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The Development of Pet Blood Donor Mobile Application for Empire Animal Medical Centre

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Abstract

Since pet blood banks are not yet well established, finding a matching pet blood donor is very difficult. The Pet Blood Donor mobile application is designed to facilitate the process of finding matching cat and dog blood donors for pet blood transfusions. This application has two types of users: veterinary staff as admins and pet owners as users. The application allows users to schedule an appointment to check pet blood donation eligibility and view pet blood donation history while admins manage these records through a website. Object-Oriented Analysis and Design (OOAD) is the methodology used to develop this application. Android Studio is used to develop the application and Visual Studio Code is used to develop the web-based admin side. Firebase is used to store the database. In summary, the application is expected to increase pet blood donation awareness, increase potential pet blood donors, and ensure timely blood supply for pets.

1. Introduction

Many people consider pets to be an integral part of the family. This led to a greater focus on providing pets with proper care and medical treatment. Pet blood donation is an important process in veterinary medicine, providing life-saving blood donations to pets in need of blood transfusions [1]. However, the limited number of pet blood donors and the lack of a systematic platform to manage pet blood donation pose significant challenges. The awareness and attitudes of the general public regarding cat and dog blood donation are still low [2]. To address these issues, this project aims to develop a Pet Blood Donor mobile application. Pet Blood Donor is a mobile application dedicated to helping cats and dogs in need of blood transfusions find suitable blood donors. It provides a systematic platform that enables pet owners to register pets as pet blood donors, thereby increasing the number of potential pet blood donors. Such a mobile application allows veterinary clinics to connect with potential pet blood donors, making it easier to find compatible blood matches and potentially saving pet lives.

The first problem is that veterinary clinics typically do not set up blood banks for pets. Therefore, whenever a pet needs a blood transfusion, the veterinary clinic needs to temporarily find a pet blood donor instead of getting blood from a blood bank. The second problem is that there is currently no dedicated platform to find matching pets to donate blood in Malaysia. The third problem is that a pet's blood type is rarely recorded. The fourth problem is the lack of public awareness about pet blood donation activities. Most pet owners do not know pets are able to donate blood and are unaware of the existence of pet blood banks [3].

The objectives of this project are to design a Pet Blood Donor mobile application using an object-oriented approach, to develop the designed Pet Blood Donor mobile application that runs on Android platforms and has a web-based admin panel, and to test the functionality and usability of the developed Pet Blood Donor mobile application.

The study domain of this project is the development of the Pet Blood Donor mobile application. This study aims to facilitate and simplify the process of finding matched pets to donate blood. The case study location will be at a veterinary clinic. This mobile application will involve two types of system users which are the admin and users. The admins are veterinary medical administrators or veterinary medical staff, while the users are pet owners. The user side is Android-based, while the admin side is web-based. The system modules include user authentication, user and admin management, profile management, articles management, appointment management, blood donation history, rewards management, as well as feedback and rating modules.

The expected outcome of this project is to create a Pet Blood Donor mobile application that helps in promoting and simplifying the process of pet blood donation. It has two sides, namely admin and user. Admins and users should be able to log in and out of accounts without errors. For new admins, existing admins should be able to add them. New users should be able to register a new account. The expected results of the admin side are to be able to manage users, pets, admins, articles, appointment details, pet blood donation records and reward redemption records. Admin should be able to view feedback and ratings sent by users. The expected results of the user side are to be able to read articles, make appointments, view pet blood donation records, redeem rewards, manage user profiles, manage pet profiles and provide feedback and ratings about the application.

2. Related Work

This section will discuss the technology used to develop the proposed application. It also will discuss the three similar existing systems, namely Pet Blood Bank, Blood4Pet and Hot Blood Cat Attendant mobile applications.

2.1 Technology Used

The technologies used to develop the proposed application include the Android operating system, Android Studio, Firebase, Visual Studio Code, Java, HyperText Markup Language (HTML), Cascading Style Sheets (CSS) and JavaScript.

2.2 Study of Existing Related Systems

The three similar existing systems are Pet Blood Bank, Blood4Pet and Hot Blood Cat Attendant mobile applications. Pet Blood Bank is a mobile application designed to manage dog blood donations [4]. The Pet Blood Bank mobile app is available in the United Kingdom, but not in Malaysia. To register an account with Pet Blood Bank, pet owners need to fill up an online registration form on the Pet Blood Bank website. After verifying that the dog is an eligible blood donor, the charity creates a user account for the pet owner. This application allows users to choose the preferred blood donation location for pets. When the selected venue opens blood donation appointments, users need to make an appointment for pets to donate blood. After selecting a blood donation location, users need to confirm which pet will donate blood and select a donation date and time.

Blood4Pet is a mobile application designed to connect dog owners around the world, allowing dog owners to reach out to each other in emergencies that require blood transfusions for pets [5]. The mobile application allows users to register dogs as pet blood donors by submitting a form. After verification, if the dog is eligible for blood donation, the pet owner's details are displayed on the donor list page. Users looking for pet blood donors are able to search by selecting country, state and city to find available pet blood donors based on the location.

Hot Blood Cat Attendant is a mobile application designed to assist pet owners in finding matching cat and dog blood donors for pets in need of blood transfusions [6]. Unfortunately, this application is not available in Malaysia. Moreover, it is entirely in Mandarin, with no other language options available. Users need to register an account and then log in to the account to use this application. The application allows users to post searches for pet blood donors and pets in need of blood transfusions. When there is a match, both pet owners need to take the pets to the designated veterinary hospital or clinic.

2.3 Comparison with the Existing Systems

Table 1 shows the comparison of features between the three existing systems and the proposed system. Existing systems are Pet Blood Bank, Blood4Pet and Hot Blood Cat Attendant mobile applications. The proposed system is the Pet Blood Donor mobile application.

Table 1 *System's Comparison*

Features/System	Pet Blood Bank [4]	Blood4Pet [5]	Hot Blood Cat Attendant [6]	Pet Blood Donor
1. Operating system (user side)	Android and IOS	Android	Android and IOS	Android
2. User authentication using email and password	Yes	No	Yes	Yes
3. Articles module	No	Yes	No	Yes
4. Blood donation history	No	No	No	Yes
5. Appointment module	Yes	No	No	Yes
6. Reward module	Yes	No	No	Yes
7. User profile management	Yes	No	Yes	Yes
8. Feedback and rating	No	Yes	No	Yes

3. Methodology

The development of the mobile application for this project adopted the Object-Oriented Analysis and Design (OOAD) methodology. OOAD is a methodology used for analysing and designing software systems based on object models of the systems [7]. OOAD has four phases which are the object-oriented analysis phase, object-oriented design phase, object-oriented implementation phase, and object-oriented testing phase.

3.1 Object-Oriented Analysis Phase

The project started with a brainstorming technique to determine the project title. This session involved jotting down a list of potential titles and then selecting the most appropriate one. The idea for the title came from real-life observations and internet browsing. After selecting the project title, a draft project proposal including project introduction, objectives, problem statements and scope was prepared based on the title. To ensure that the project title was acceptable, the supervisor held an online meeting via Microsoft Teams to discuss the draft project proposal. Afterwards, the supervisor asked for a complete project proposal. During this phase, the main focus is on analysing the system requirements related to the proposed mobile application. Therefore, it is necessary to interview target users to determine the requirements. Interview questions include open-ended and closed-ended questions. Veterinary expertise and insights were critical in providing useful information for the development of the mobile application. Hence, a veterinarian from the Empire Animal Medical Center in Batu Pahat, Johor was interviewed via Google Meet. Twelve interview questions were prepared. Apart from that, a pet owner was interviewed via Zoom. Eight interview questions were asked to learn more details about user requirements. Furthermore, both functional and non-functional requirements were determined in this phase.

Next, the project literature review was carried out. It involved a more in-depth study of system requirements. The study was implemented by gathering and analysing information from articles, research papers, conference papers, and journals searched on the internet, Google Scholar, IEEE Xplore, and the Perpustakaan Tunku Tun Aminah (PTTA) website. In addition, the existing related systems were studied. Features among the existing system and proposed system were studied. A comparison table between the existing system and the proposed system was created.

3.2 Object-Oriented Design Phase

During this phase, system design diagram was designed. Unified Modelling Language (UML) diagrams were created to visually represent the design, structure, and behaviour of a system through standardized diagrams and notations. The diagrams include the use case diagram, sequence diagram, activity diagram and class diagram. The tools used to create UML diagrams are Draw.io and Lucidchart. After that, the mobile application database was designed. The data dictionary was generated and presented in tabular form. It is used to centralize and manage metadata, providing a comprehensive and structured description of data elements, attributes, and relationships within a database. Moreover, the object-oriented design phase includes the generation of user interface designs. User interface design is used to conceptualize and plan the layout, structure, and visual elements of the mobile application, ensuring that the user interface aligns with user needs, enhances usability, and promotes a positive user experience [8]. The tool used to draw interface wireframes is Figma.

3.3 Object-Oriented Implementation Phase

The object-oriented implementation phase refers to the process of translating a design represented using object-oriented concepts and diagrams into executable code. This phase is the one that took the longest time among all phases as the coding implementation is the most challenging stage. During this phase, the mobile application

interfaces were developed, followed by the mobile application modules. System integration was implemented to combine and connect all the system interfaces and system modules to create a fully functional mobile application. Android Studio software was used as the coding editor platform for mobile application development. It involves the Java programming language. Visual Studio Code was used to develop the web-based admin side. HyperText Markup Language (HTML), Cascading Style Sheets (CSS) and JavaScript were used in developing the website. Additionally, the tool used to develop and configure the database is Firebase. The database was developed based on the data dictionary created during the object-oriented design phase. It was then integrated with the mobile application. The database allows the mobile application to store, retrieve, and synchronize data in real-time, facilitating seamless and efficient data management for enhanced user experience.

3.4 Object-Oriented Testing Phase

The object-oriented testing phase is the final phase in this project development lifecycle. It is used to verify and validate the functionality of the created mobile application. The test plan generated during the object-oriented design phase was used to test the features and performances of the developed system. The test plan serves as a roadmap for testing the modules of the mobile application, checking whether the actual results of each system module are the same as the expected results. This helps identify and fix defects, ensuring the quality and reliability of the mobile application before it is released to users. During this phase, it also focuses on fixing errors and bugs found while testing the developed mobile application. Parts of the code were rewritten to produce correct interfaces and bug-free modules. This ensures that the final released mobile application functions properly and does not have any defects.

3.5 System Development Workflow

Table 2 shows the mobile application development activities and the task. Each phase has its assignment and output that needs to be produced during the entire project development lifecycle.

