommendations with AI must be generated instantly at the user entry or preferences updates.
  - The system must provide instantaneous comments when an adoption request is sent or a shelter responds to a message.

3.5.4 Performance

- Make sure that all main operations, such as looking for pets, reserve pet services and manage user profiles, have a response time of less than 2 seconds, even under the maximum user load.
- **Optimized data retention:** Use the tanstack query (consultation reaction) to handle real -time updates and storage in cache efficiently, reducing redundant server calls and improving general performance.

- **Purse charging and code division:** implements a lazy load for images, videos and large data sets to guarantee soft page interactions. Use the division of the code to load only the necessary components when necessary.
- **Optimization of the database:** Optimize database and indexing consultations for a rapid recovery of pet listings, user service provider details and interactions.
- **CDN implementation:** Use a content delivery network (CDN) to accelerate the delivery of static assets such as images, CSS and JavaScript files.

3.5.5 Security

- **Authentication and authorization:** Implement Oauth 2.0, tokens JWT and multifactor authentication (MFA) for safe user session.
- **ROLES BASED ACCESS CONTROL (RBAC):** Restrict access based on user roles (for example, pet owners, service providers, administrators).
- **Data encryption:** Cifre confidential user data using AES-256 for storage and TLS 1.3 for data transmission.
- **Attack protection:** Implement SQL injection security measures, cross -site command sequences (XSS) and falsification of cross sites applications (CSRF).
- **Regular security audits:** Perform periodic penetration tests and code audits to guarantee security compliance.

3.6 External Interface Requirements

The Petpal web application must interact without problems with users, external software and hardware components. This section defines user interfaces, software interfaces, hardware interfaces and communication protocols necessary for soft operation and integration.

3.6.1 User Interfaces Requirements

The system must provide a responsive, intuitive, and accessible interface to enhance user experience.

Web-Based UI	• Designed using Next.js and Tailwind CSS for a modern and responsive layout. • Optimized for desktop, tablet, and mobile devices with a clean, easy-to-navigate structure. • Supports dark mode and high-contrast settings for accessibility. • Ensures a maximum of three clicks to perform key actions like searching for pets or submitting applications.
Interactive Elements	• Search and Filter Panel: Allows users to filter pets by species, breed, age, size, and location. • Messaging Interface: Provides real-time chat with shelters using a minimalist, WhatsApp-style chatbox.

	• Dashboard for Shelters: Displays pet listings, adoption requests, and application statuses in a centralized admin panel. • Adoption Application Form: Step-by-step, guided application process with auto-save functionality.

3.6.2 Software Interfaces

The system must interact with API and third -party services for improved functionality.

Authentication and user management	• Use the authentication of Firebase or Oauth 2.0 for sure user session listing, Google or Facebook.
Database management	• Postgresql for structured data storage (users, pets, applications). Redis Cache for the performance of optimized consultations and session management.
AI engine and recommendation	• Automatic learning API (based on Python) to coincide with adopters with preferences -based pets.
Messages and notifications	• Socket.io for chat in real time between adopters and shelters. API Twilio for SMS/Email notifications in the status of the application.
Payment and donation integration (optional future expansion)	• Striped API or paypal to allow shelters to receive rates or adoption donations.

3.6.3 Hardware Interfaces

Hardware interfaces Although mainly a web -based platform, the system must admit external devices when necessary.

Server housing	• Implemented in AWS, Firebase or DigitaloCean for scalability and reliability of activity time.
Mobile capacity	• Totally optimized for Android and iOS devices (initially a native mobile application is not required).
QR code scanner (future expansion)	• Shelters can use QR codes for pet profile scan, directly linking to the pet adoption page.

3.6.4 Communications Interfaces

The platform must admit the transmission of safe and efficient data between users and external systems.

API communication	• Use API Restful for backend communication with authentication and processing adoption applications.
Security and encryption	• All data transmissions must be encrypted SSL/TLS to protect user privacy.
Management and registration of errors	• Centralized registration (Elk or AWS Cloudwatch) to monitor system performance and track errors.

3.7 Use case Analysis

3.7.1 Use Case #1 User Registration and Authentication

UC Identifier	*UC1*
UC Name	*Register and Authenticate User*
Requirements Traceability	*FR-1 (User Registration and Authentication)*
Purpose	*To allow users (adopters, shelters, and administrators) to securely register and log in to the PetPal system.*
Priority	*High*
Preconditions	*The user is successfully authenticated and granted access to their designated dashboard.*
Post conditions	*The conditions that will be satisfied after the use case successfully completes*
Actors	*Pet Adopter, Shelter Representative, Platform Administrator.*
Extends	*None*
Main Success Scenario	

3.7.2 Use Case #2 Use Case for Search and Filtering

UC Identifier	*UC2*
UC Name	*Search and Filter Pets*
Requirements Traceability	*FR-2 (Pet Search and Filtering)*
Purpose	*Allows adopters to search for pets using various filters to find a suitable match.*
Priority	*High*
Preconditions	*The user must be logged in to access advanced filters and save preferences.*
Post conditions	*The system displays a list of pets matching the user's search criteria.*
Actors	*Pet Adopter.*
Extends	*None*
Main Success Scenario	

3..7.3 Use Case #3 Use Case for Adoption Application Process

UC Identifier	*UC3*
UC Name	*Submit Adoption Application*
Requirements Traceability	*FR-4 (Adoption Application Process)*
Purpose	*Allows adopters to apply for pet adoption and shelters to review applications.*
Priority	*High*
Preconditions	*The user must be logged in and have selected a pet for adoption.*
Post conditions	*The shelter receives the application and begins the review process.*
Actors	*Pet Adopter, Shelter Representative*
Extends	*None*
Main Success Scenario	

3.7.4 Use Case #4 Location Services

UC Identifier	*UC4*
UC Name	*Find Nearby Shelters and Pets*
Requirements Traceability	*FR-7 (Location-Based Search)*
Purpose	*Allows adopters to search for available pets and shelters based on their geographic location.*
Priority	*High*
Preconditions	*The user must allow **location access** or enter a zip code/city manually.*
Post conditions	*The system displays a list of **nearby shelters and adoptable pets** based on location.*
Actors	*Pet Adopter, Shelter Representative, System GPS API*
Extends	*None*
Main Success Scenario	

3.7.5 Use Case #5 Integration with Veterinary Services

UC Identifier	*UC5*
UC Name	*Connect with Veterinary Services*
Requirements Traceability	*FR-8 (Veterinary Support and Health Tracking)*
Purpose	*Allows adopters to access veterinary services, book appointments, and receive pet health updates.*
Priority	*Medium*
Preconditions	*The pet must be **successfully adopted** and the adopter must have an active account.*

Post conditions	*The adopter receives access to **vet consultations, vaccination reminders, and pet care resources**.*
Actors	*Pet Adopter, Veterinarian, Shelter Representative, System API (Vet Service Provider)*
Extends	*None*
Main Success Scenario	

3.7.6 Use Case #6 Event Scheduling and Management

UC Identifier	*UC6*
UC Name	*Schedule and Manage Adoption Events*
Requirements Traceability	*FR-9 (Event Scheduling and Management)*
Purpose	*Allows shelters and administrators to create, manage, and promote pet adoption events.*
Priority	*Medium*
Preconditions	*The user must be **a verified shelter representative or administrator** to create an event.*
Post conditions	*The event is successfully created, and adopters can view and register for it.*
Actors	*Shelter Representative, Platform Administrator, Pet Adopter*
Extends	*None*
Main Success Scenario	

3.7.7 Use Case #7 Donation and Volunteer Management

UC Identifier	*UC7*
UC Name	*Manage Donations and Volunteers*
Requirements Traceability	*FR-10 (Donation and Volunteer Management)*
Purpose	*Allows users to donate funds, supplies, or time as volunteers to support shelters and rescue organizations.*
Priority	*Medium*
Preconditions	*The user must be **registered** to donate or sign up as a volunteer.*
Post conditions	*The donation or volunteer request is successfully processed, and the user receives confirmation.*
Actors	*Pet Adopter, Shelter Representative, Platform Administrator, Donor, Volunteer*
Extends	*None*
Main Success Scenario	

3.7.8 Use Case #8 Donation and Volunteer Management

UC Identifier	*UC10*
UC Name	*Generate Reports and View Analytics*
Requirements Traceability	*FR-11 (Reporting and Analytics)*
Purpose	*Allows administrators and shelters to generate reports and view adoption, donation, and user engagement analytics.*

Priority	*High*
Preconditions	*The user must be an **authorized shelter representative or platform administrator** to access reports.*
Post conditions	*The system generates and displays **real-time analytics and downloadable reports**.*
Actors	*Shelter Representative, Platform Administrator*
Extends	*None*
Main Success Scenario	

