



BILKENT UNIVERSITY

DEPARTMENT OF COMPUTER ENGINEERING

Senior Design Project

Petrium

High-Level Design Report

24 December 2021

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1. Introduction

Petriam is a mobile application to serve the people with pets while they are unable to take care of their pets during their time outside their homes. The project aims to favor both sides of its target group which are hosts and clients. Using Petriam, clients who are pet owners could list the possible temporary homes for their pets while hosts who may or may not be pet owners can earn money by taking care of the pets of their clients.

Petriam will be focusing on the specific service of pet accommodations for the time being to accurately deliver a solution to the problem. In the application, a client could reserve a date for their pet, get in contact with the host, ask their questions and rate them at the end of their stay. On the other hand, hosts could accept or reject a reservation depending on the client and describe their services to the clients. In simpler words, Petriam will be a free marketplace for people who are looking for hosts and people who want to earn money by taking care of pets. Surely, the host registration process will have extra verification steps than the user registration process in order to create a trusting environment in the application. What makes Petriam an investment worthy application is that Petriam is only the middleman in this process. While correctly solving the issue, Petriam will not own any pets or pet homes to minimize expenditures. The main difference between Petriam and other pet care applications is that Petriam is the only mobile application that solely addresses this issue.

Moreover, by not relying on pet hotels, less waste is created by using Petriam since Petriam favors the principle of sharing rather than buying new equipment for pets. Pet hotels are expensive to maintain in terms of resources such as electricity, water and gas which are used in much higher amounts compared to a regular house [1]. Thanks to Petriam, leaving pets during travels will be cheaper, environmentally safer and economically sustainable.

1.1 Purpose of the System

The purpose of Petriam is to create a fast, secure and efficient environment for pet owners where they can safely find a place for their pets when they are unable to take care of them. The application aims to build a virtual marketplace for people who are willing to host pets in their homes as an extra income. The sole purpose of Petriam is to solve the problem of leaving pets alone or asking people around for looking after their pet that solution of the given problem can create new ways of income for people while leaving the pets of the people in safe hands.

1.2 Design Goals

1.2.1 Usability

- The user interface of the system should be user-friendly, understandable and simple
- Users should have no confusion about how the system works
- Users should be able to easily register and sign in to the system

1.2.2 Supportability

- The system should be able to work on both IOS and Android operating systems.
- The system should be able to support the use of any APIs such as Google Maps.

1.2.3 Efficiency

- The Delay between user requests and the system providing them should not exceed 5 seconds
- Log in process should not last more than 5 seconds.

1.2.4 Scalability

- The number of pet owners and pet users registered to the system should not affect the overall performance and quality of the system. The system should be to support large numbers of users.

- The system should be to handle multiple host arrangements and messaging processes at the same time without any issues or conflicts.

1.2.5 Reliability

- The system should not crash ever during its runtime if possible. The number of crashes must be kept at a minimum and the time interval between these crashes should be long enough
- The system should be to roll-back its operations in case of failure or crash of the system or servers.

1.1.6 Security

- The system should store the user information in a database system securely by taking necessary precautions such as encryption.
- Any third-party person or organization should not be able to view any user's private and sensitive information.

1.3 Definitions, acronyms, and abbreviations

- **Node.js:** an open-source, cross-platform, back-end JavaScript Runtime Environment [2]
- **JWT:** JSON Web Token is a safe standard for transmitting information between JSON parties [3]
- **MongoDB:** Mongo Database is a text-based database that is No-SQL [4]

1.4 Overview

Petriam creates a virtual environment for pet owners to help them find a host for their pets for a limited amount of time or help them to host other pet owners' pets to earn money or have fun with taking care of an animal. If a real-life pet owner wants to become a part of Petriam's virtual social environment to benefit from its advantages, first they need to register to Petriam by providing information related to them like name, surname, username, and address, etc.

After pet owners register to the Petriam system, they become a user and can start using Petriam to find a shelter for their pet or they can sign up to become pet hosts for other pet owners. When a user registers to the Petriam system, they are greeted by a map of their location with pins on it. These pins represent other pet owners that registered to the system as pet hosts and are ready to arrange a time interval with other pet owners to provide a shelter for their pets with including the agreed fee. By clicking these pins, users are able to preview the profile page of the pet host and these profile pages contain information like verification status, address, and determined daily fee of the host. This helps pet owners to find a suitable pet host with the necessary skills and reasonable prices for sheltering their pets.

If users do not want to search a host by using a map view, they can list available hosts that are closer to them. Users are able to filter the list of hosts according to name, location, or what kind of pet they can host to find a suitable host for their pet. Also, this list of hosts presents more information related to the host than a pin on a map. While a map with pins provides a piece of visual information related to the location and distance of a host to a user, a list of hosts provides more detailed written information related to the hosts that are available.

Other than finding a shelter for their pet, users can also sign up to become a host to provide a shelter for pet owners' pets. To become a host, users need to provide additional information to the system like daily fee amount, social security number, and criminal record. By requiring social security numbers and criminal records to become a host, Petriam aims to improve the accountability of the users that want to become a host. Verification of the host plays a crucial role in providing the safety of the pets that are being sheltered and such kind data will play important role in the verification process of the hosts. After being verified, any user can become a host registered in the system.