Table 2 *Mobile Application Development Activities and the Task*

Phase	Task	Output
1. Object-oriented requirement analysis	• Generates ideas for project title • Prepare draft project proposal • Discuss with supervisor • Prepare project proposal • Prepare interview • Conduct interview • Determine the requirements • Study current system • Compare the current system and the proposed system	• Project title • Project proposal draft • Revised project proposal draft • Final project proposal • Interview questions • Current preliminary process of pet blood donation • System requirements • Existing relevant systems were studied • Differences and similarities between the existing system and the proposed system are determined
2. Object-oriented design	• Design UML diagram • Design database • Design wireframe	• Use case diagram, sequence diagram, activity diagram and class diagram • Data dictionary • Wireframe
3. Object-oriented implementation	• Develop system interfaces • Develop system modules • Integrate system • Connect with the database	• System interfaces • System modules • System interfaces were integrated with system modules • Database was integrated with the system
4. Object-oriented testing	• Test the system • Fix errors and bugs	• Test plan result • Errors and bugs were identified and resolved

3.6 Project Planning

To ensure that the project is completed on time, a project plan was developed. The project plan was represented in the form of a Gantt chart created using Microsoft Project. The Gantt Chart is attached in Appendix H.

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4. Analysis and Design

This section will discuss the analysis and designs of the Pet Blood Donor mobile application and admin website.

4.1 System Design Diagram

System design converts the system requirements into a detailed design that is ready for implementation [9]. The person icon indicates the type of system user. The cylinder represents the system's database. The rectangles are the modules of the system. The arrow lines are used to link all components and then indicate the direction of flow. The system design diagram of the proposed system is shown in Appendix A.

4.2 Unified Modelling Language(UML)

There are two major categories of UML diagrams: behavioural diagrams and structural diagrams. Behavioural diagrams are use case, sequence and activity diagrams while structural diagrams are class diagrams.

4.2.1 Use Case

A use case diagram is a diagram that visually represents the observable interactions among actors and the system being developed. The person icons represent the actors which are the system users while the oval shapes indicate the use cases. The arrow lines are used to connect the actors and use case components. The use case diagram of the proposed system is shown in Appendix B.

4.2.2 Sequence Diagram

A sequence diagram is used to illustrate the interactions and communication among different components or objects in a system. Appendix C and Appendix D show the sequence diagram for the user and admin of the proposed application respectively.

4.2.3 Activity Diagram

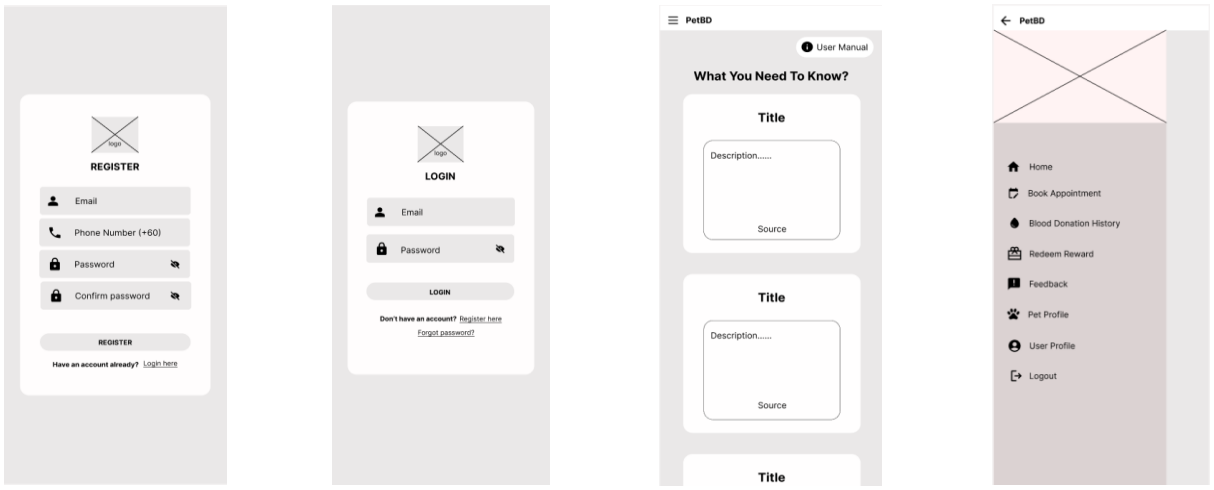
Activity diagrams serve as visual representations of business and software processes, illustrating a series of actions performed by individuals, software components, or computers [10]. Appendix E and Appendix F show the activity diagrams for the user and admin of the proposed application respectively.

4.2.4 Class Diagram

Class diagram holds the unique status of being the only diagram that can be directly translated into an object-oriented language. Appendix G shows the class diagram of the proposed application.

4.3 Interface Design

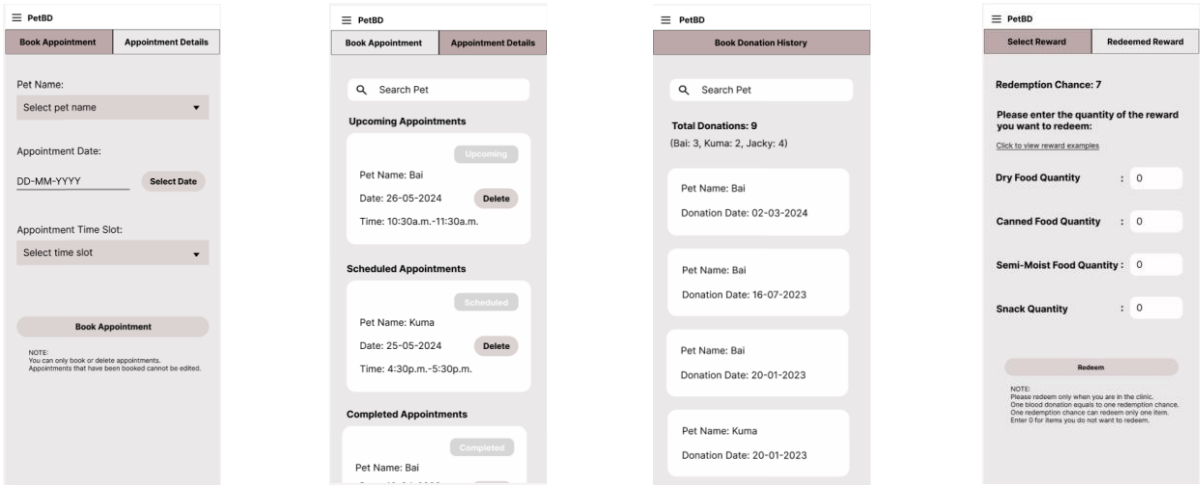
Figure 1(a) shows the user register page. Figure 1(b) shows the user login page. Figure 1(c) shows the homepage. Figure 1(d) shows the hidden menu, which acts as the navigation bar.



(a) **(b)** **(c)** **(d)**

Fig. 1 *(a) Register Page; (b) Login Page; (c) Homepage; (d) Hidden Navigation Bar*

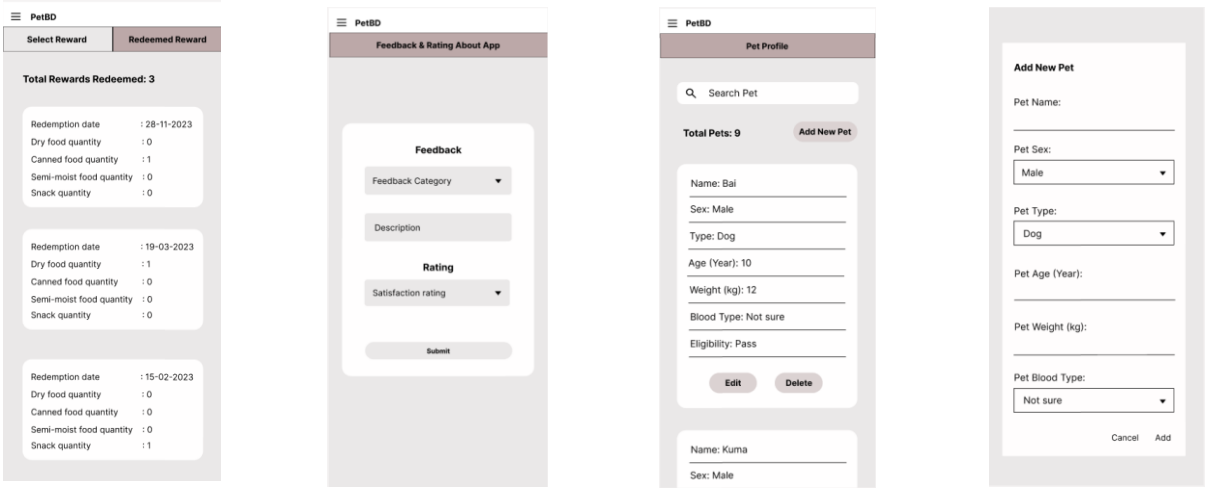
The appointment booking page has two tabs, including the Book Appointment and Appointment Details tabs. Figure 2(a) shows the Book Appointment tab. Figure 2(b) shows the Appointment Details tab. Figure 2(c) shows the pet blood donation history page. The reward redemption page has two tabs, including the Select Reward and Redeemed Reward tabs. Figure 2(d) shows the Select Reward tab.



(a) **(b)** **(c)** **(d)**

Fig. 2 *(a) Appointment Page (Book Appointment Tab); (b) Appointment Page (Appointment Details Tab); (c) Pet Blood Donation History Page; Reward Redemption Page (Select Reward Tab)*

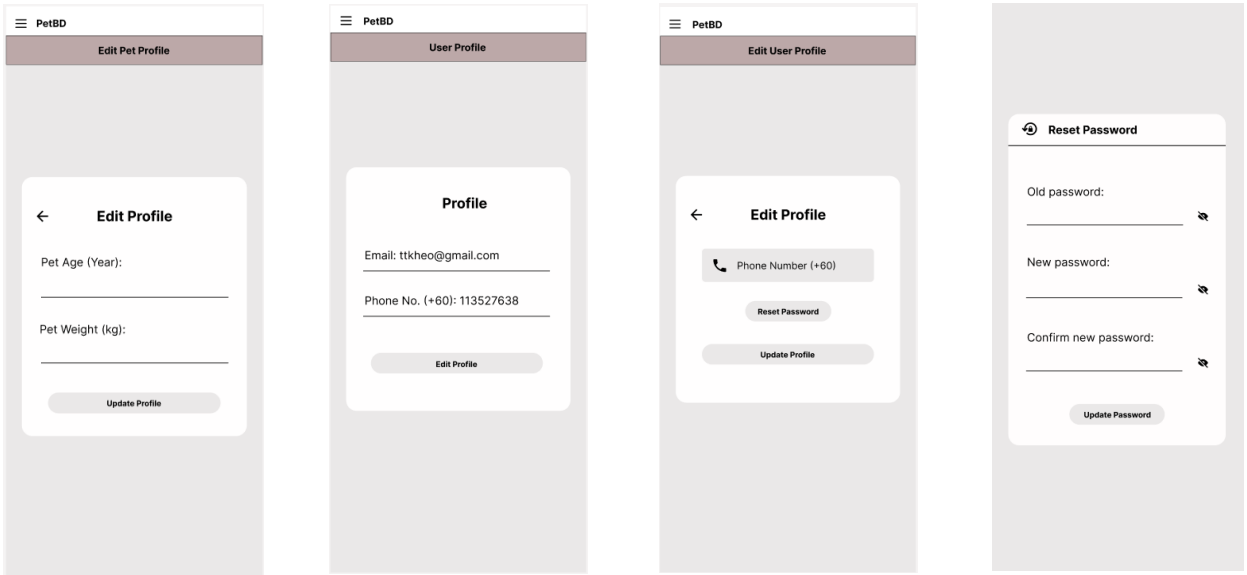
Figure 3(a) shows the Redeemed Reward tab. Figure 3(b) shows the feedback page. Figure 3(c) shows the pet profile page. Figure 3(d) shows add new pet dialog.