3.7.9 Use Case Diagram

- **User Registration and Authentication**

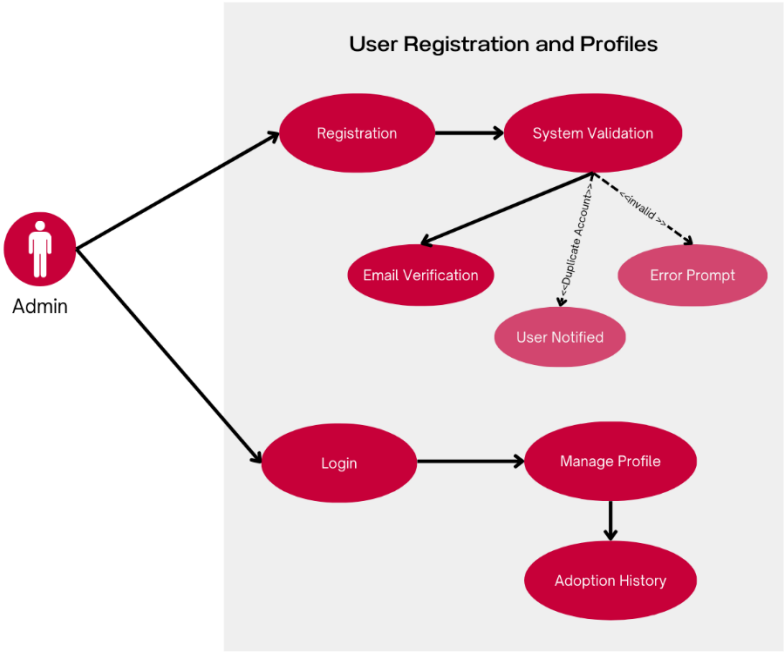


Figure 1 Use Case for Admin Registration and Authentication

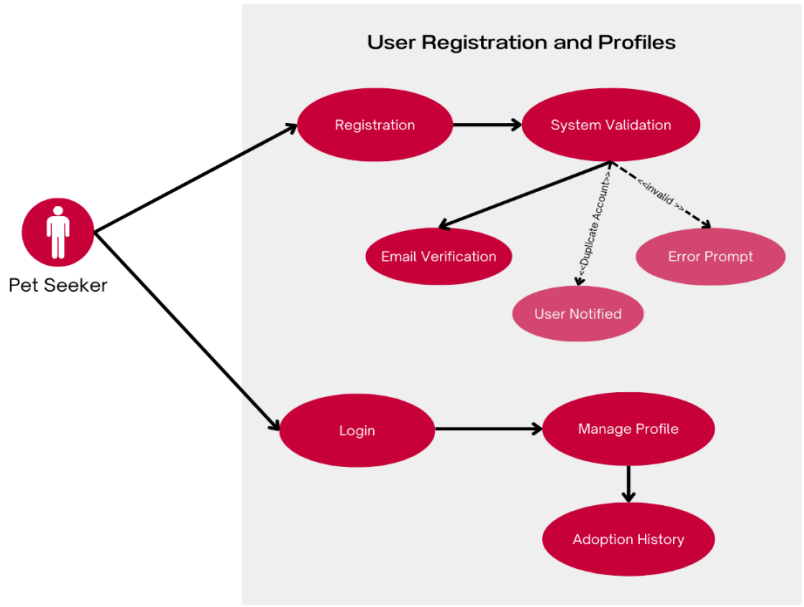


Figure 2 USe Case For PetSeeker Registration and Authentication

- **Use Case for Pet Listings and Profiles**

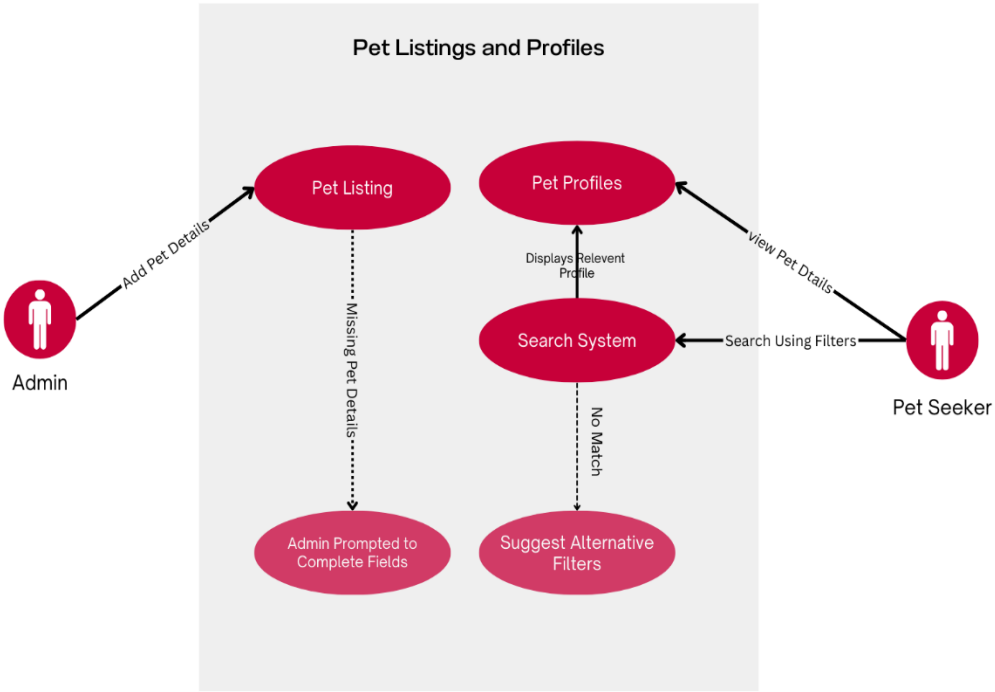


Figure 3 Use Case for Pet Listings and Profiles

- **Use Case for Adoption Process Management**

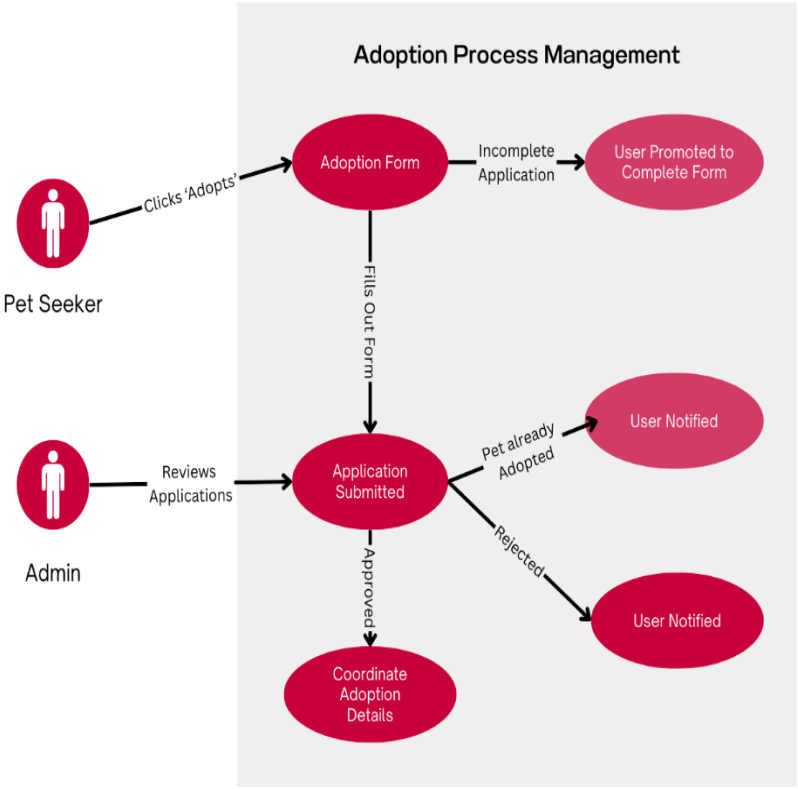


Figure 4 Use Case for Adoption Process Management

- **Use Case for Location Services**

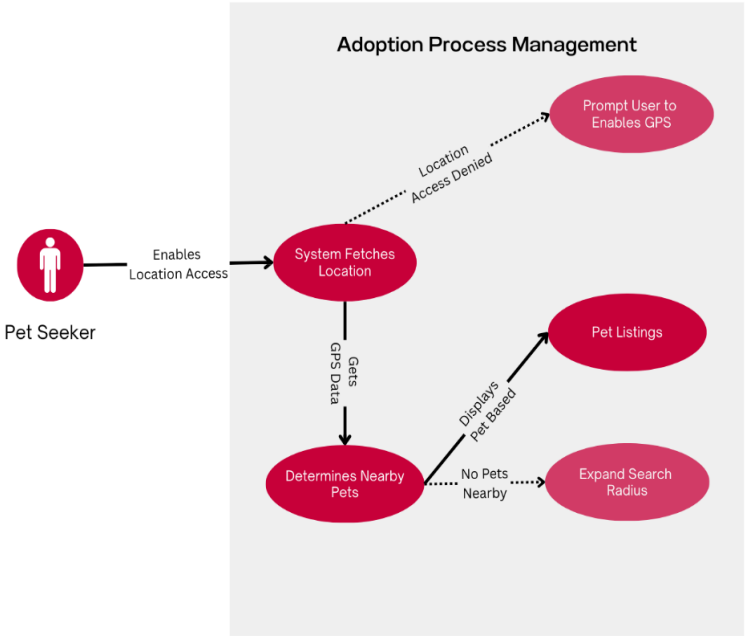


Figure 5 Use Case for Location Services

- **Use Case for Integration with Veterinary Services**

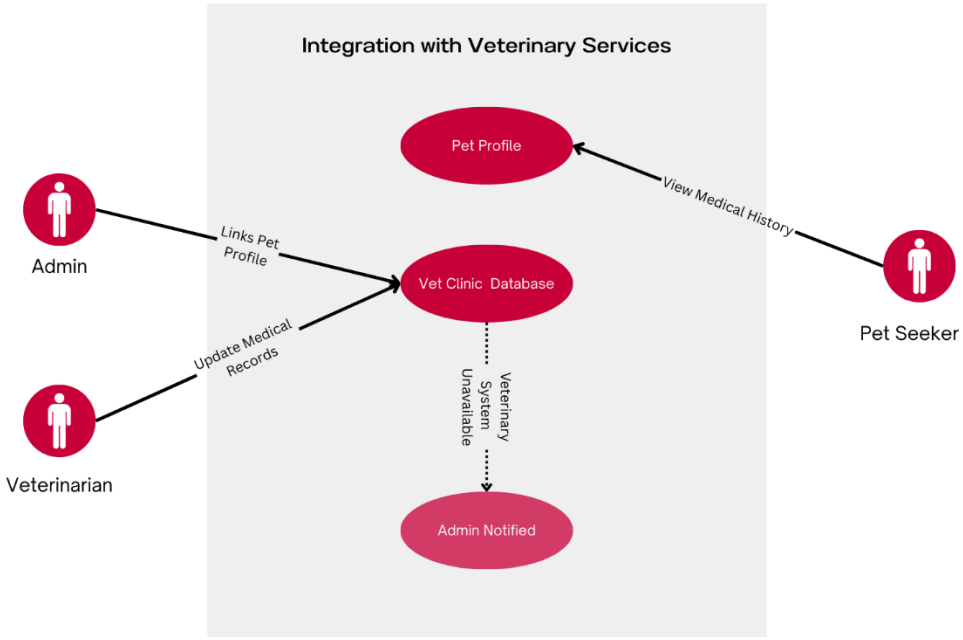


Figure 6 Use Case for Integration

- **Use Case for Event Scheduling and Management**

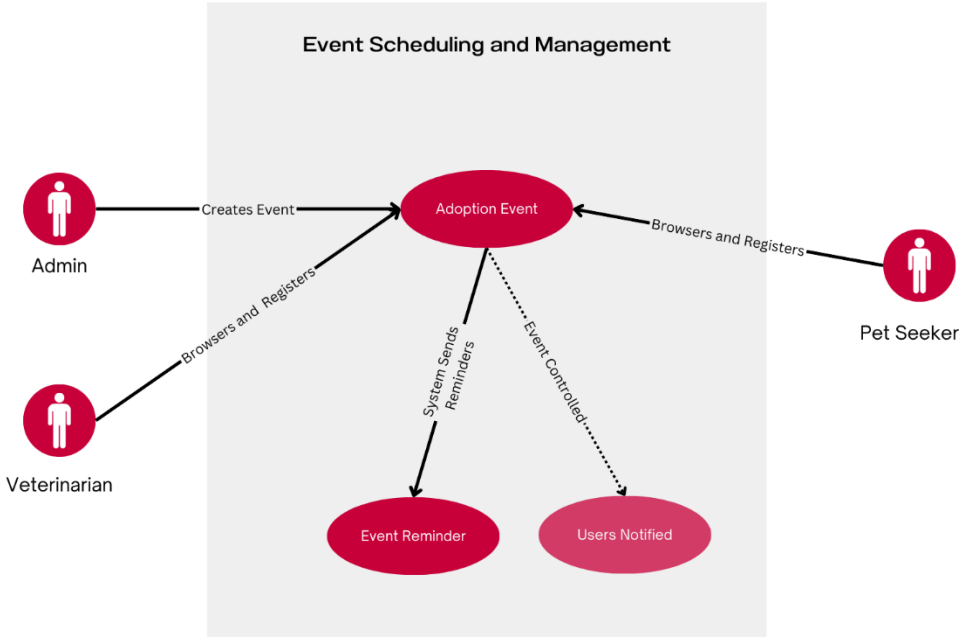


Figure 7 Use Case for Event Scheduling and Management

- **Use Case for Donation and Volunteer Management**

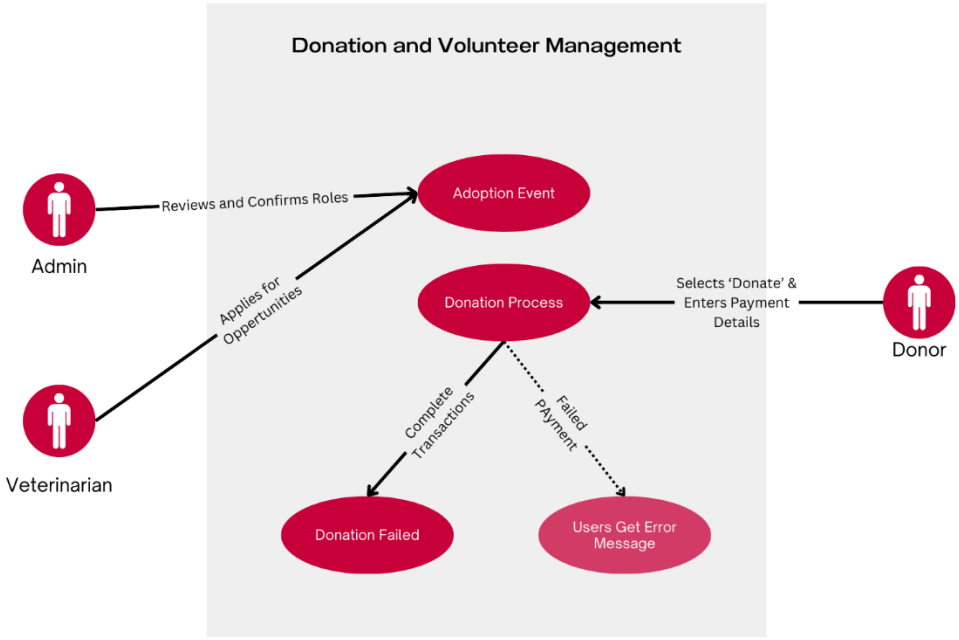


Figure 8 Use Case for Donation and Volunteer Management

- **Use Case for Reporting and Analytics**

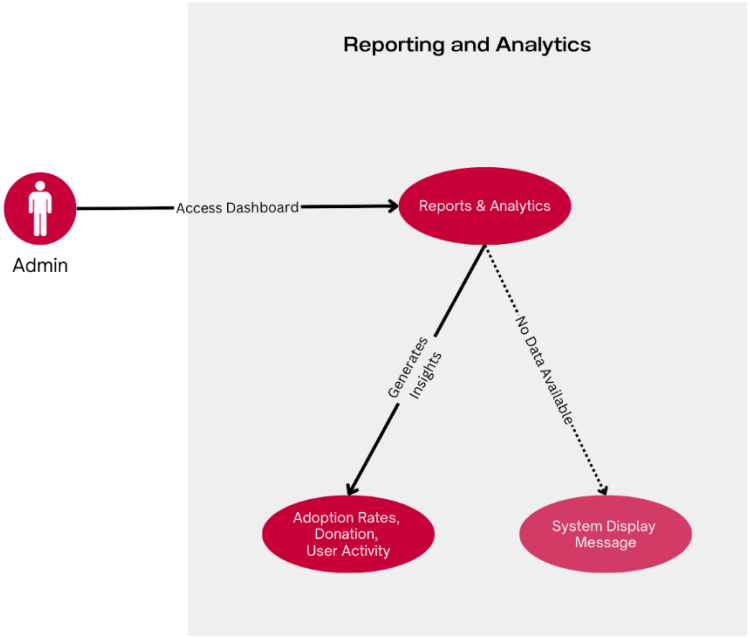


Figure 9 Use Case for Reporting and Analytics

3.8 Storyboarding

Story Board# 01 Pet Search and Filtering

A graphic scripts diagram for the search and filtering function of pets in the Petpal web application illustrates the user's trip when looking for pets adoptable depending on filters such as species, age, race and location.

Steps	Description
1.	**Home Screen** (User lands on the homepage)
2.	**Go to Search Page** (User navigates to the pet search page)
3.	**Enter Search Query** (User types keywords)
4.	**Apply Filters** **(**User selects filters like species, age, breed, and location)
5.	**View Search Results** (Filtered results are displayed)
6.	**Select a Pet** (User clicks on a pet for more details)
7.	**View Pet Details** (The pet's profile is displayed)
8.	**Return to Search or Proceed with Adoption** (User can go back to search results or apply for adoption)

Story Board# 02 Adoption Process Management

A graphic script diagram for the management of adoption processes in the Petpal web application illustrates the user's trip by administering an adoption request from the presentation to approval or rejection.