3. Proposed Software Architecture

3.1 Overview

The following sections discuss the internal workings of the system as in subsystem decomposition, hardware/software mapping, persistent data management, access control and security, global software control and boundary conditions. The aim of Petriam is to create a fast, safe and efficient environment for pet owners that the discussed elements are designed according to the mentioned purposed of the system.

3.2 Subsystem Decomposition

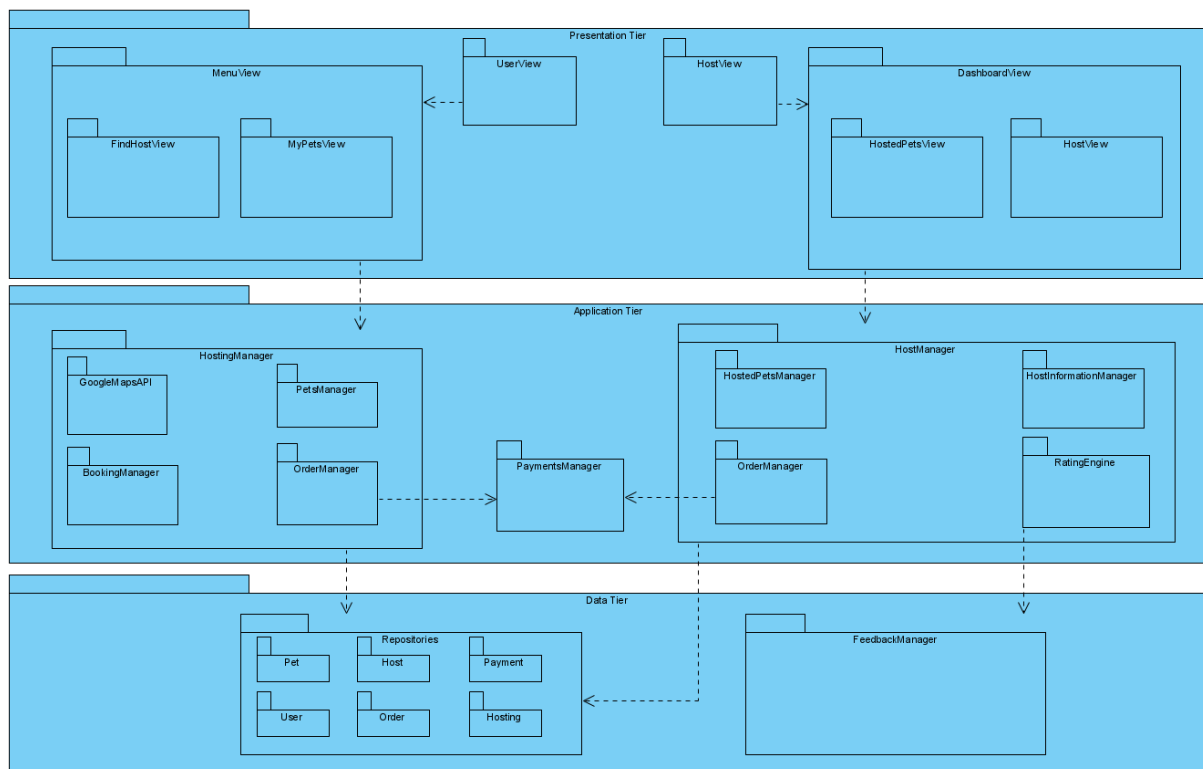


Figure 1: Subsystem Decomposition of Petriam

The architectural style of the system is 3-tier architectural style that consists of three different layers: Presentation, Application and Data. The choice of 3-tier architectural style was made due to the scalability created by three different layers. As each layer has its own infrastructure, the development teams can work on their own simultaneously without running into problems.

The presentation tier represents the user interface of the application where the users can either see the application as a “user” or as a “host”. Depending on their view, they can access to different functionalities of the system. The Application tier on the other hand is where the logical operations of the system are handled. For example, whenever a user wants to register their pet on the system, an add operation is made on PetManager that can be viewed on MyPetsView. The third and the last layer which is the Data Tier is responsible for the actions that concern the database of the system. The previously mentioned example registers a pet to the system but it must also be registered to the database. The Data Tier is responsible for such record keeping. In a way, the Application Tier is the bridge between the Data Tier and the Presentation Tier.