(a) **(b)** **(c)** **(d)**

Fig. 3 *(a) Reward Redemption Page; (b) Feedback Page; (c) Pet Profile Page; (d) Add New Pet Dialog*

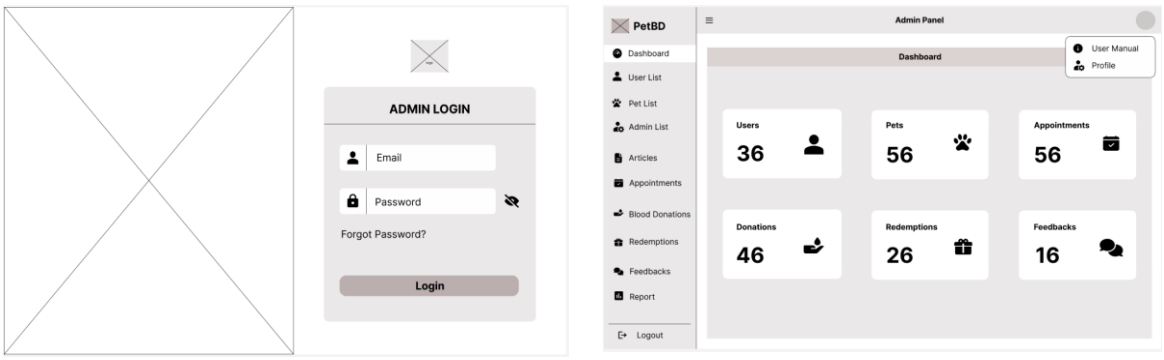
Figure 4(a) shows the edit pet profile page. Figure 4(b) shows the user profile page. Figure 4(c) shows the edit user profile page. Figure 4(d) shows the reset password dialog.



(a) **(b)** **(c)** **(d)**

Fig. 4 *(a) Edit Pet Profile Page; (b) User Profile Page; (c) Edit User Profile Page; (d) Reset Password Dialog*

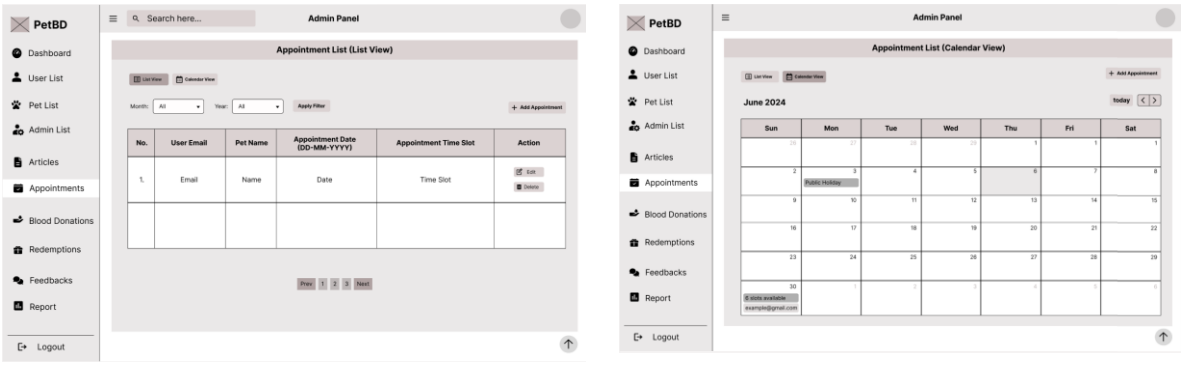
Figure 5(a) shows the admin login page. Figure 5(b) shows the admin homepage, which also functions as a dashboard page.



(a) **(b)**

Fig. 5 *(a) Admin Login Page; (b) Admin Homepage*

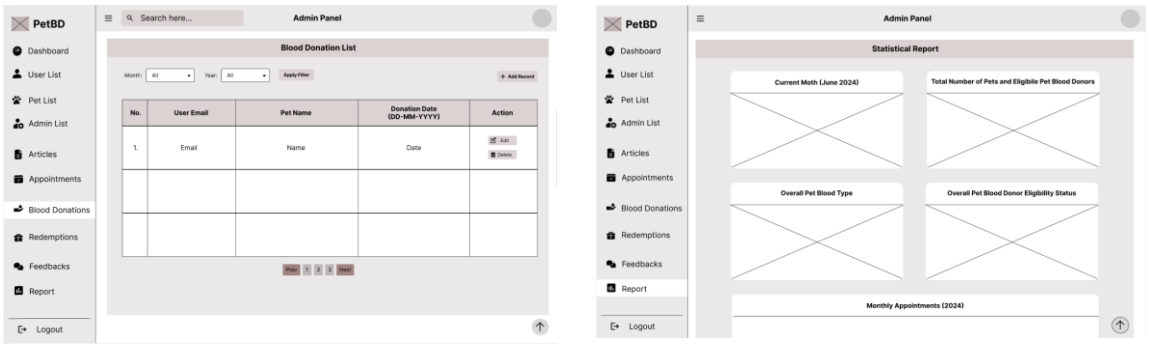
Figure 6(a) shows the list view appointment management page. Figure 6(b) shows the calendar view appointment management page.



(a) **(b)**

Fig. 6 *(a) List View Appointment Management Page; (b) Calendar View Appointment Management Page*

Figure 7(a) shows the pet blood donation management page. Figure 7(b) shows the statistical report page.



(a) **(b)**

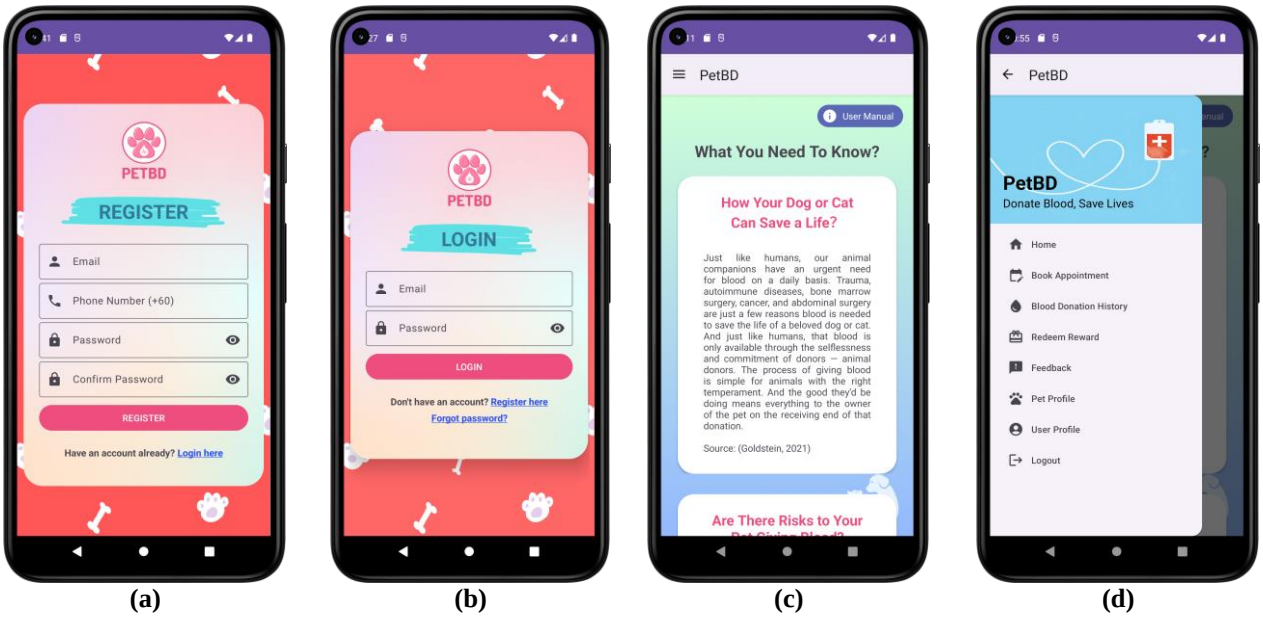
Fig. 7 *(a) Pet Blood Donation Management Page; (b) Statistical Report Page*

5. Implementation and Testing

This section will discuss the implantation and testing of Pet Blood Donor mobile application and admin website.

5.1 Implementation

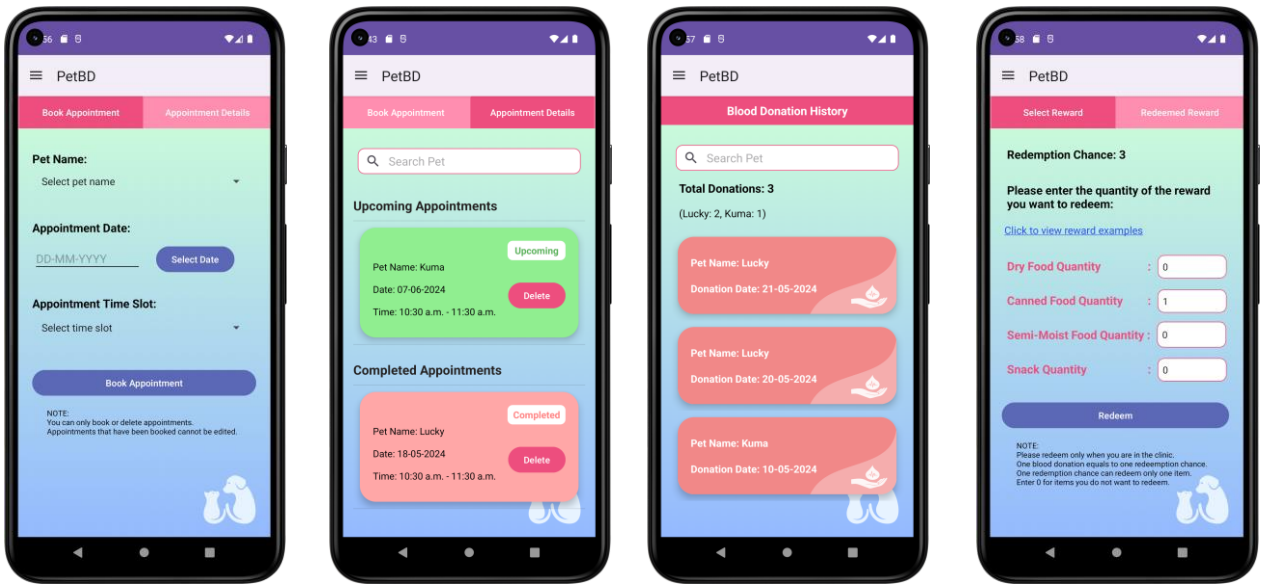
Figure 8(a) shows the user register interface. On this page, pet owners as new users need to fill in an email address, phone number, password and confirm password to register a new account. To be a valid Malaysian phone number, the phone number must be between 9 and 10 digits along with +60. The password and confirm password should be the same. The password must be at least 8 characters long, including uppercase letters, lowercase letters, and special characters. All these requirements should be met; otherwise, the user will not be able to register for an account. If the user already has an account, the user should click on the "Login here" link to access the login page. Figure 8(b) shows the user login interface. The user needs to enter the registered email address and password to log in. If the user does not have an account, the user needs to click on the "Register here" link to visit the register page. If the user forgets the password, the user should click the "Forgot password?" link. After clicking the "Forgot password?" link, it displays the forgot password dialog and asks the user to enter the registered email address in order to send the reset password email to the user. Figure 8(c) shows the homepage interface. After the users successfully log into the application, it directs the user to this page. In the upper left corner of the page, the three-line icon is a hidden navigation bar. On this page, users are able to view the articles published by the admin. Figure 8(d) shows the hidden navigation bar. An image is at the top of the hidden navigation bar.