Steps	Description
1.	**User Logs In** (The user logs into the system)
2.	**Browse Available Pets** (The user views pets available for adoption)
3.	**Submit Adoption Request** (The user fills out and submits an adoption form)
4.	**Request Processing** **(**The rescue center reviews the request)
5.	**Background Verification** (The user's adoption history is checked)
6.	**Decision Phase** If **Approved**, the user is notified and proceeds with finalization.

	If **Rejected**, the user receives a rejection notice with possible feedback.
8.	**Finalize Adoption** (The adoption process is completed, and the pet is assigned to the adopter)

Story Board# 03 Donation and Volunteer Management

A graphic script diagram for the management of adoption processes in the Petpal web application illustrates the user's trip by administering an adoption request from the presentation to approval or rejection.

For Donation Process:

Steps	Description
1.	**User Logs In** (The user logs into the system)
2.	**Navigation to donation page** (The user accesses the donation section)
3.	**Enter Donation Details** (The user selects the donation amount and payment method)
4.	**Confirm Payment** **(**The user reviews and confirms the donation)
5.	**Receive Donation Receipt** (The system sends a confirmation and receipt)

For Volunteer Process:

Steps	Description
1.	**User Logs In** (The user logs into the system)
2.	**Navigate to Volunteer Signup** (The user accesses the volunteer registration page)
3.	**Submit Volunteer Application** (The user fills out the application form)
4.	**Application Review** **(**The rescue center reviews the application)
5.	**Approval or Rejection** If **Approved**, the user is notified and given tasks. If **Rejected**, the user receives feedback.

3.9 Summary

The processes of identification of requirements and analysis of cases of use are essential to ensure that the Petpal web application meets its objectives of optimizing

the adoption of pets and providing a perfect user experience. The requirements identification process implies several key steps, beginning with the analysis of interested parties to understand the needs of adopters, shelters, veterinarians and administrators. This is followed by obtaining requirements, where research, surveys and interviews are conducted to meet functional and non -functional requirements.

Once identified, these requirements are specified and documented to create a structured plan for the development of the system. To guarantee clarity and viability, the requirements experience validation and refinement, minimizing possible design defects and scope.

The use of use cases plays a crucial role in translation of the system requirements into real world interactions, describing how users will get involved with the platform. Each use case defines actors, system responses, success scenarios and exceptions, helping developers anticipate and accommodate different user behaviors. This structured approach improves the usability of the system, safety and efficiency.

In general, the requirement engineering process is essential to align the project with its objectives, ensuring that the system is easy to use, scalable and comply with adoption regulations. By defining the clear and well-structured requirements from the beginning, Petpal can avoid development inefficiencies, improve system performance and offer a solution that effectively unites the gap between adopters and rescue organizations.

Chapter No 4

Software Design Specification

4.1 System Design

The Petpal web application is designed as a centralized digital platform that facilitates the adoption of PET, shelter management and support after adoption. The system works as an application based on the web that interacts with multiple external services and API, which allows perfect integration with location services, real -time messages, payment catwalks and veterinary support systems.

The application follows a modular architecture, ensuring scalability, flexibility and maintenance ease. It consists of the following central components:

- **Frontend (User Interface):** developed with Stact.js and CSA css, providing an intuitive and receptive experience for adopters, shelters and administrators.
- **Backend (server layer and API):** built with node.js and express.js, authentication management, pet listings, adoption applications and messages.
- **Database management:** Use PostgreSQL for structured data storage (user profiles, pet records, applications) and Redis to store in cache to improve performance.
- **Third Party Integrations:**
  - Google Mapi API for location -based pets searches.
  - Socket.io for real -time messages between adopters and shelters.
  - API Stripe/Paypal to process donations and refuge funds.
  - API of the veterinary service for the appointment reservation and the management of health records.

4.2 Design Considerations

1. Assumptions and Dependencies:

Assumptions	**a)** User Adoption & Engagement
	b) Internet and Device Accessibility
	c) Security and Compliance
	d) Shelter Participation
	e) AI and Matching Algorithm Accuracy
	f) Scalability and Performance
Dependencies	**a)** Third-Party APIs & Services
	b) Authentication & Security
	c) Database & Storage
	d) Hosting & Cloud Services
	e) Regulatory Compliance

2. **Limitations**:

Functional	a) Internet Dependency
	b) Limited AI Accuracy
	c) Shelter Verification Delays
	d) Fraudulent Activity Risks

Performance	**a)** Scalability Challenges
	b) Real-Time Messaging Delays
	c) Pet Image and Video Storage
Regulatory and Compliance	**a)** Regional Adoption Laws
	b) Data Privacy Constraints
	c) Third-Party Service Dependency

4.3 Requirements Traceability Matrix

Requirement ID	Scope	Requirement Description	Design Specification
R_1	User Management	The system shall allow users (adopters, shelters, admins) to register, log in, and manage profiles securely.	Component "User Authentication & Role Management"
R_2	Pet Listing Management	The system shall allow adopters to search for pets using filters such as breed, age, size, and location.	Component "Pet Search & Filtering Module"
R3	Pet Listing Management	Shelters shall be able to upload, update, and manage pet listings with details and images.	Component "Pet Management & Database Storage"
R4	Adoption Application	System shall track the course progress of learner	Component "Track", class course
R5	Communication System	The system shall allow real-time messaging between adopters and shelters.	Component "Real-Time Messaging System (Socket.io)"
R6	Post-Adoption Support	The system shall provide adopters with resources, training guides, and veterinary support.	Component "Post-Adoption Support & Pet Care Resources"
R7	Location-Based Services	The system shall allow users to find nearby shelters and pets using GPS or manual location input.	Component "Google Maps API Integration & Location Module"
R8	Veterinary Services	The system shall enable adopters to book veterinary appointments and receive health notifications.	Component "Veterinary Services Integration Module"

R9	Event Scheduling & Management	Shelters shall be able to schedule and promote adoption events.	Component “Event Scheduling & Notifications”
R10	Donation & Volunteer Management	Users shall be able to donate funds or sign up as volunteers for shelters.	Component “Donation & Volunteer Management System”
R11	Reporting & Analytics	Admins and shelters shall generate reports on adoptions, donations, and user activity.	Component “Reporting & Analytics Dashboard”

4.4 Design Models

Petpal's web application follows an object -oriented development approach, which incorporates several design models to illustrate the structure, behavior and system interactions. The key models used to describe the system design are presented below:

4.4.1 Design Class Diagram (DCD)

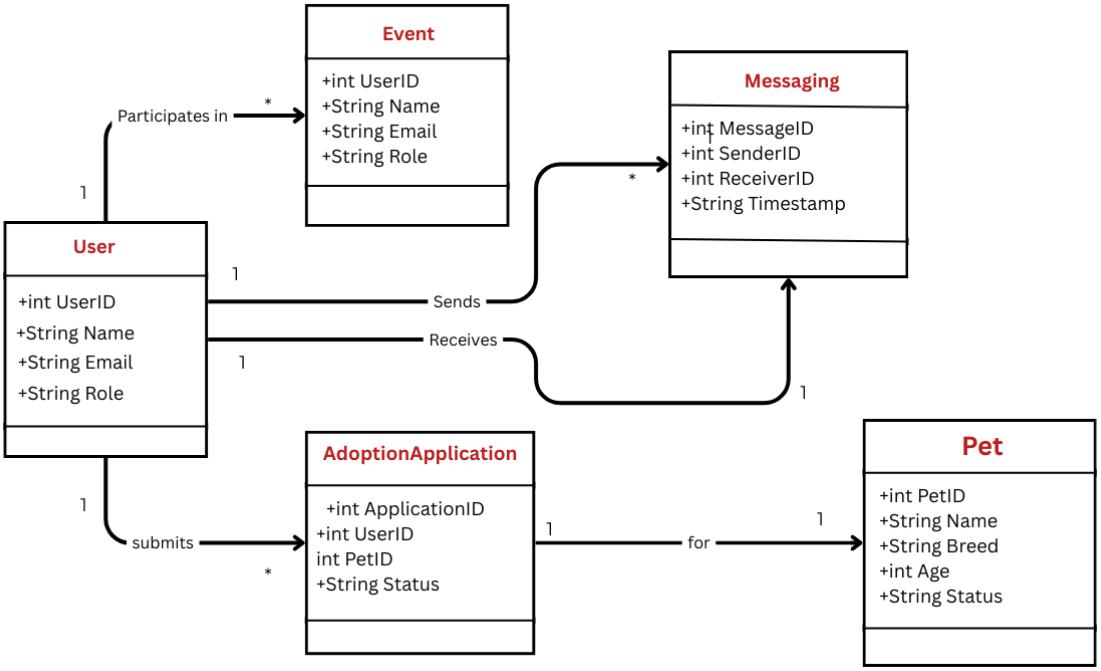


Figure 10 Class Diagram (DCD)

4.4.2 Interaction Diagram

Sequence Diagram:

1. **Sequence for User Registration**

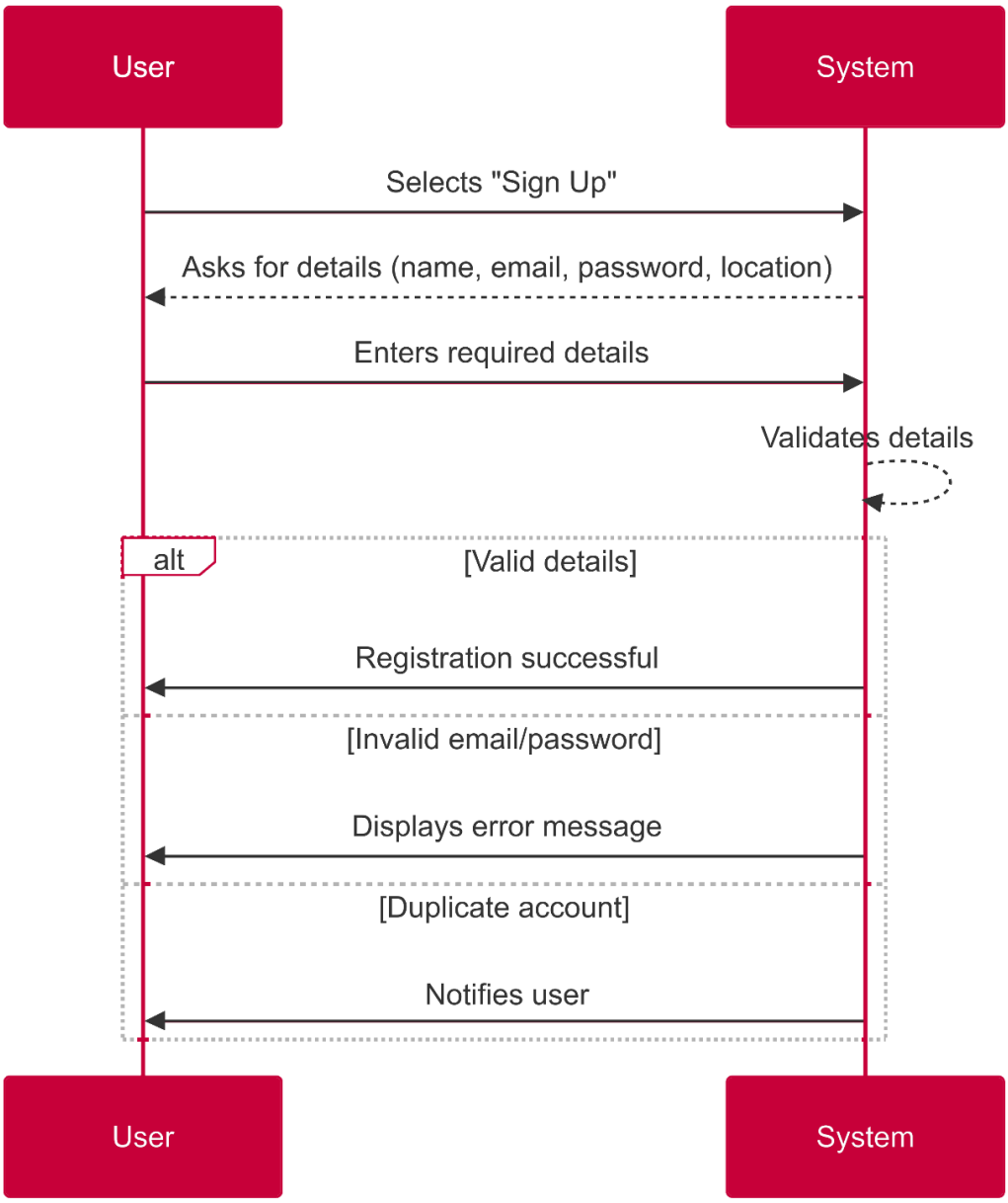


Figure 11 Sequence Diagram for User Registration

2. 2- Sequence for Pet Listings

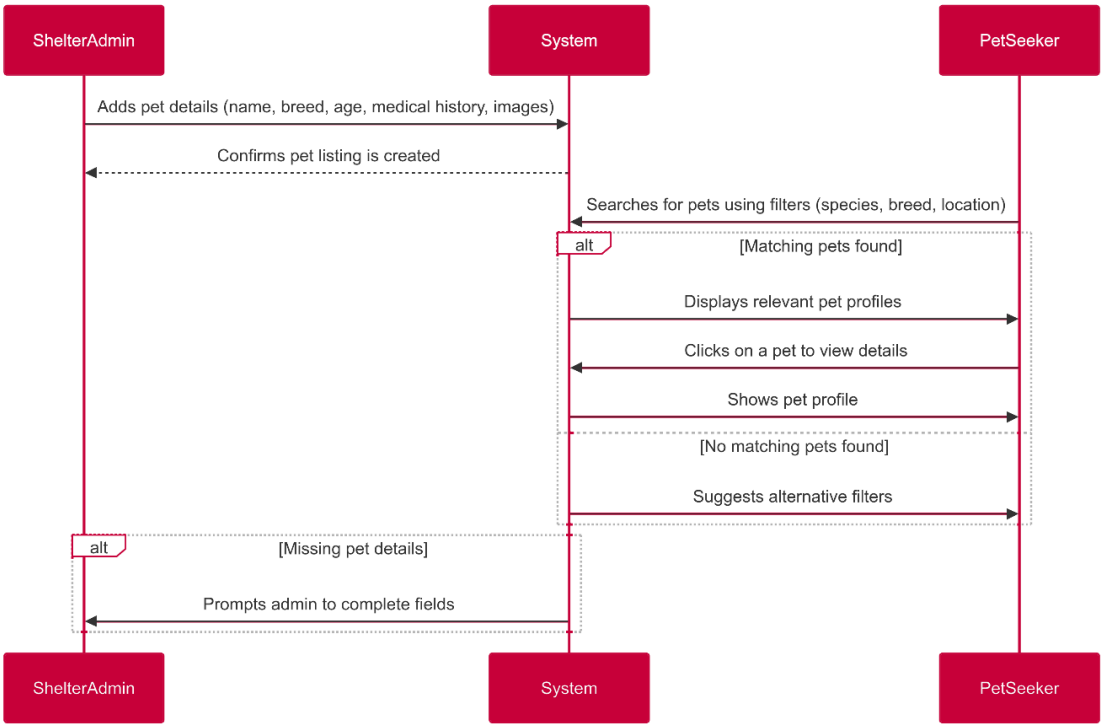


Figure 12 Sequence for Pet Listings

3. Sequence for Adoption Process

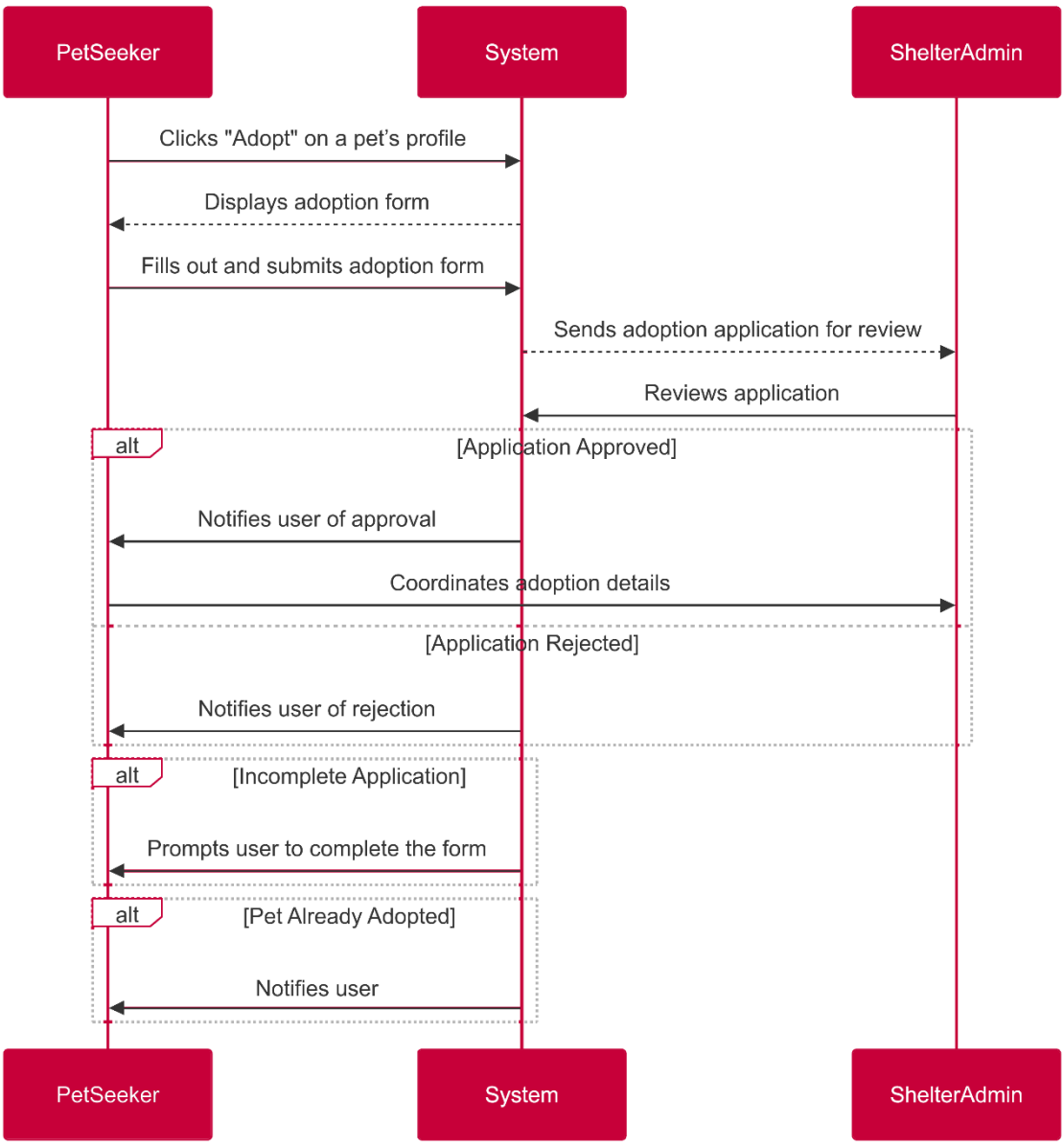


Figure 13 Sequence for Adoption Process

4. Sequence for Location Services

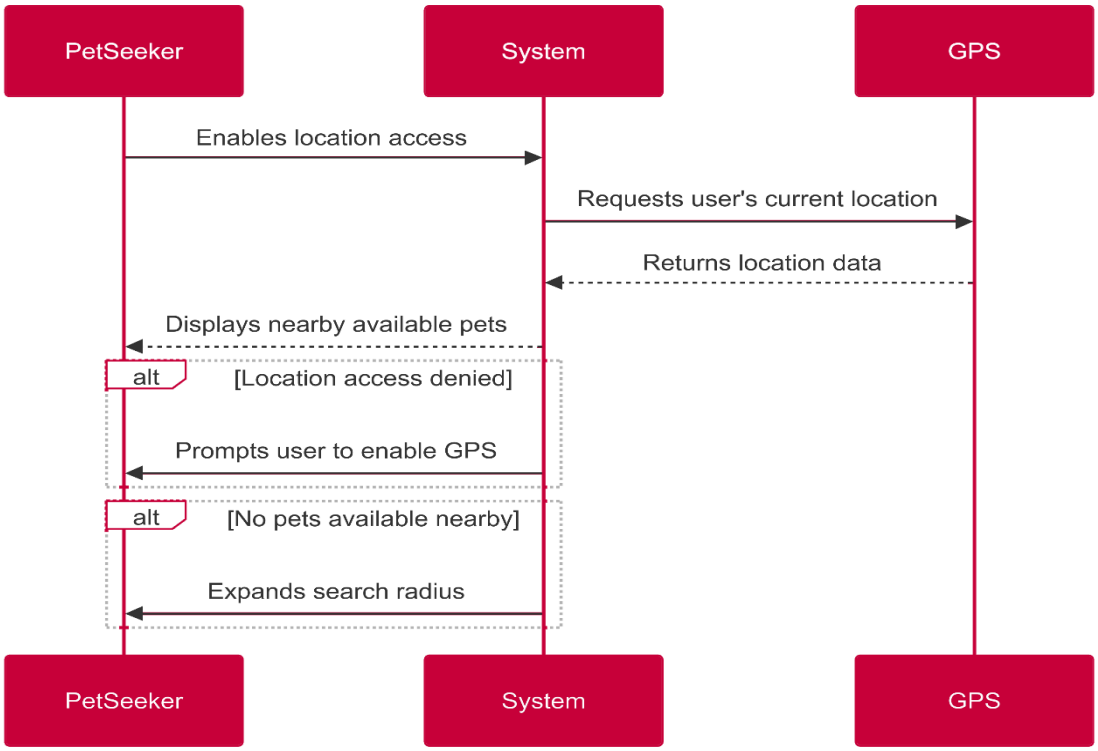


Figure 14 Sequence for Location Services

5. Sequence for Event Management

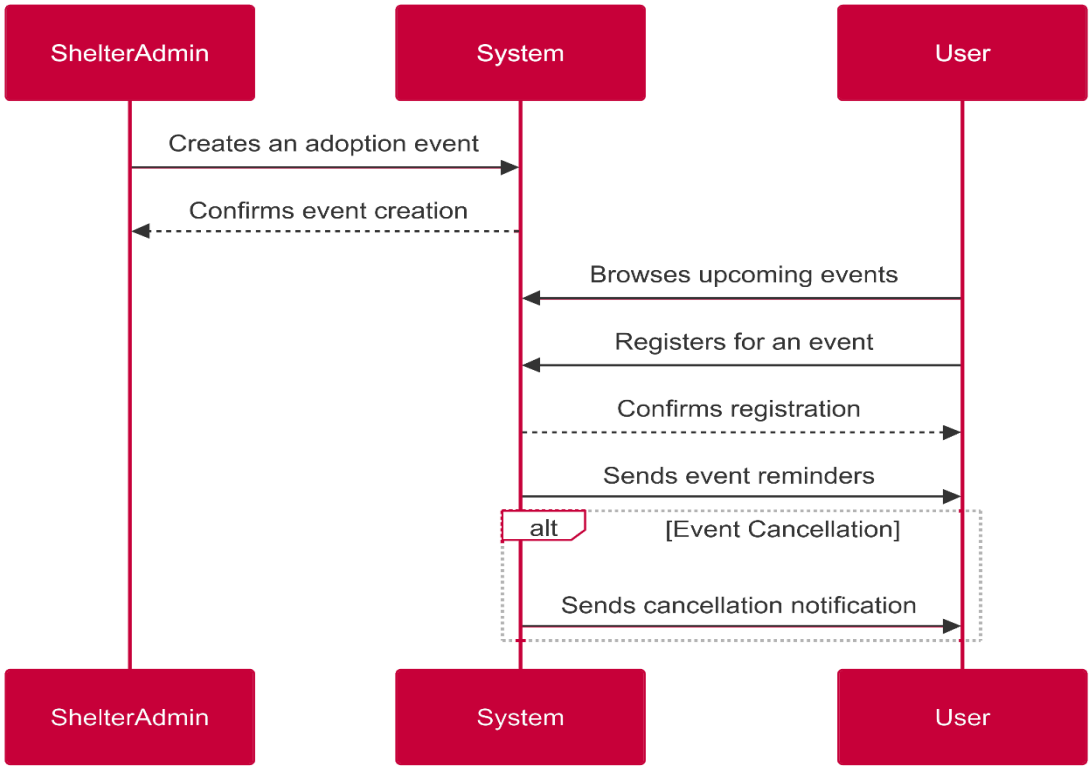


Figure 15 Sequence for Event Management

6. Sequence for Donations

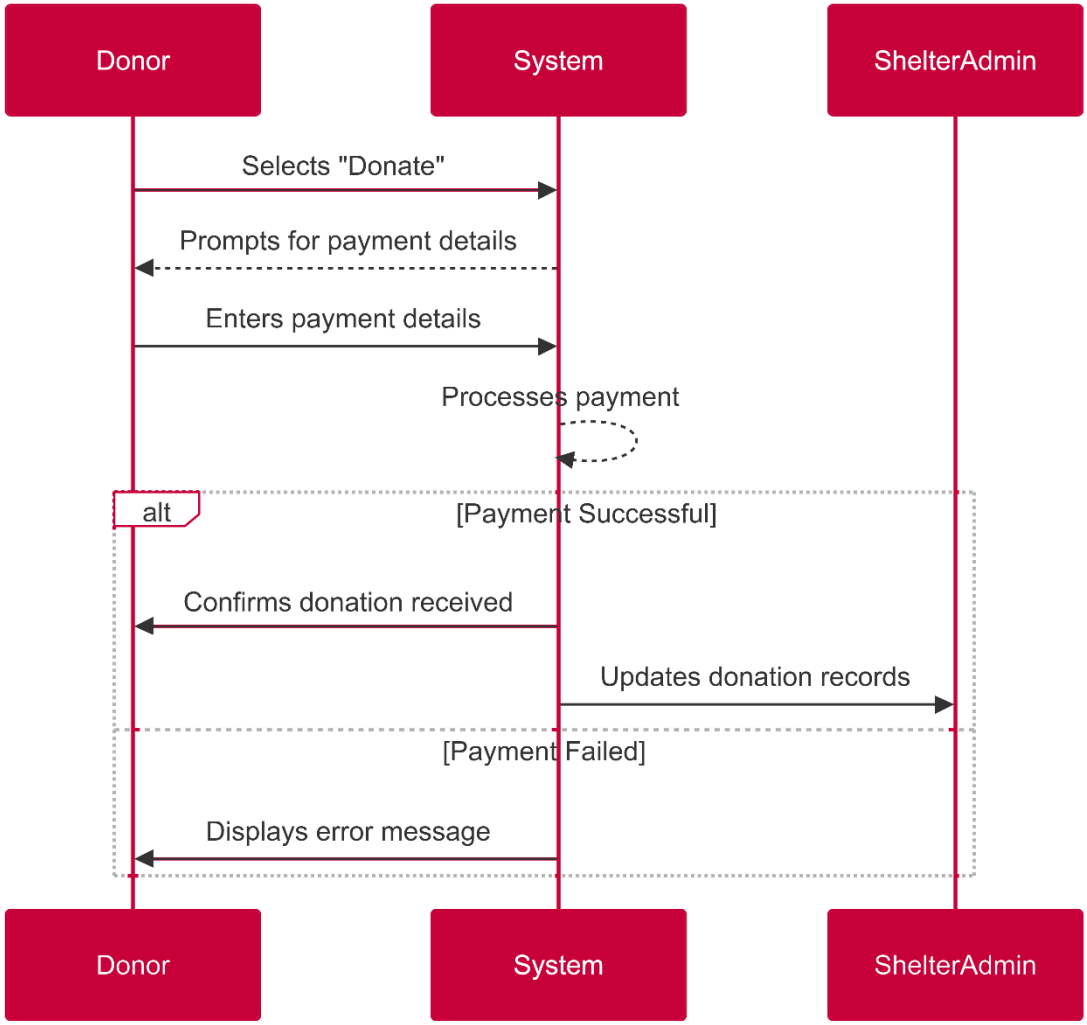


Figure 16 Sequence for Donations

7. **Sequence for Security**

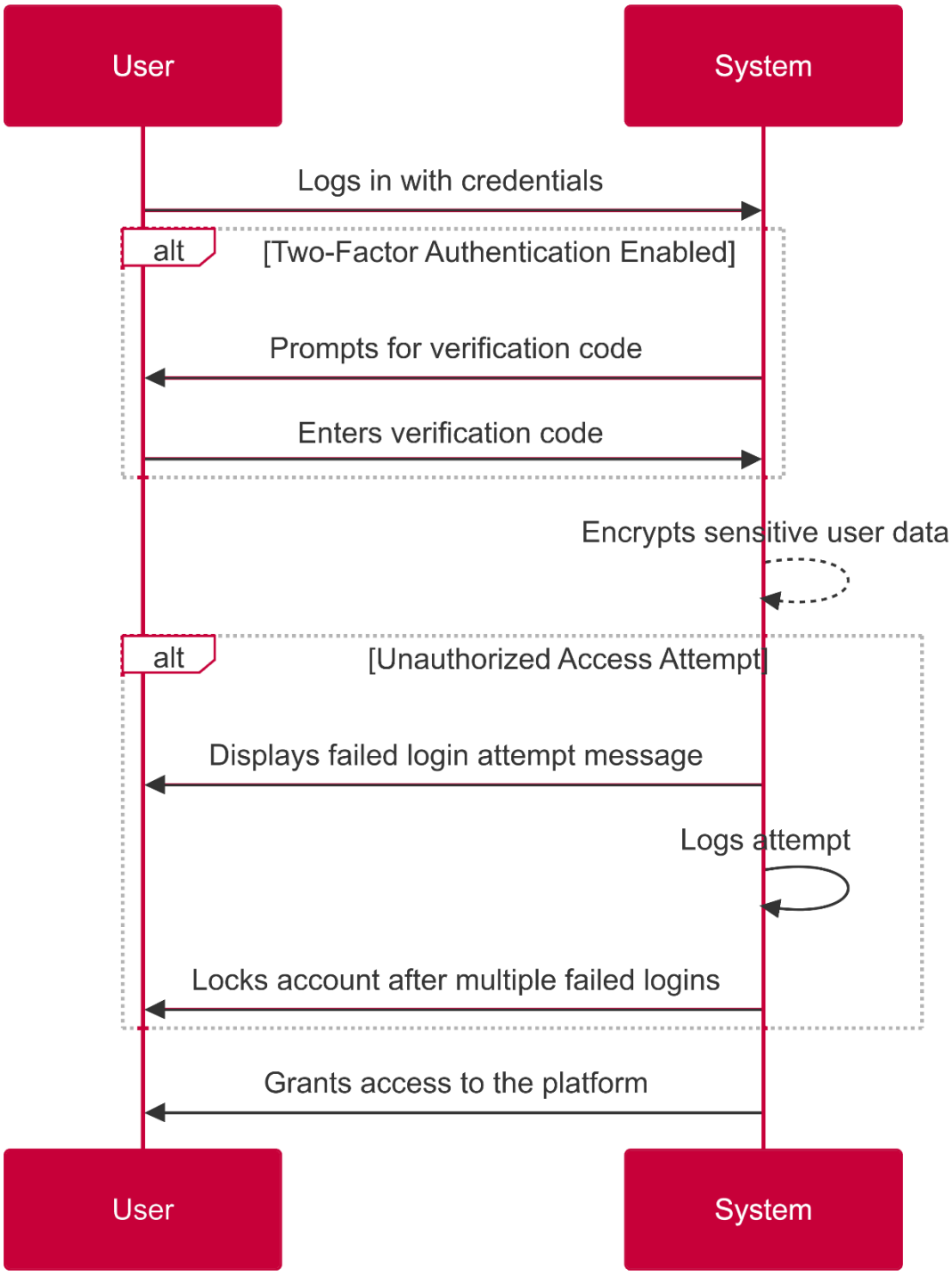


Figure 17 Sequence for Security

4.4.3 State Transition Diagram

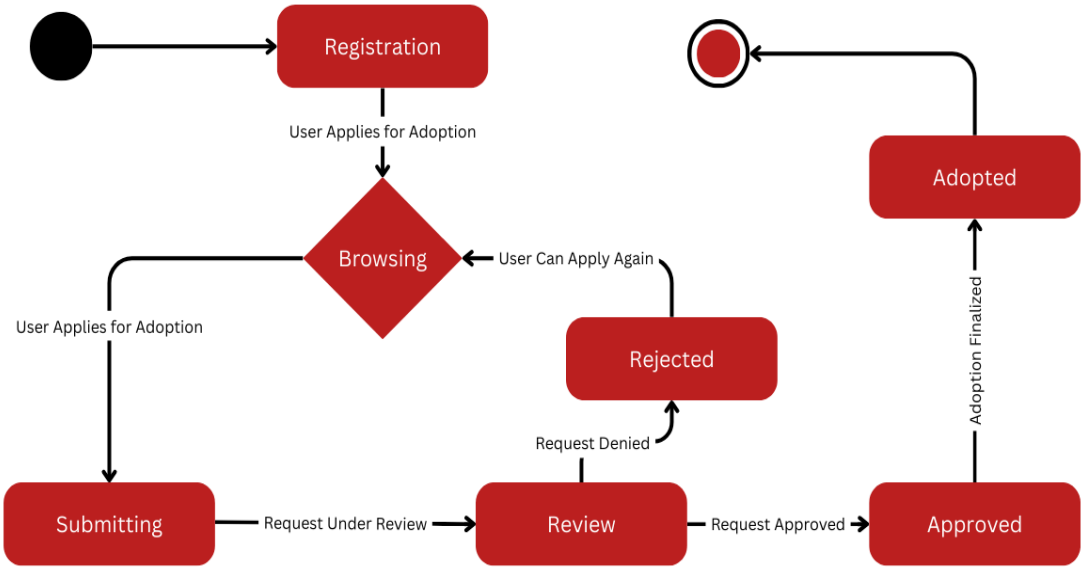


Figure 18 State Transition Diagram

4.5 Architectural Design

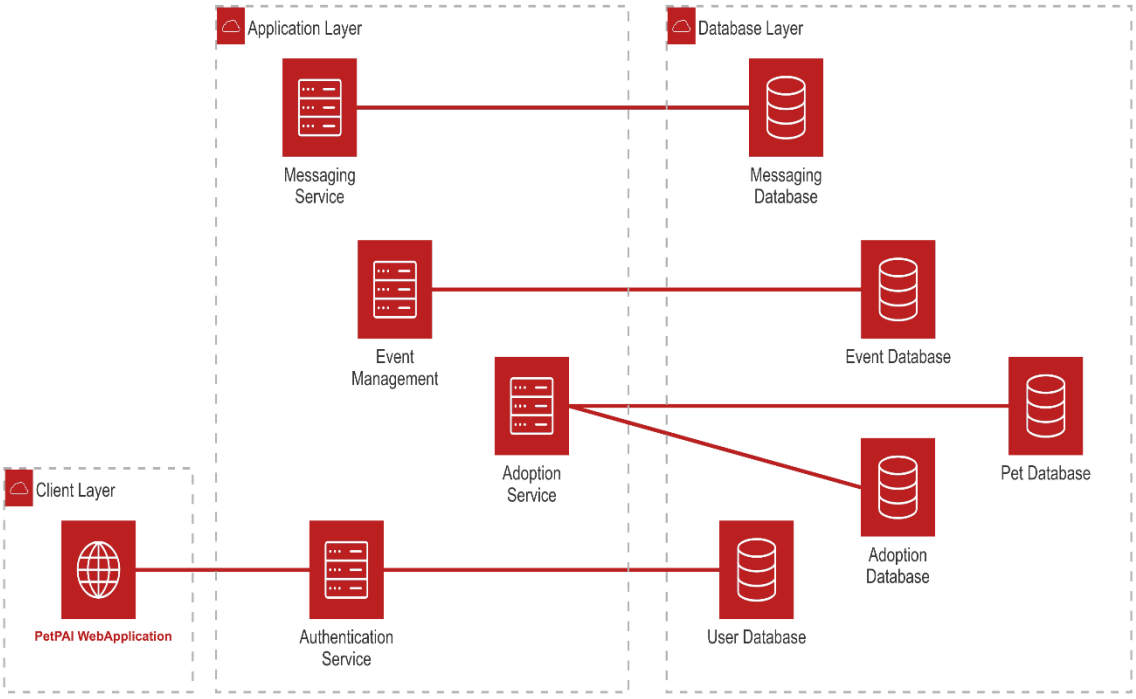


Figure 19 Architectural Design

4.6 Data Design

The data design of the Petpal web application defines how information is structured, stored, processes and recovers within the system. This includes database scheme, data entities, relationships and storage mechanisms to guarantee efficient data, safety and scalability management.

4.6.1 Relationships Between Tables

A. Saving data and organization:

The system uses a relational database (PostgreSQL) and mechanisms of storage (Redis) for efficient storage and loading of structured data. The data is organized in multiple tables and represents users, pets, adoption records, sending messages, gifts and events.

Database management system: PostgreSQL (structured data).
Meso deposit mechanism: Redis (optimized queries).
File Storage: AWS S3 / Firebase Storage (PET pictures, adoption documents).

B. Main data entities and relationships.

Entity Relations:

- The user (adopter/shelter) can submit multiple adoption applications.
- Each pet is given in the shelter and can have one or more applications.

- The shelter can organize multiple actions and take gifts.
- Users can send messages and receive notifications via the message sending system.

C. Data processing flow

User interaction:	Log in and log in and search for pets.
QUESTION:	SQL Questions Load relevant PET statements based on filters.
Application:	Adopter applies to adoption and data is entered in the database.
Filter review:	Shelter updates the status of the application in the system.
Message sending system:	adoptors and shelters communicate through real time chat.
Adoption support:	The system updates veterinary records and protocols of participation in events.

4.6.2 Data Dictionary

The data dictionary provides an alphabetical list of system entities, attributes and their descriptions, helping developers and interested parties to understand data types, relationships and functionality. The Petpal web application follows an object -oriented approach (OO), so this dictionary includes objects, attributes and methods with parameters.

Alphabetical List of System Entities (Major Data Attributes):

A) Adoption Application (Stores pet adoption requests submitted by adopters)

Entity	Attribute	Description
Adoption Application	**application_id** (INT, PK)	Unique identifier for each adoption application.
	adopter_id (INT, FK)	References the adopter submitting the application
	pet_id (INT, FK)	References the pet being adopted.
	status (ENUM)	Status of the application (Pending, Approved, Rejected).
	submitted_at (TIMESTAMP)	Date and time the application was submitted.

B) Donation (Stores details of monetary or in-kind donations to shelters.)

Entity	Attribute	Description
Donation	**donation_id** (INT, PK)	Unique identifier for each adoption application.
	donor_id (INT, FK)	References the adopter submitting the application
	shelter_id (INT, FK)	References the pet being adopted.
	amount (DECIMAL)	Status of the application (Pending, Approved, Rejected).
	payment_method (VARCHAR))	Payment type (Credit Card, PayPal, Bank Transfer).
	donated_at (TIMESTAMP)	Date and time of the donation transaction.

C) Event (Stores details about adoption and fundraising events)

Entity	Attribute	Description
Event	**event_id** (INT, PK)	Unique identifier for each event.
	shelter_id (INT, FK)	References the shelter organizing the event.
	event_name (VARCHAR)	Title of the event.
	event_date (DATE)	Date when the event is scheduled.
	location (VARCHAR)	Physical/virtual location of the event.