(a) **(b)** **(c)** **(d)**

Fig. 8 *(a) Register Interface; (b) Login Interface; (c) Homepage Interface; (d) Hidden Navigation Bar Interface*

Figure 9(a) shows the book appointment interface. Under the Book Appointment tab, users are able to book a blood test appointment for pets. Users should select a pet name and then choose an appointment date by clicking on the Select Date button to select a date from calendar. Next, the user needs to select the available time slot for the appointment. The time slot is represented using a drop-down list which includes 9:30 a.m. - 10:30 a.m., 10:30 a.m. - 11:30 a.m., 12:30 p.m. - 1:30 p.m., 2:30 p.m. - 3:30 p.m., 3:30 p.m. - 4:30 p.m., 4:30 p.m. - 5:30 p.m. and 5:30 p.m. - 6:30 p.m. time slot options. If one of the time slots is already booked by another user, that time slot will not be displayed. Figure 9(b) shows the appointment details interface. Under the Appointment Details tab, users are able to view the booked appointment details. The details include pet name, appointment date and time slot. If the user wants to delete an appointment, the user may simply click on the Delete button. Figure 9(c) shows the blood donation history interface. On this page, users are able to view the pet blood donation record. The record includes user email address, pet name and blood donation date. Figure 9(d) shows the redeem rewards interface. On this page, under the Select Reward tab, users who have pets successfully donate blood are able to choose the rewards want to be redeemed. The reward given is pet food which are in the category of dry food, canned food, semimoist food and snack options. The number of redemption chances is displayed. One pet blood donation equals to one redemption chance. One redemption chance can redeem only one item. Users need to enter the number of rewards users want to redeem, and 0 for items users do not want to redeem. Users may simply click on the Redeem button to redeem the reward.



(a) **(b)** **(c)** **(b)**

Fig. 9 *(a) Book Appointment Interface; (b) Appointment Details Interface; (c) Blood Donation History Interface; (d) Redeem Rewards Interface*

Figure 10(a) shows the redemption history interface. Under the Redeemed Reward tab, users are able to view the reward redemption record. The details include the redemption date and quantity of each reward. The total number of rewards redeemed is shown at the top. Figure 10(b) shows the feedback interface. On this page, users need to select a feedback category. Feedback category options include comment, complaint, praise and suggestion. Then, users need to fill in the feedback description. Below the feedback is the satisfaction rating including very satisfied, satisfied, neutral, unsatisfied and very unsatisfied options. Once the user has filled in all the fields, the users may simply click the Submit button to submit. Figure 10(c) shows the pet profile interface. On this page, users are able to search, add, edit and delete pet details. To find specific pet information, user just need to enter the pet name in the search bar. To add a pet, users need to click the Add New Pet button. After clicking the Add New Pet button, it displays add new pet dialog. If the user clicks the Delete button to delete pet in pet profile page, alert dialog box will appear to reconfirm that the user wants to delete the pet. Figure 10(d) shows the add new pet dialog interface. In this dialog, users need to fill in pet name, pet sex, pet type, pet age, pet weight and pet blood type.

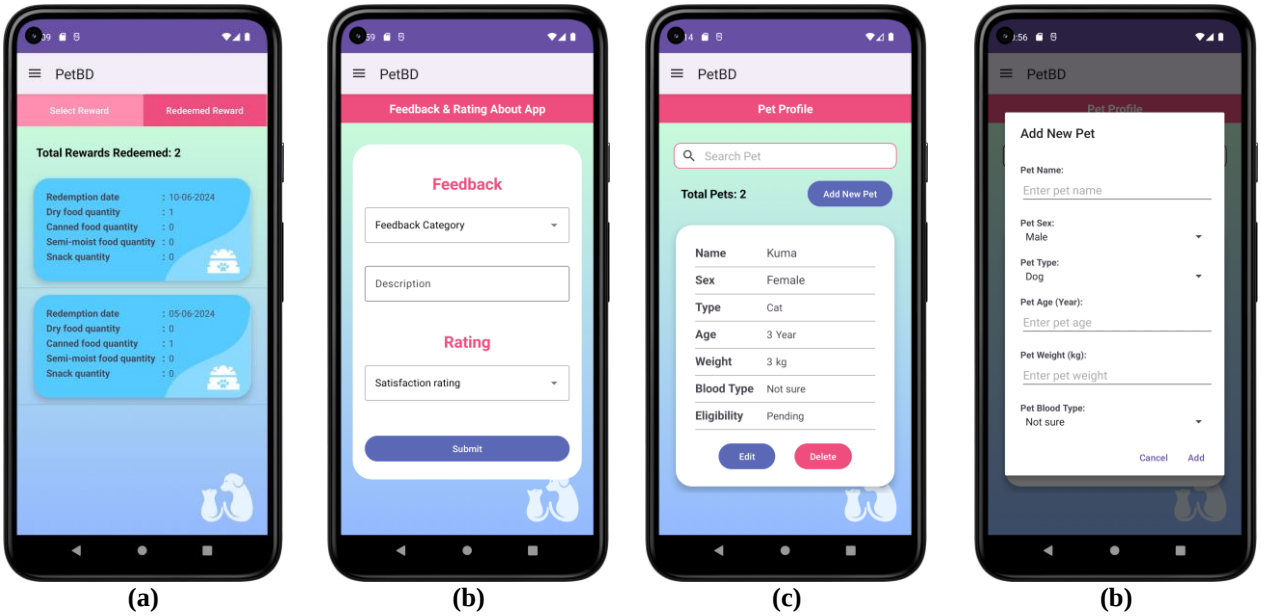


Fig. 10 *(a) Redemption History Interface; (b) Feedback Interface; (c) Pet Profile Interface; (d) Add New Pet Dialog Interface*

Figure 11(a) shows the edit pet profile interface. On this page, users are able to edit pet age and weight. Once the user has filled in all the information that needs to be updated, the user may simply click on the Update Profile button. If the users want to return back to the pet profile page, the users may simply click on the arrow back icon. Figure 11(b) shows the user profile interface. On this page, users are able to view the personal information, including email address and phone number. If the user wants to edit personal information, user may simply click on the Edit Profile button. Figure 11(c) shows the edit user profile interface. On this page, user is able to edit the phone number and reset the password. Figure 11(d) shows the reset password dialog interface. This dialog is displayed after the Reset Password button in the edit user profile page is clicked. To reset the password, users need to enter the old password, new password and confirm new password. Once the user has filled in all the input fields, the user may simply click on the Update Password button to reset the password.

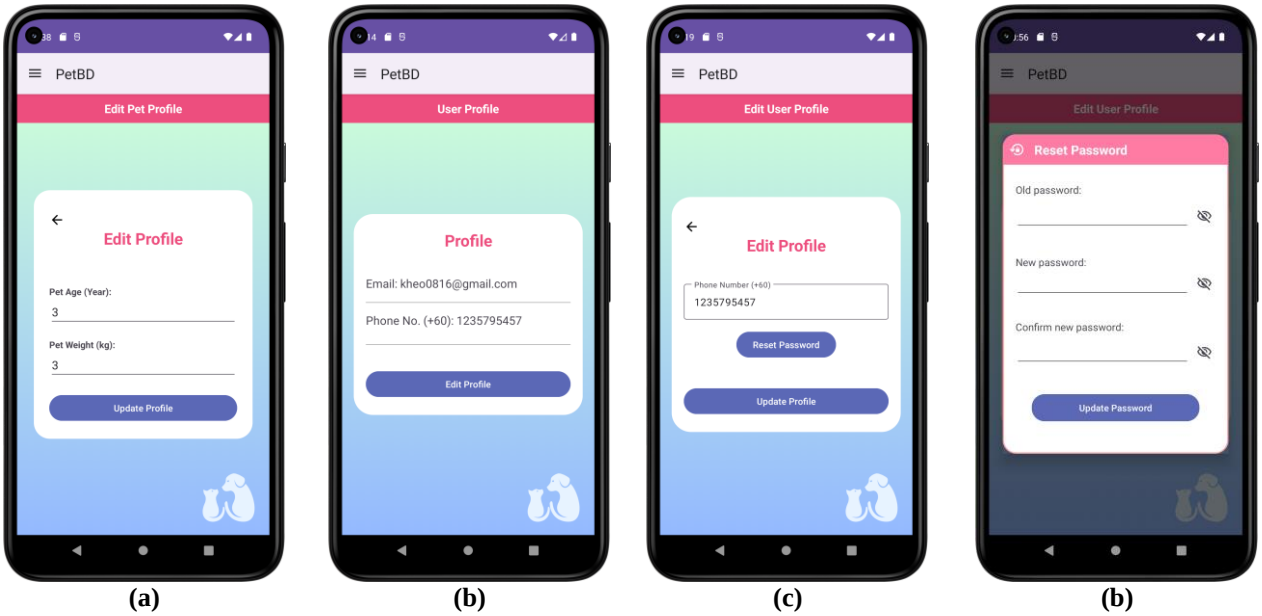


Fig. 11 *(a) Edit Pet Profile Interface; (b) User Profile Interface; (c) Edit User Profile Interface; (d) Reset Password Dialog Interface*