D) Messaging (Stores chat messages between adopters and shelters.)

Entity	Attribute	Description
Messaging	**message_id** (INT, PK)	Unique identifier for each message.
	sender_id (INT, FK)	References the user sending the message.
	receiver_id (INT, FK)	References the user receiving the message.
	message_text (TEXT)	Content of the message.
	sent_at (TIMESTAMP)	Date and time the message was sent.

E) Pet (Stores pet details listed by shelters for adoption.)

Entity	Attribute	Description
Pet	**pet_id** (INT, PK)	Unique identifier for each pet.
	name (VARCHAR)	Name of the pet.
	breed (VARCHAR)	Breed of the pet.
	age (INT)	Age of the pet in years.
	size (ENUM)	Size category (Small, Medium, Large).
	health_status (TEXT)	Medical conditions and vaccination details.
	adoption_status (ENUM)	Pet's availability status (Available, Adopted, Pending).

F) User (Stores user profiles, including adopters, shelter representatives, and administrators.)

Entity	Attribute	Description
User	**user_id** (INT, PK)	Unique identifier for each user.
	name (VARCHAR)	Full name of the user.
	email (VARCHAR, UNIQUE)	User's email address.
	password_hash (TEXT)	Encrypted password for security.
	role (ENUM)	User role (Adopter, Shelter, Admin).
	location (VARCHAR)	City or region of the user.
	created_at (TIMESTAMP)	Date and time the user registered.

Structured Approach: Functions and Function Parameters:

Function	Data_Type	Parameters	Description
searchPerts()	VARCHAR, INT	• breed, • age, • size, • location	Retrieves pets matching user filters.
submitApplication()	INT	• adopter_id, • pet_id	Allows adopter to apply for a pet.
sendMessage()	INT, TEXT	• sender_id, • receiver_id, • message_text	Sends a message from adopter to shelter.

processDonation()	INT, DECIMAL, VARCHAR	• donor_id, • shelter_id, • amount, • payment_method	Processes a user donation.
scheduleEvent()	INT, VARCHAR, DATE	• shelter_id, • event_name, • event_date, • location	Creates a new adoption event.

Object-Oriented (OO) Approach: Objects, Attributes, Methods & Method Parameters:

Object	Attributes	Methods
User	• **user_id:** INT (Primary Key) • **name:** VARCHAR • **email:** VARCHAR (Unique) • **password_hash:** TEXT • **role:** ENUM(Adopter, Shelter, Admin) • **location:** VARCHAR	• registerUser(name, email, password, role, location): Registers a new user. • login(email, password): Authenticates the user. • updateProfile(user_id, name, location): Updates user details.
Pet	• **pet_id:** INT (Primary Key) • **name:** VARCHAR • **breed:** VARCHAR • **age:** INT • **size:** ENUM(Small, Medium, Large) • **health_status:** TEXT • **adoption_status:** ENUM(Available	• **addPet(name, breed, age, size, health_status, shelter_id):** Adds a pet to the system. • **updatePetStatus(pet_id, status):** Updates adoption status. • **getPetDetails(pet_id):** Retrieves pet information.

	, Adopted, Pending) • **shelter_id:** INT (Foreign Key)	
AdoptionApplication	• application_id: INT (Primary Key) • adopter_id: INT (Foreign Key) • pet_id: INT (Foreign Key) • status: ENUM(Pending, Approved, Rejected) • submitted_at: TIMESTAMP	• submitApplication(adopter_id, pet_id) – Creates an adoption application. • updateApplicationStatus(application_id, status) – Updates approval status. • viewApplicationStatus(adopter_id) – Retrieves application progress.

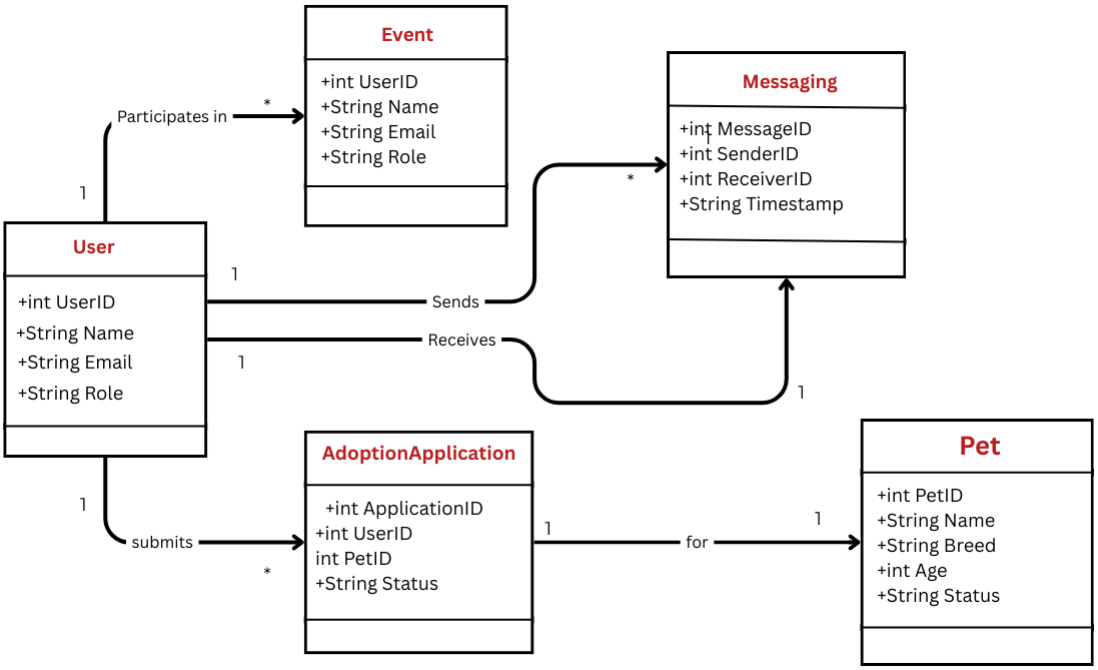


Figure 20 Class Diagram

2.7 User Interface Design

The Petpal web application is designed to be easy to use, intuitive and accessible to users who seek to adopt pets, communicate with shelters, donate and participate in

events. The interface guarantees a perfect user experience with clear navigation, feedback messages and interactive elements.

General Description of the User Interface
The system is divided into three main user roles:

1- **Adopters:** Users seeking to adopt pets.
2- **Shelters/rescue centers:** Organizations that manage lists of pets and adoption requests.
3- **Administrators:** Supervises users, pets and system configuration.

Functionalities and user interaction

1- **home page (destination page)**
   - Outstanding samples, upcoming adoption events and donation appeals.
   - Provide login/registration buttons for new users and return.
   - Search bar for fast pets.
2- **User authentication (login/registration)**
   - Users can register by email/password or social networks.
   - Comments: Successful messages or error in sending the form.
3- **Pet search and filtering**
   - Users can filter by species, race, age and location.
   - When clicking on a pet, opens detailed pet profiles.
4- **pet profile page**
   - Show pet information: name, age, race, description, health status and adoption availability.
   - The "Request for adoption" button for interested users.
   - Comments: Confirmation message after sending an adoption application.
5- **PASURE ADOPTION APPLICATION PROCESS**
   - Users can see their adoption requests sent.
   - Review of shelters, approve or reject applications.
   - Comments: Users receive notifications about the status of the application.
6- **Messaging system**
   - Adoptants can communicate with shelters with respect to pets.
   - Input tray function for chat in real time.
   - Comments: Message sent confirmation.
7- **donation system**
   - Users can donate shelters with Stripe/Paypal.
   - Comments: Confirmation of donation and receipt email.
8- **Event management:**
   - Users can navigate and register for adoption events.
   - Shelters can create and manage events.
   - Comments: Confirmation of event registration.

9- User Dashboard:

- Sample adoption requests, pet favorites, donations made and messages.
- Viewers see pending requests, pet listings and the details of the event.

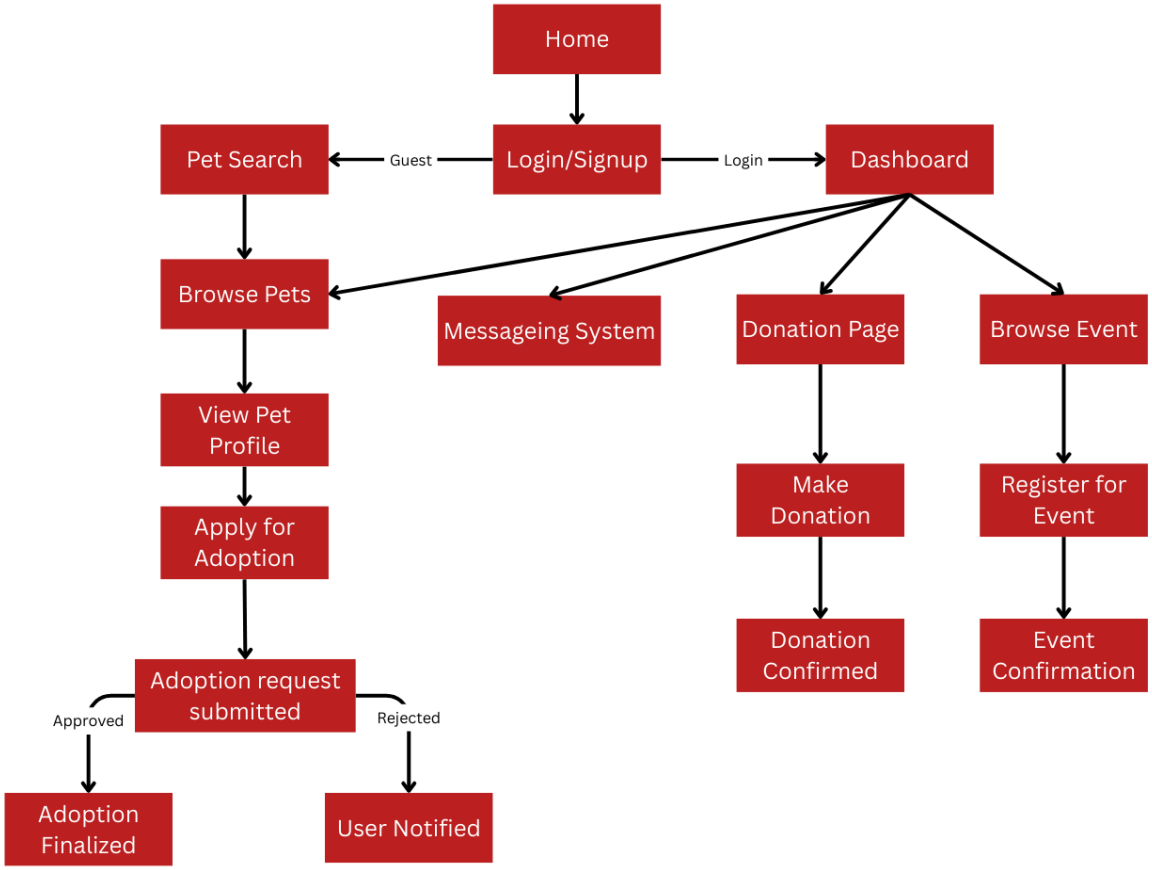
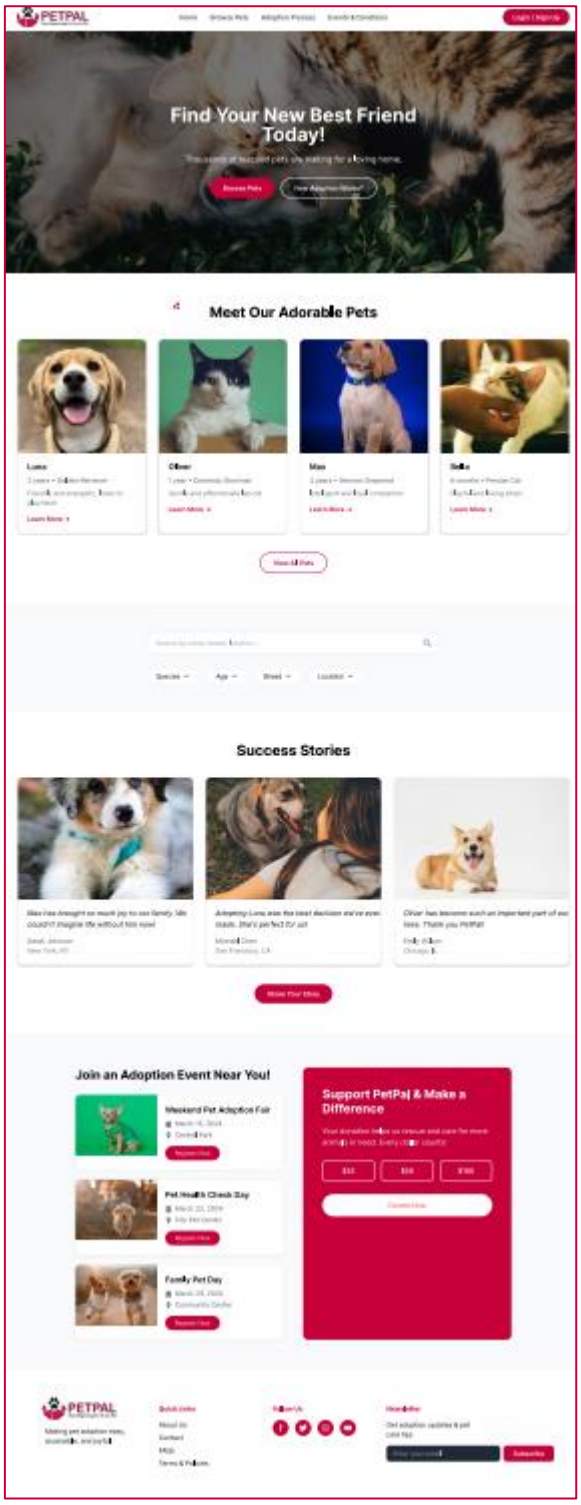
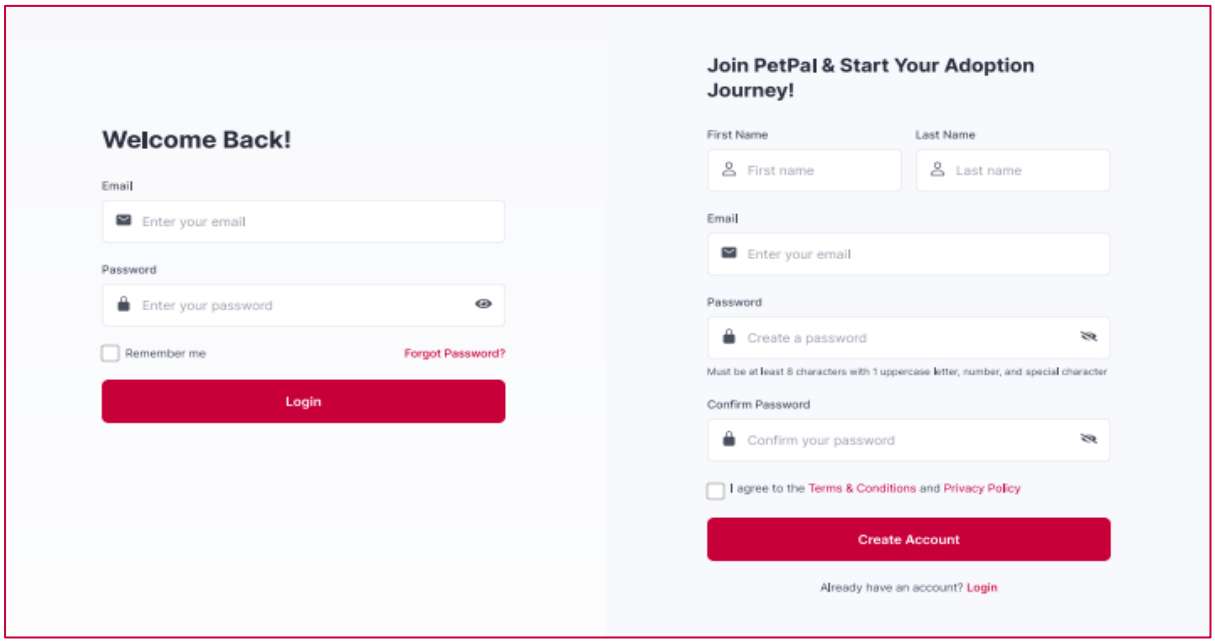


Figure 21 User Interface

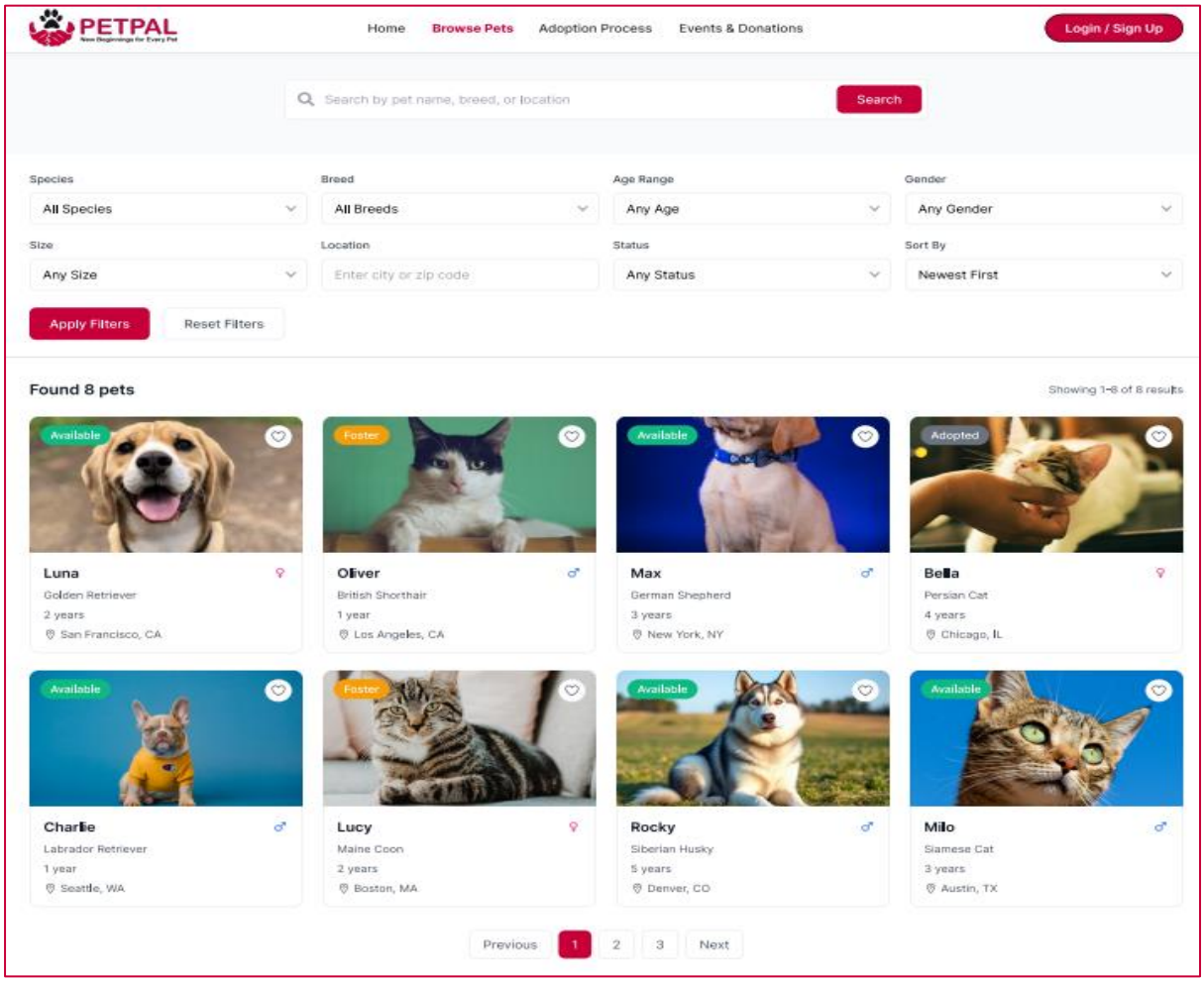
1- Home Page


Find Your New Best Friend Today!
Meet Our Adorable Pets
Success Stories
Join an Adoption Event Near You!
Support PetPal & Make a Difference