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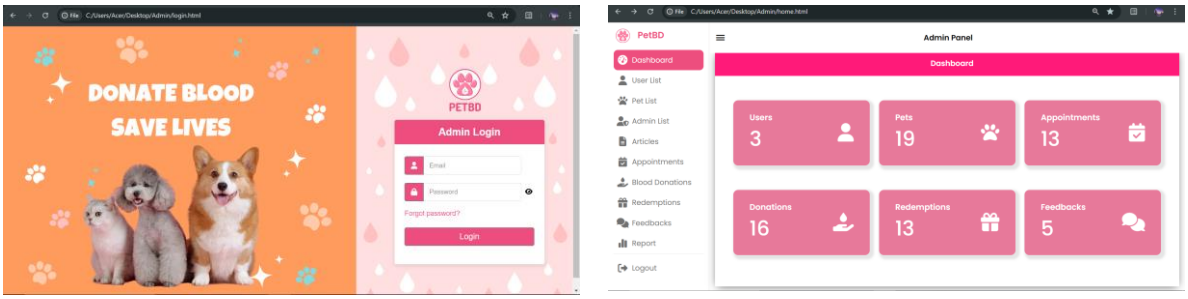
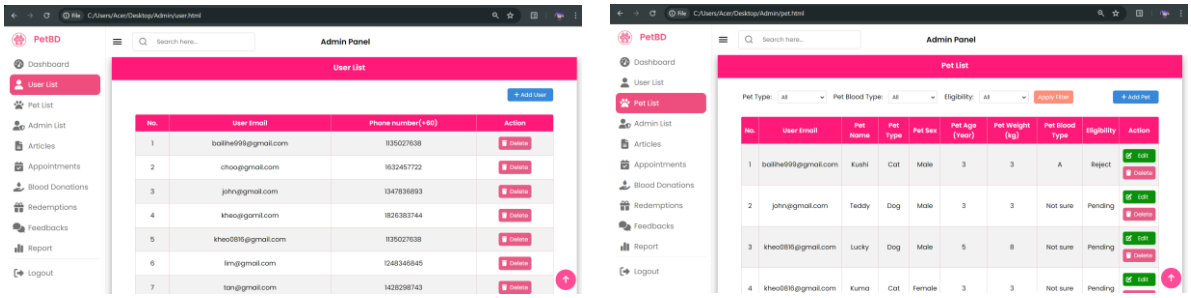
Figure 12(a) shows the admin login page. On this page, the admin needs to enter the authenticated email and password in order to log into the account. If the admin forgets the password, the admin needs to click the "Forgot password?" link to reset the password through the email. Figure 12(b) shows the dashboard interface, which is also the admin homepage. The navigation bar is on the left and can also be hidden using the three-line icon. At the header, there is a profile image icon in the upper right corner, and when hovering over it, a drop-down box with a user manual and profile navigation buttons appears. On this page, the total number of users, pets, blood test appointments, pet blood donations, redemption rewards, and user feedback are displayed.



(a) **(b)**

Fig. 12 *(a) Admin Login Page; (b) Admin Homepage*

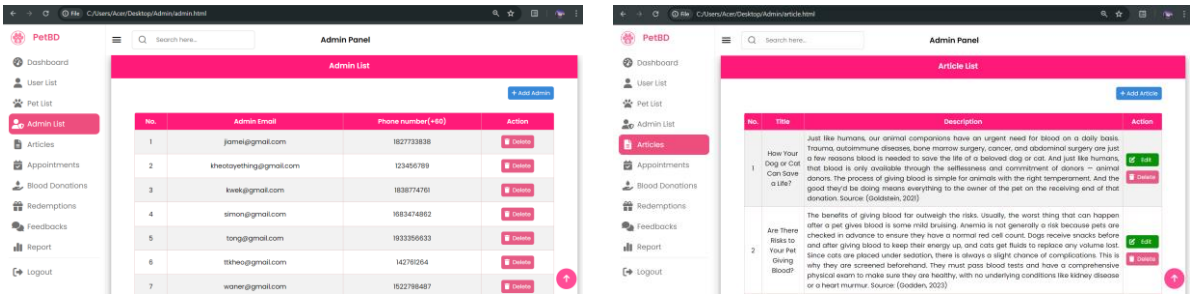
Figure 13(a) shows the user management page. On this page, the admins are able to add and delete users. Figure 13(b) shows the pet management page. On this page, the admins are able to add, edit and delete pets.



(a) **(b)**

Fig. 13 *(a) User Management Page; (b) Pet Management Page*

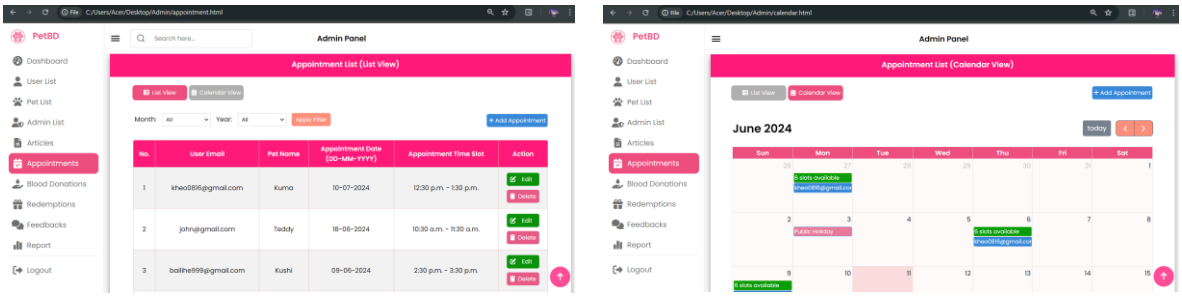
Figure 14(a) shows the admin management page. On this page, the admins are able to add and delete admin. Figure 14(b) shows the article management page. On this page, the admins are able to manage the article published on the user homepage of the Pet Blood Donor mobile application.



(a) **(b)**

Fig. 14 *(a) Admin Management Page; (b) Article Management Page*

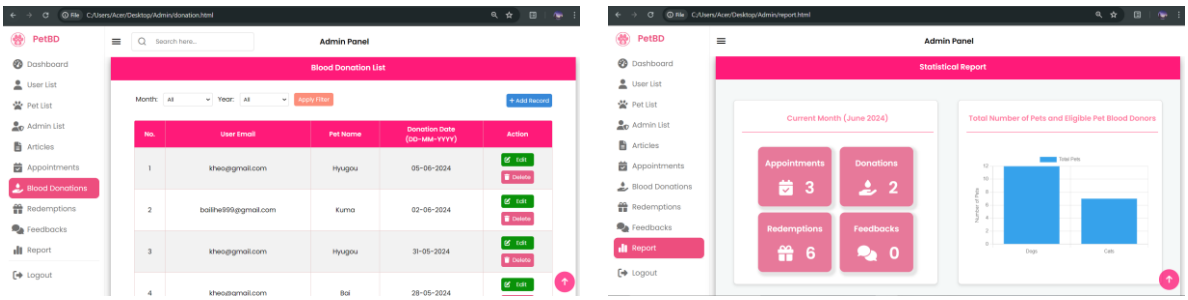
Figure 15(a) shows the list view appointment management page. On this page, the admins are able to manage the appointment information booked by users. The admins are able to add, delete and update appointment. For editing, admins only able to edit user's appointment date and time slot. Admins are able to search specific appointment information by entering the keywords in the search bar. Admins are able to filter the appointment list based on month and year. Admin is also able to view the appointments in the calendar by clicking the Calendar View button. Figure 15(b) shows the calendar view appointment management page. Admins are also able to add, delete and update appointments here. Admins are also able to view public holidays and the number of available appointment time slots every day, making appointment management easier.



(a) **(b)**

Fig. 15 *(a) List View Appointment Management Page; (b) Calendar View Appointment Management Page*

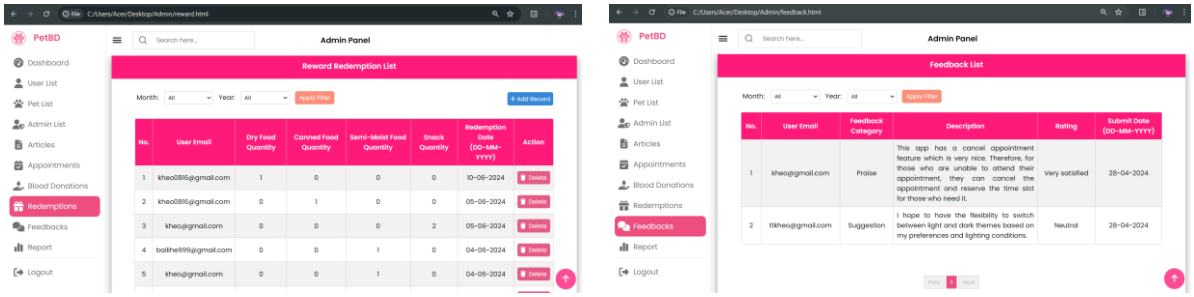
Figure 16(a) shows the pet blood donation management page. On this page, the admins are able to manage the pet blood donation record. The admins are able to add, delete and update pet blood donation information such as user email, pet name and pet blood donation date. Admins are able to search specific pet blood donation information by entering the keywords in the search bar. Admins are also able to filter the blood donation list by month and year. Figure 16(b) shows the statistical report page. On this page, system data will be presented as a report analysis in the form of charts. There are seven graphs. The total number of pets and eligible pet blood donors are represented by a bar chart. Overall pet blood type and overall pet blood donor eligibility status are represented in stacked bar charts. Monthly appointments for the current year are represented using a bar graph, while monthly donations for the current year are represented using a line graph. Overall, redeemed reward types are represented using a doughnut chart, while overall feedback is represented using a pie chart.



(a) **(b)**

Fig. 16 *(a) Pet Blood Donation Management Page; (b) Statistical Report Page*

Figure 17(a) shows the reward redemption management page. On this page, the admins are able to add and delete reward redemption records. Figure 17(b) shows the feedback page. On this page, the admins are able to view the feedback and rating about the mobile application send by users. The information includes user email, feedback category, feedback description, satisfaction rating and user submission date.



(a) **(b)**

Fig. 17 *(a) Reward Redemption Management Page ; (b) Feedback Page*

5.2 Testing

Testing for the Pet Blood Donor mobile application and admin panel website involves evaluating their functionalities, performance, and user experience to ensure they meet specified requirements and standards. Table 3 shows the result of Test Plan for the Pet Blood Donor mobile application and its admin panel website.