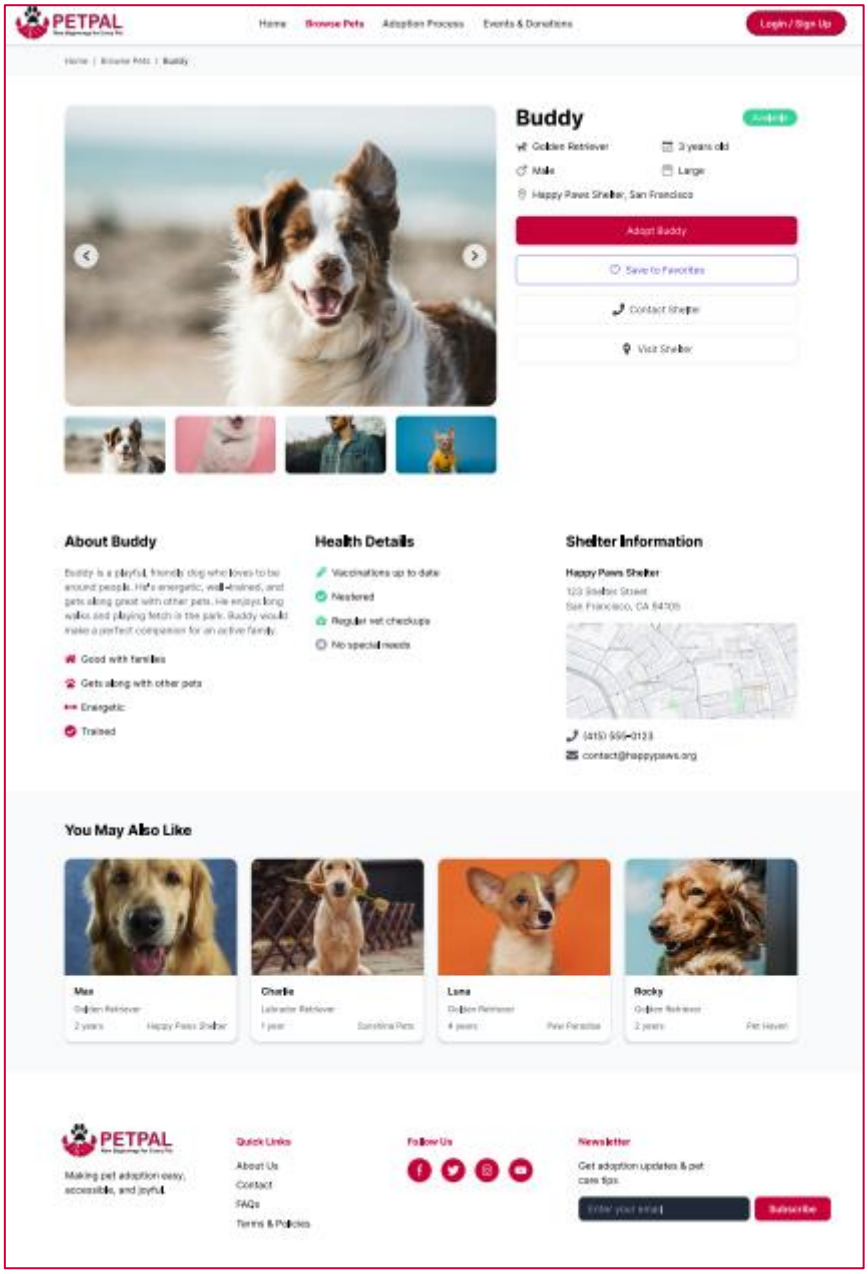
2- Login & Registration Page



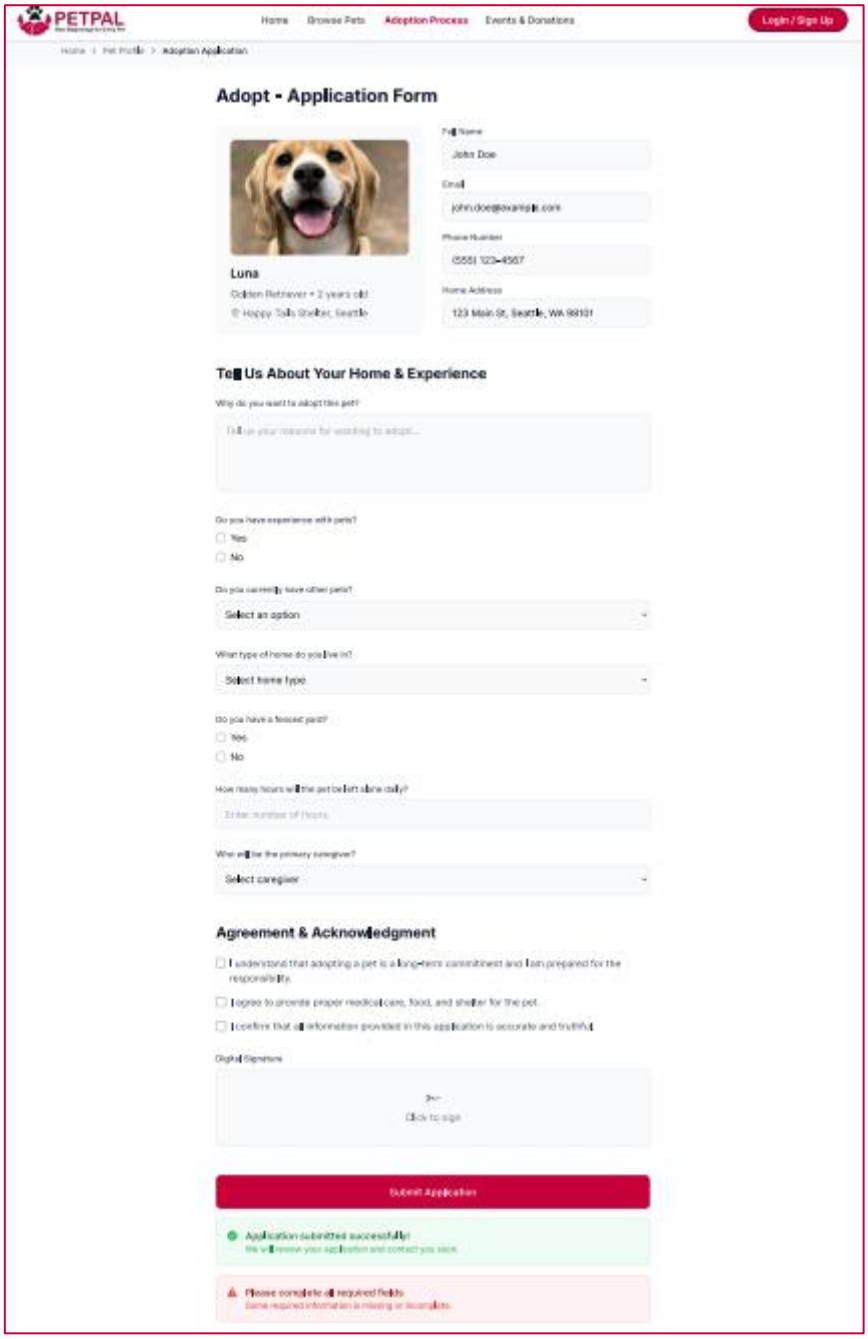
3- Browse Pet and Filtering



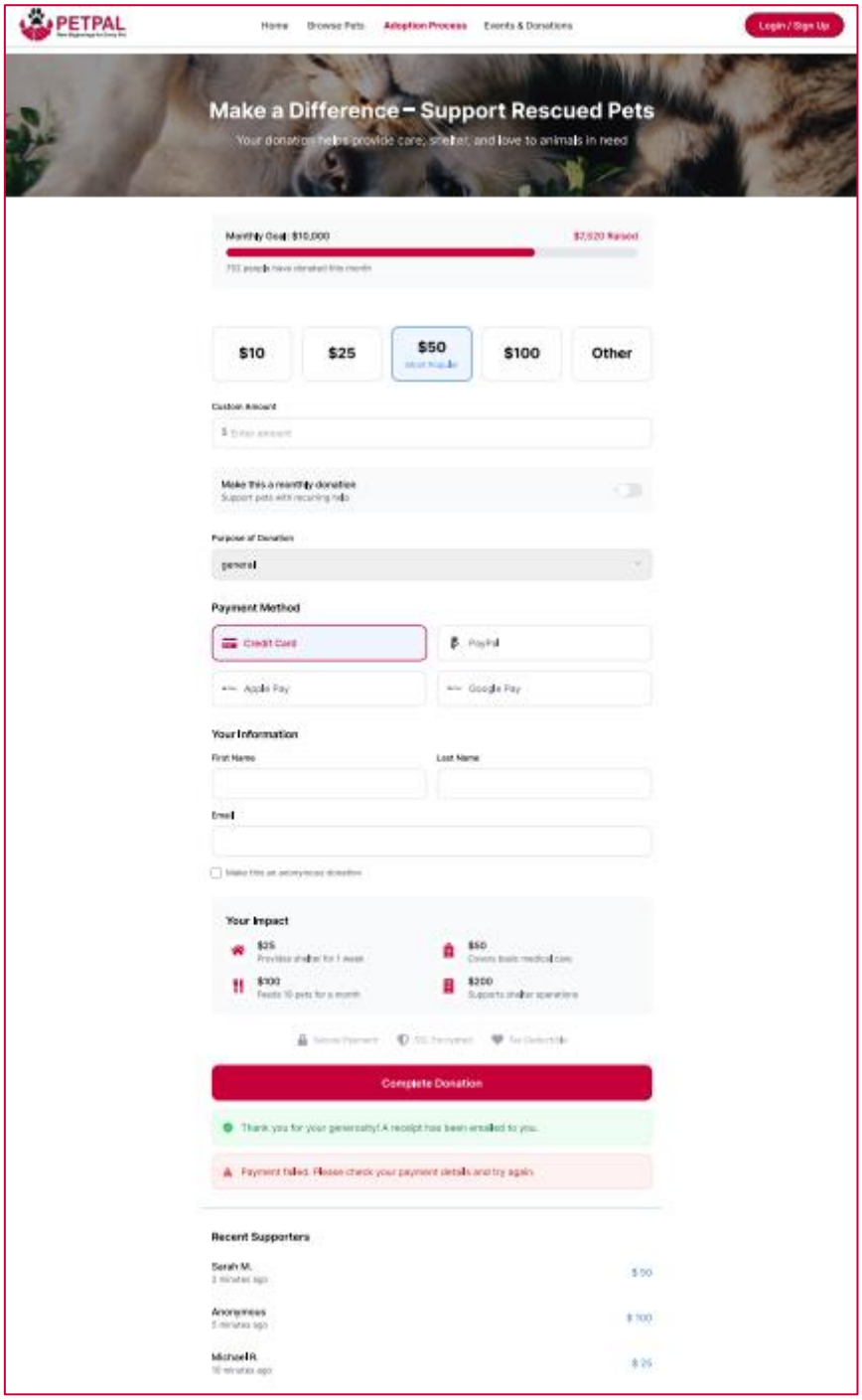
4- Pet Profile



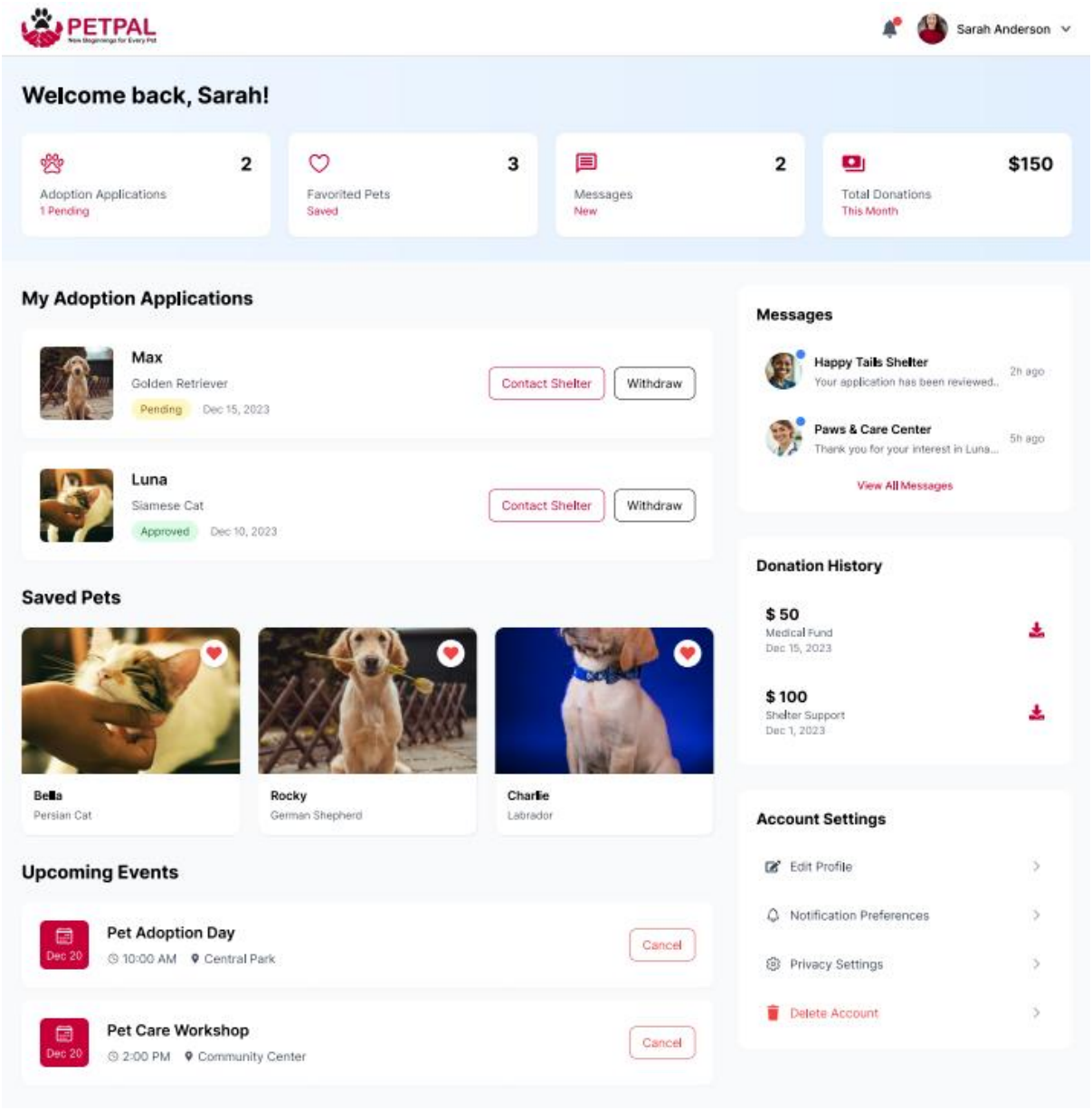
5- Adoption Form



6- Make Donation for Rescue



7- User Profile



4.8 Design Decisions

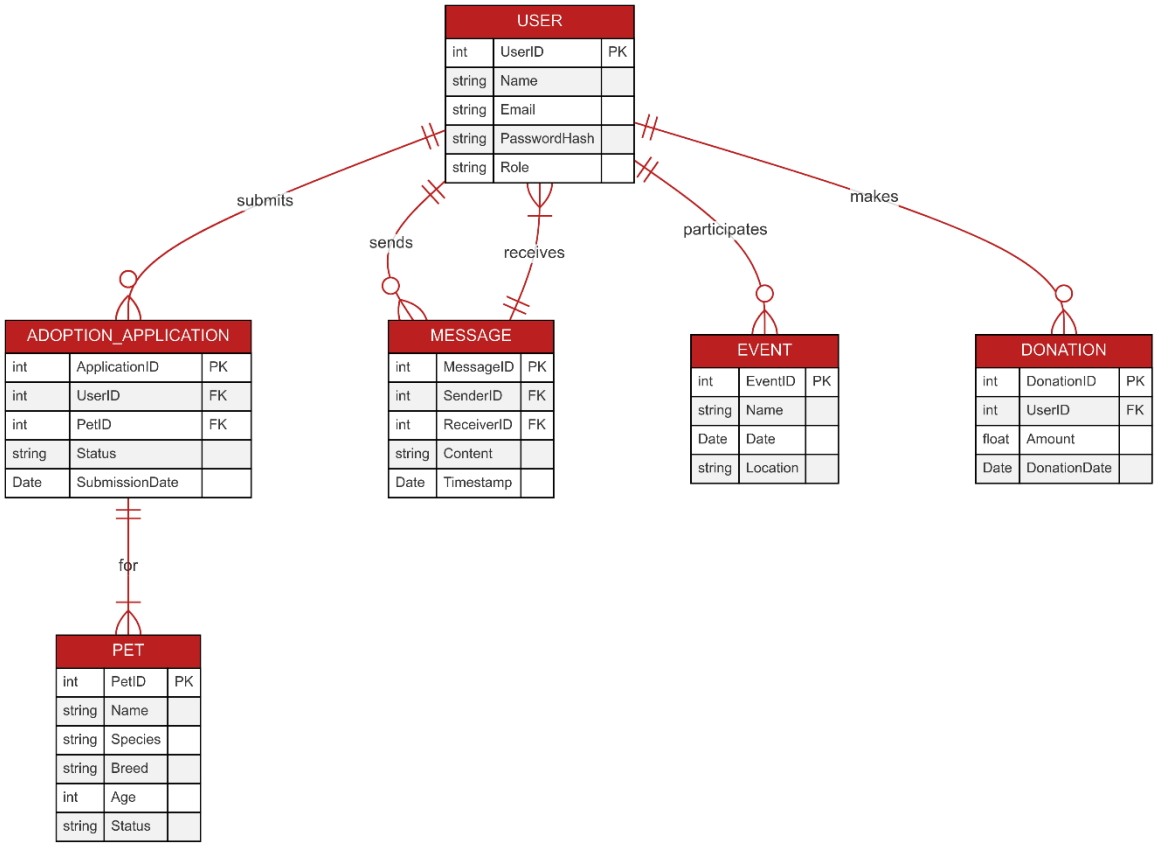


Figure 22 ERD Diagram

4.9 Summary

The Petpal web application was designed with an approach to scalability, security, efficiency and user experience. To achieve this, a multiple level architecture was implemented based on the model vision controller (MVC), ensuring a clear separation of concerns between the layers of Fronte, Backend and Databases. The backend was developed using an object -oriented approach, which allows the modularity and reuse of central functionalities, such as pet management, adoption applications and messaging services. Postgresql was chosen as the main database due to its support for complex consultations and relationships, and normalized to the third normal form (3NF) to eliminate redundancy and maintain the integrity of the data. To improve system performance, storage in REDIS cache was integrated, allowing frequent access data, such as PET search results, quickly recover without overloading the database.

The search and filtering of pets were optimized using full -based search and text consultations based on indexed, ensuring that users can quickly find pets based on race, location and age. Security was a priority, with JWT -based authentication, password hash using BCrypt and roles -based access control (RBAC) implemented to protect user data and avoid unauthorized access. To facilitate donations, Stripe and PayPal's payment catwalks were integrated, allowing users to make unique or recurrent contributions to support rescue shelters. The border was built using React.js (or Vue.js) with a mobile approach first, ensuring a fast, receptive and component -based user interface that works without problems on different devices. When implementing these design options, Petpal guarantees a safe, scalable and easy to use platform for adopters and shelters. The combination of optimized database management, safe authentication, efficient search functionalities and an interactive user interface make Petpal a reliable and intuitive pet adoption system. These strategic decisions improve the general performance, usability and security of the platform, which finally helps more pets to find love homes.

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