Table 3 *Test Plan Results*

Module	Test Cases	Expected Output	Actual Output
1. System user authentication	• New user registers a new account. • Existing admin and user log into the account by entering authenticated email and password. • Admin and user are able to reset the password if forget the password.	• New user successfully created new account. • Existing admin and user successfully log into the account. • Admin and user successfully received the reset password email to set a new password.	Pass
2. User, pet and admin management	• Admin creates new users, pets and admins. • Admin updates pet information. • Admin deletes user, pet and admin information.	• New user, pet and admin information added successfully. • Pet information updated successfully. • User, pet and admin information removed successfully.	Pass
3. User and admin profile management	• Admin and user update personal details.	• Admin and user information updated successfully.	Pass
4. Pet profile management	• User creates new pet profile. • User updates pet profiles. • User deletes pets.	• New pet profile successfully added to user account. • Pet profile updated successfully • Pet removed successfully.	Pass
5. Article management	• Admin create, delete and update articles.	• Articles added, removed and updated successfully.	Pass
6. Appointment management	• User makes an appointment for the pet. • User cancels appointment when he/she is unable to attend. • Admin creates, deletes and updates appointment details.	• Appointment booked successfully. • Appointment deleted successfully. • Appointments added, removed and updated successfully.	Pass
7. Blood donation history	• Admin creates, deletes and updates pet blood donation record.	• Pet blood donation record added, removed and updated successfully.	Pass

Table 3 *Test Plan Results (continued)*

Module	Test Cases	Expected Output	Actual Output
8. Reward redemption management	• User redeems the rewards. • Admin creates, deletes and updates reward redemption record.	• Users who have the redemption chance are able to successfully redeem the rewards. • Reward redemption record added, removed and updated successfully.	Pass
9. Feedback and rating	• User sent feedback and ratings about the mobile application.	• Admin successfully receives the feedback and ratings from user.	Pass
10. Dashboard	• Admin view an overview of relevant data in the system.	• Admins are able to see a proper overview of total number of users, pets, appointments, pet blood donations and feedback.	Pass
11. Statistical Report	• Admin view statistical reports on system data.	• System data is successfully presented in graphs and charts.	Pass

6. Conclusion

The advantages and disadvantages, and the recommendations of the system were discussed in this section.

6.1 Achievement of the Overall Objectives

The objectives of this project were achieved. The objectives are to design a Pet Blood Donor mobile application using an object-oriented approach, develop the designed Pet Blood Donor mobile application that runs on Android platforms and has a web-based admin panel, as well as test the functionality and usability of the developed Pet Blood Donor mobile application.

The project successfully utilized an object-oriented approach to design a comprehensive mobile application for pet blood donation. This involved identifying key features, user requirements, and system architecture to create a solid foundation for development.

The designed application was effectively developed to run on Android platforms. Additionally, a web-based admin panel was created to manage various aspects of the application, such as user data, appointments, pet blood donation records, and more.

A Test Plan was conducted to check the functionality and usability of the Pet Blood Donor mobile application. This ensured that the mobile application met the expected requirements and provided a seamless experience for both users and admins.

6.2 System Advantages

The advantages of the developed system are discussed are listed below:

i. If admins and users forget their passwords, the system allows them to reset their passwords through email.
ii. Both the mobile application and the admin panel website include a user manual to assist beginner users in utilizing the system effectively.
iii. Both the mobile application and the admin panel website include search function.
iv. User is able to view the appointment details.
v. If the user is unable to attend the appointment, the appointment can be deleted.
vi. User is able to add, edit and delete pet profiles.
vii. User is able to view pet blood donation history.
viii. User is able to view reward redemption records.
ix. There is a calendar view appointment management on the admin panel website.
x. There is a statistical report regarding system data on the admin panel website.

6.3 System Disadvantages

The disadvantages of the developed system are listed below:

i. There is no notification module about upcoming appointments.
ii. There is no multi-factor authentication for the login process.
iii. Images are not included in the article management module on the admin panel website.

6.4 Recommendations

The developed system's recommendations are listed below:

i. It is recommended to add notifications about upcoming appointments to the mobile application to inform users.
ii. Systems may include multi-factor authentication as part of the login process.
iii. The article management module on the admin panel website is suggested to be enhanced by adding an option for uploading images as part of articles.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Kheo Tay E Thing, Rozanawati Darman; **data collection:** Kheo Tay E Thing, Rozanawati Darman; **analysis and interpretation of results:** Kheo Tay E Thing, Rozanawati Darman; **draft manuscript preparation:** Kheo Tay E Thing, Rozanawati Darman. All authors reviewed the results and approved the final version of the manuscript.

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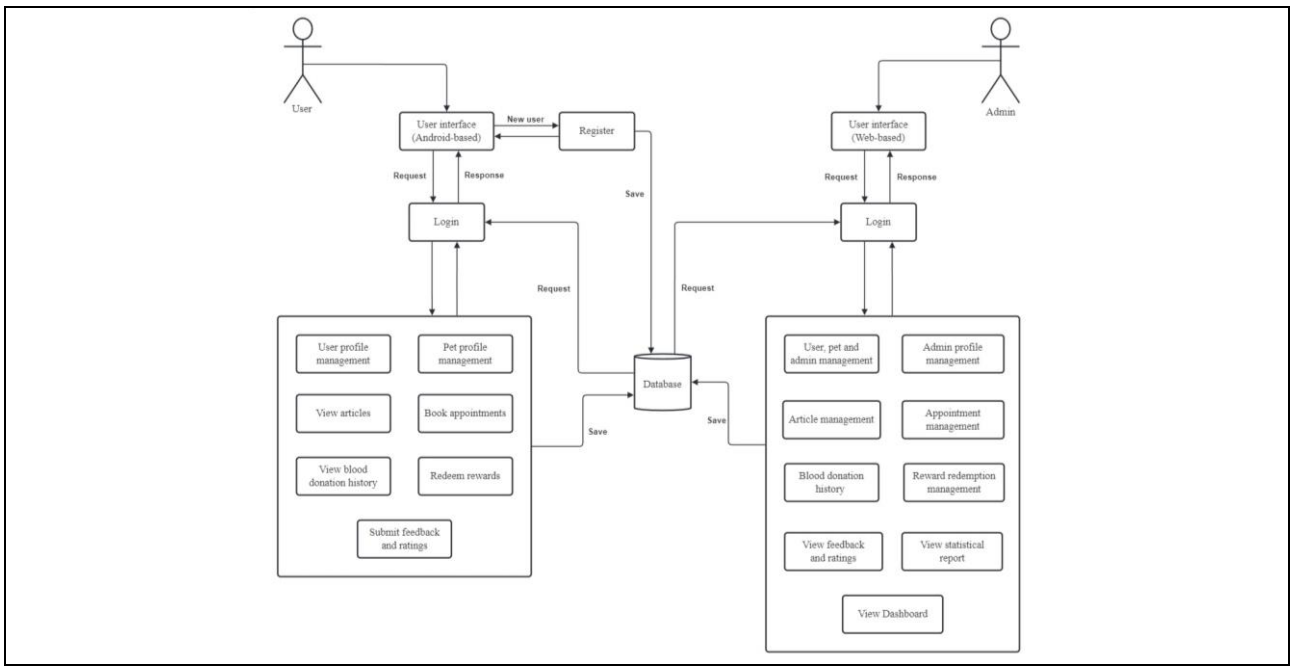
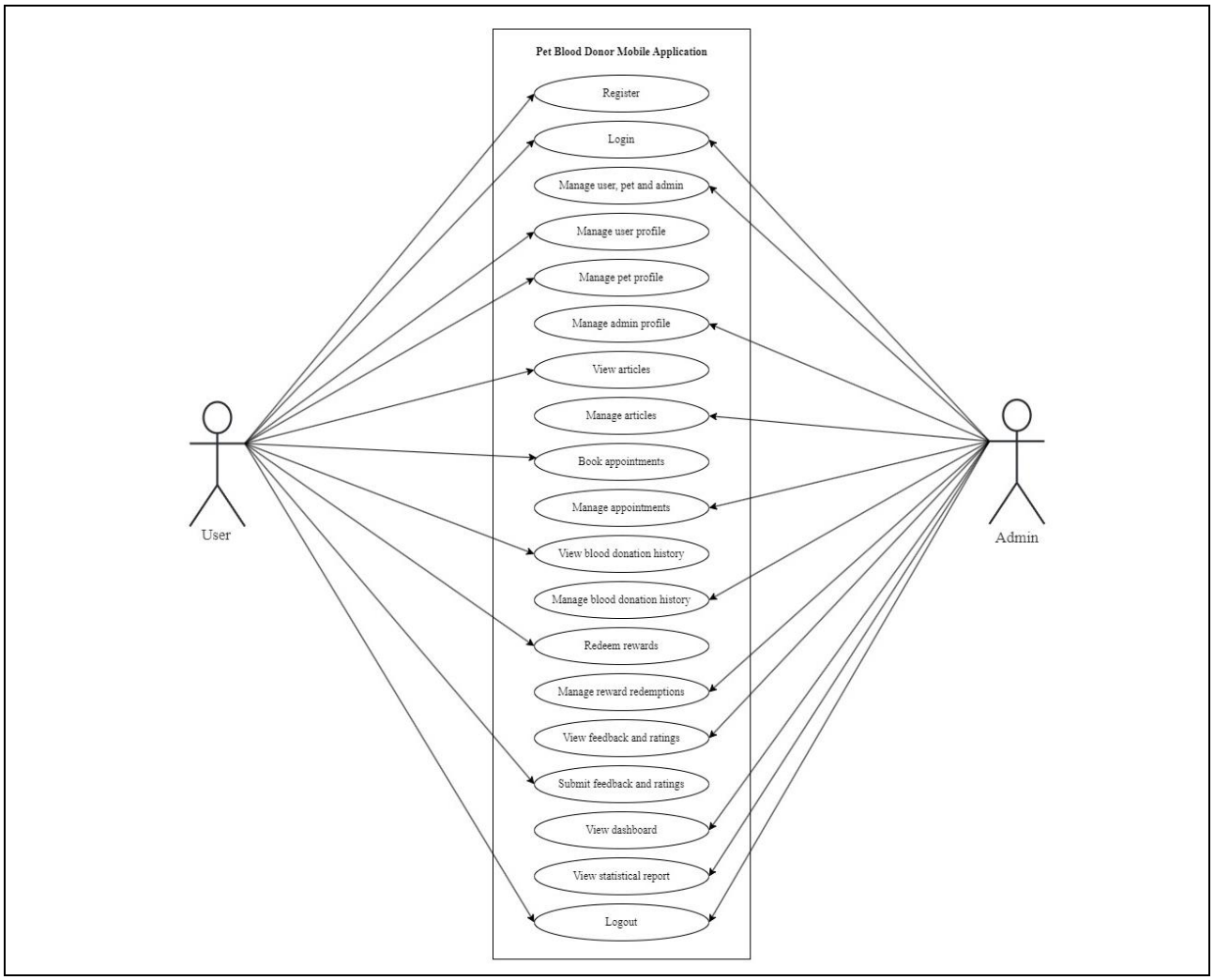
Appendix A: System Design Diagram



Appendix B: Use Case Diagram



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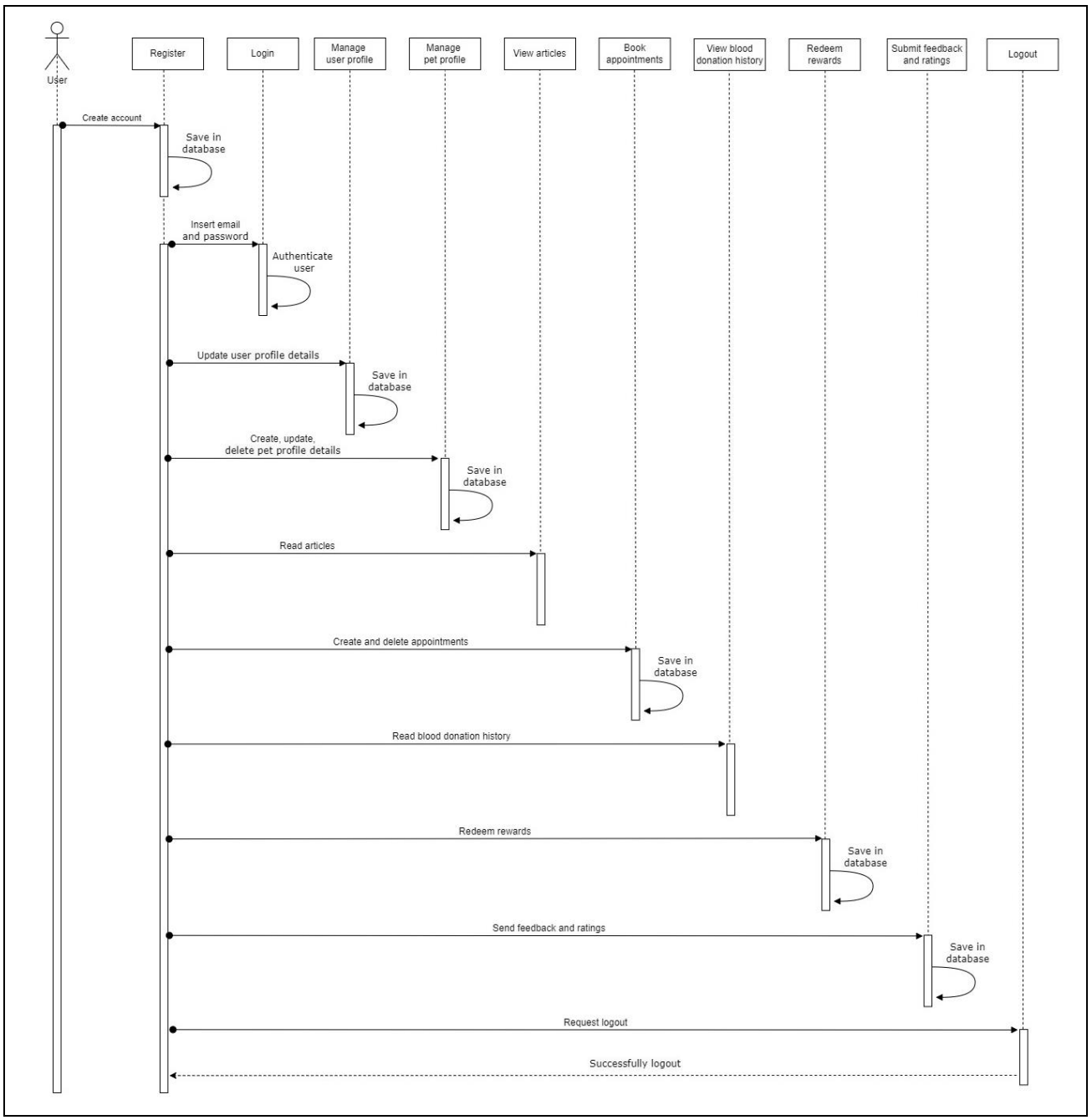
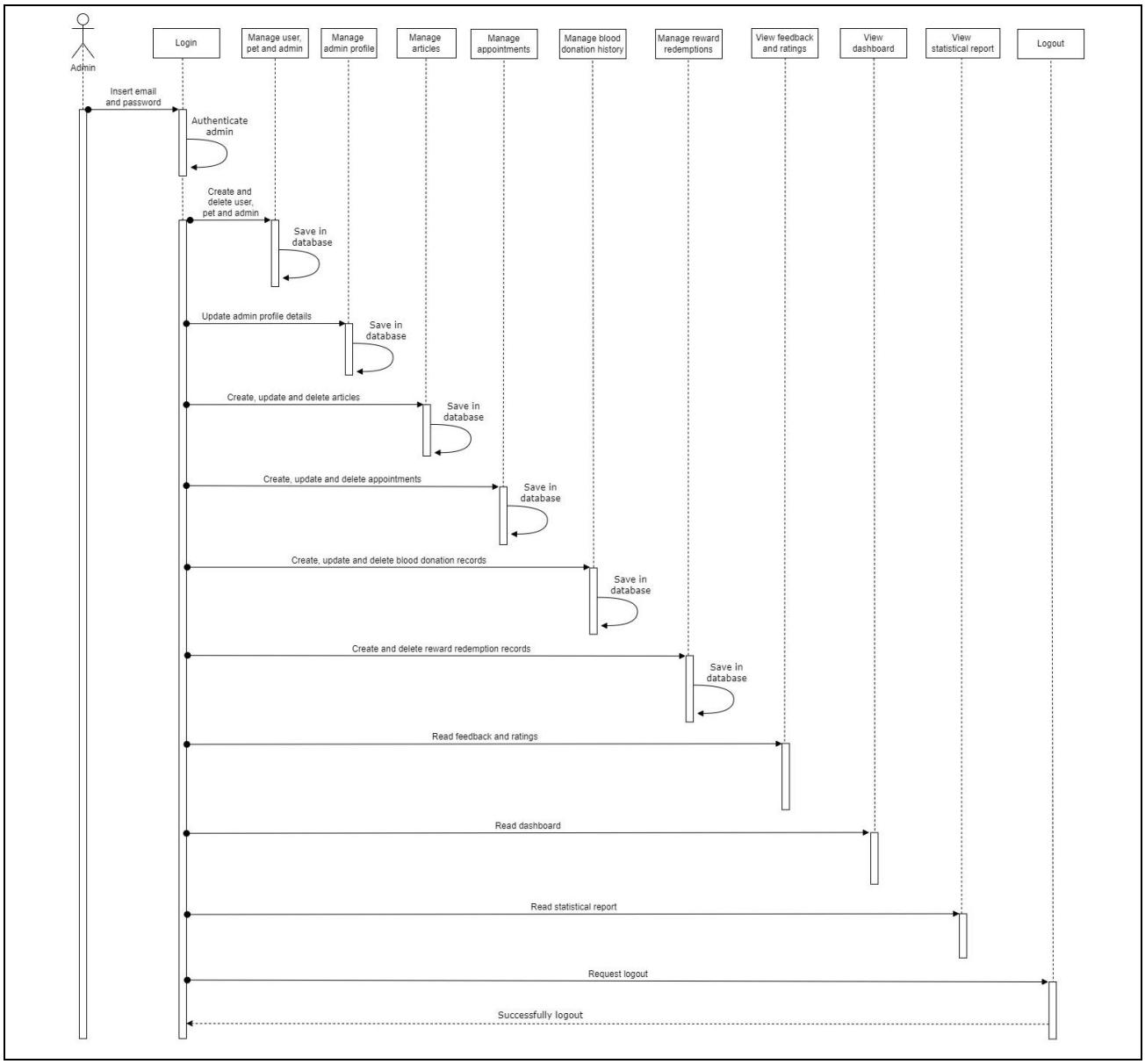
Appendix C: Sequence Diagram For User



Appendix D: Sequence Diagram For Admin



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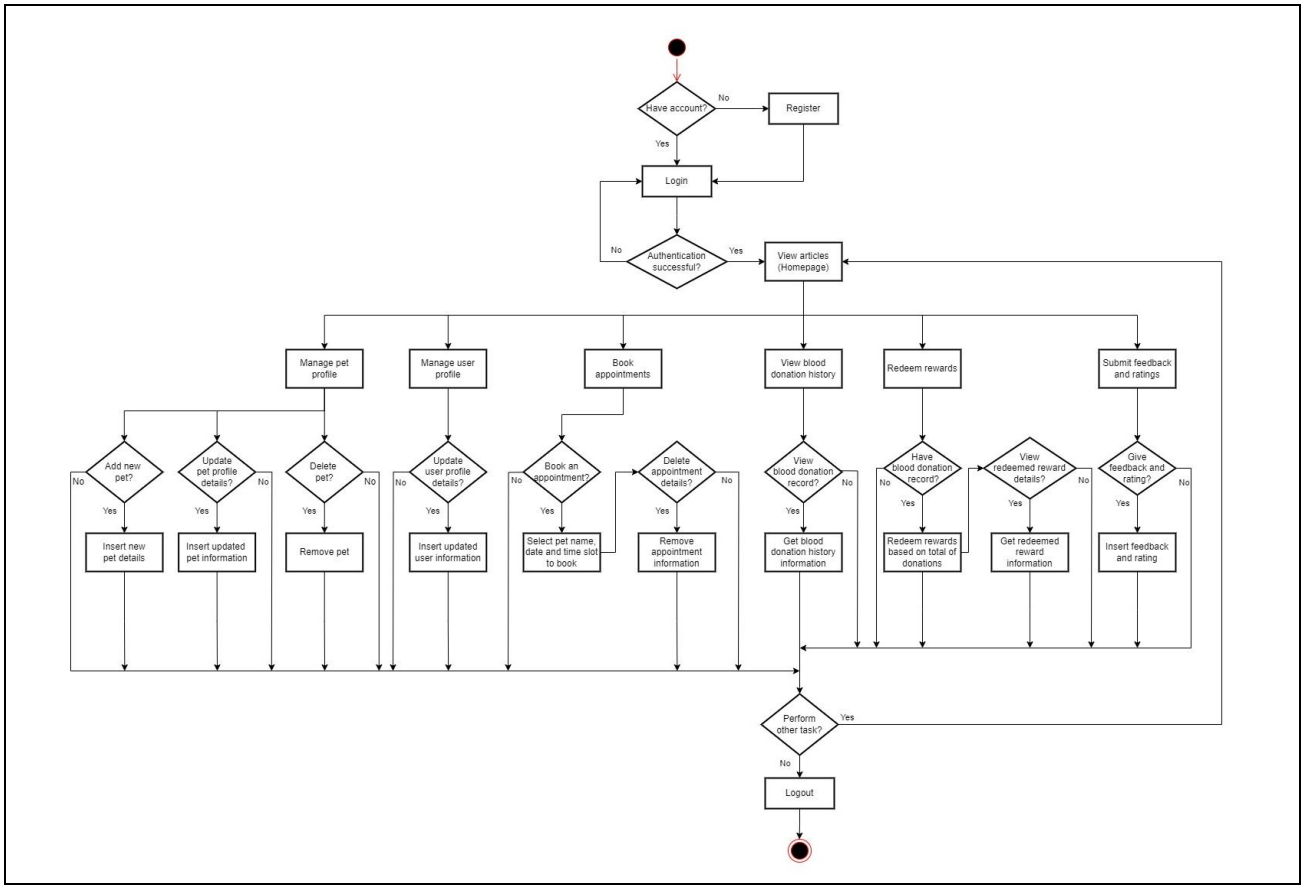
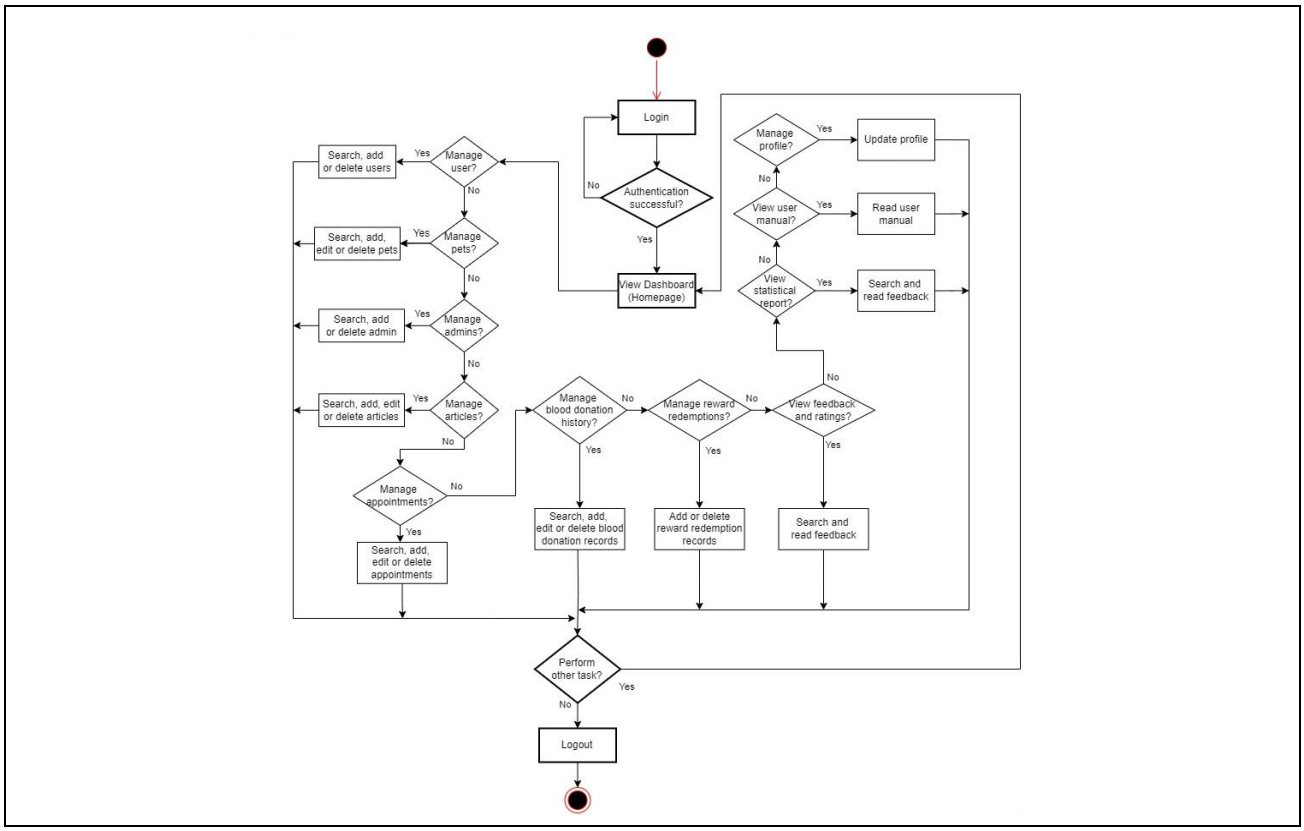
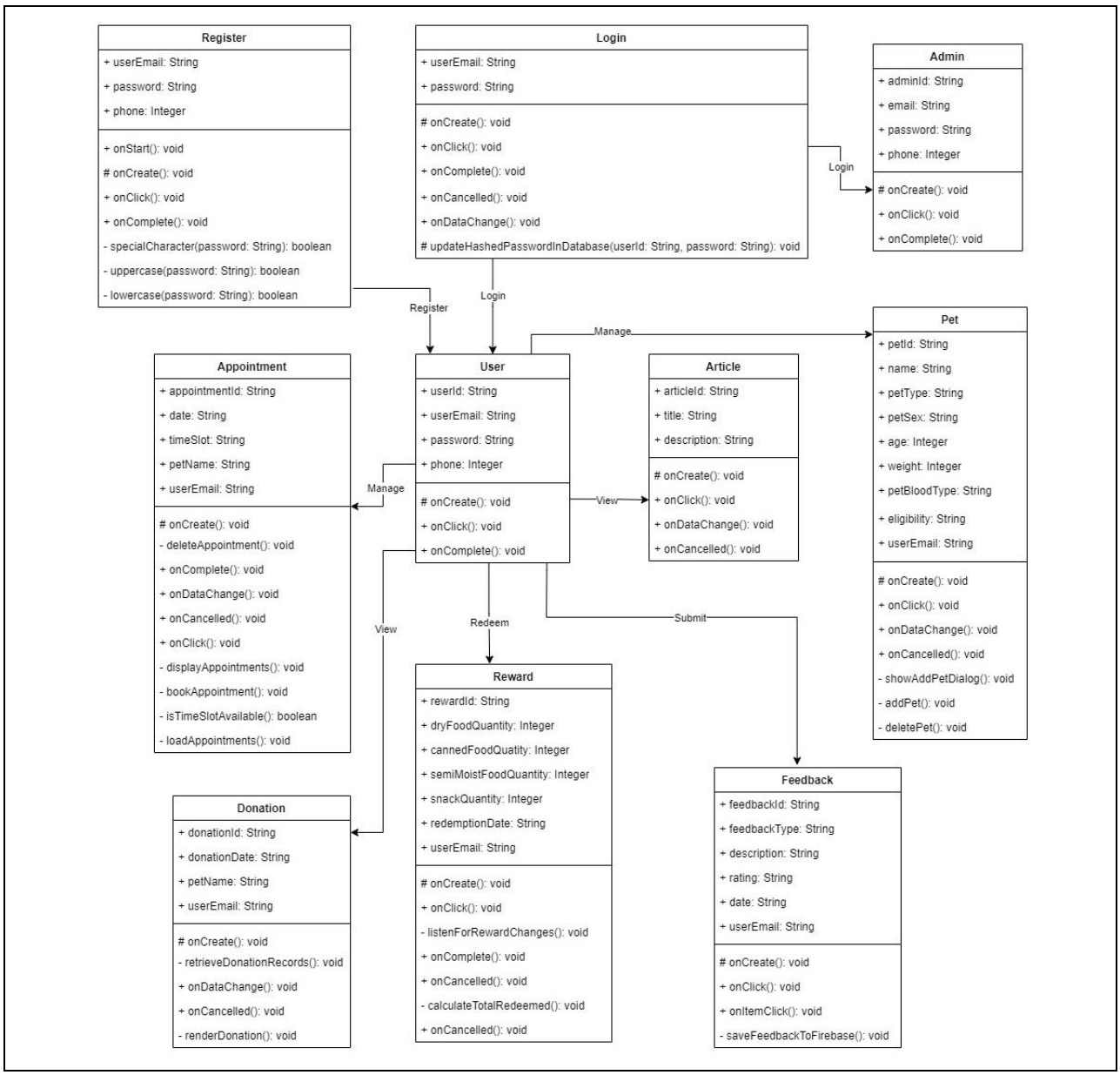
Appendix E: Activity Diagram For User



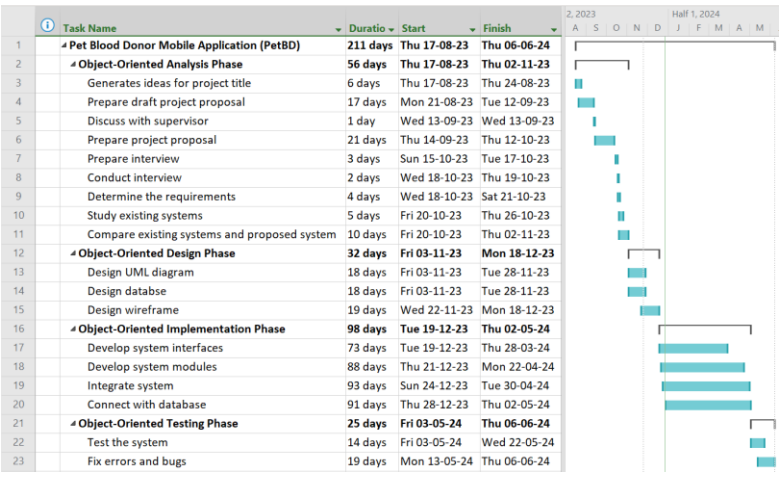
Appendix F: Activity Diagram For Admin



Appendix G: Class Diagram



Appendix H: Gantt Chart



	Task Name	Duration	Start	Finish
1	**Pet Blood Donor Mobile Application (PetBD)**	**211 days**	**Thu 17-08-23**	**Thu 06-06-24**
2	**Object-Oriented Analysis Phase**	**56 days**	**Thu 17-08-23**	**Thu 02-11-23**
3	Generates ideas for project title	6 days	Thu 17-08-23	Thu 24-08-23
4	Prepare draft project proposal	17 days	Mon 21-08-23	Tue 12-09-23
5	Discuss with supervisor	1 day	Wed 13-09-23	Wed 13-09-23
6	Prepare project proposal	21 days	Thu 14-09-23	Thu 12-10-23
7	Prepare interview	3 days	Sun 15-10-23	Tue 17-10-23
8	Conduct interview	2 days	Wed 18-10-23	Thu 19-10-23
9	Determine the requirements	4 days	Wed 18-10-23	Sat 21-10-23
10	Study existing systems	5 days	Fri 20-10-23	Thu 26-10-23
11	Compare existing systems and proposed system	10 days	Fri 20-10-23	Thu 02-11-23
12	**Object-Oriented Design Phase**	**32 days**	**Fri 03-11-23**	**Mon 18-12-23**
13	Design UML diagram	18 days	Fri 03-11-23	Tue 28-11-23
14	Design databse	18 days	Fri 03-11-23	Tue 28-11-23
15	Design wireframe	19 days	Wed 22-11-23	Mon 18-12-23
16	**Object-Oriented Implementation Phase**	**98 days**	**Tue 19-12-23**	**Thu 02-05-24**
17	Develop system interfaces	73 days	Tue 19-12-23	Thu 28-03-24
18	Develop system modules	88 days	Thu 21-12-23	Mon 22-04-24
19	Integrate system	93 days	Sun 24-12-23	Tue 30-04-24
20	Connect with database	91 days	Thu 28-12-23	Thu 02-05-24
21	**Object-Oriented Testing Phase**	**25 days**	**Fri 03-05-24**	**Thu 06-06-24**
22	Test the system	14 days	Fri 03-05-24	Wed 22-05-24
23	Fix errors and bugs	19 days	Mon 13-05-24	Thu 06-06-24