3.3 Hardware/Software Mapping

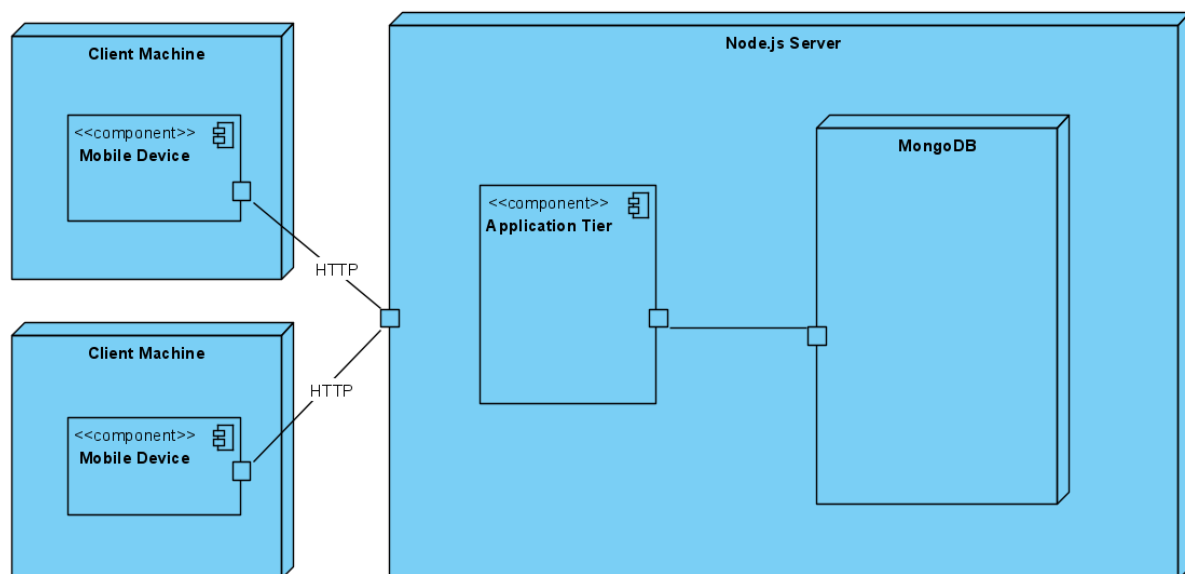


Figure 2: Component Diagram

Although Petriam is an application for mobile devices, the logic tier of the system will be run on a node.js server which is compatible with both mobile applications and web applications. Use of node.js allows the system the scalability to be expanded into the web one day. Each of the client machines connect to the node.js server through HTTP connection and the request of the clients are handled inside the server with the use of the MongoDB. After a

request is finished, the node.js server responds to the client machines through the same HTTP connection. In the meantime, any changes in the system are stored in the Mongo database.

3.4 Persistent Data Management

For users, Petriam will need to store information such as profile picture, name, email, contact number, address as well as pet information. For hosts, data such as home pictures, logistics, description of the services will be required to be stored on the database. The data collected by the application must be managed properly in order to give the users a positive experience of the platform. What is meant by properly managing data is that the reviews of the hosts must be carefully processed so that users are matched with hosts with higher ratings but also hosts who are trying to better their scores should be rewarded so that a host with an initial bad review is not outcasted by the application. The data will be stored on the Mongo Database and will be processed by the logic layer of the Node.js server.

3.5 Access Control and Security

The system allows two types of users: Users and hosts. However, a host can also benefit from the user side of the application. Currently, the system manages the authentication and authorization process through JWT which hashes the login information and passes it to the system. The JWT is later broken down by the internal authentication service using the secret hash values. For later improvements, the idea of setting up an external authentication server is in research phase. To better security, Google Authentication [5] will also be added to the system for users who are not willing to sign up for new accounts.

3.6 Global Software Control

Petriam's software control is managed by a centralized event-driven system where the requests are handled by the respective managers of the events. After the client successfully logs in to the system, if the client is a user, then he/she can update their information by adding new pets to the system. In this case, PetsManager will add the pets to the system by registering them to the system. Later this user can list the available hosts by using the

FindHostView. The FindHostView will request the list of the available hosts from the HostingManager and will place them on the map using GoogleMapsAPI. If the user wants to make a booking, then the OrderManager handles the request as well as the PaymentsManager if the transaction gets successful. These events are simultaneously registered to the database in the meantime.

3.7 Boundary Conditions

3.7.1 Initialization

To initialize the application, the users must have downloaded the application from the respective application store (Google Play / AppStore) and have a stable internet connection. After the initialization, the users must login or sign up to the application. When the authentication is complete, the users can benefit from the hosting services of the system but must have a continuous and stable internet connection during their use of the application since everything on the system runs in real time and must be synchronized with the database.

3.7.2 Termination

The users can terminate the process of Petriam by simply logging out of the system. Note that if the user logs out of the system, he/she must log in again the next time the application is initialized. However, if the application is terminated by simply terminating the application using the mobile phone interface, their accounts will not be logged out automatically.

3.7.3 Failure

The system will have failures whenever the user has an unstable internet connection. Any changes made during lost connection will not be saved to the system, hence all of the information will be lost. If the system detects that the user has no internet connection, the user will be warned and will not be permitted to perform any actions while internet connection is not available. The user will also be notified when there is an internal server problem regarding the database that will not be able to perform any actions during system failures.

4. Subsystem Services

4.1.1 UserView

The UserView class is responsible for displaying options for the user to choose from that links the user to the MenuView where he/she can get a detailed choice of services.

4.1.2 HostView

The HostView class is responsible for displaying the options of the hosts when they login. Through this view, the hosts can move onto the DashboardView where they can get specific details of their host account.

4.1.3 MenuView

The MenuView class is created to have a detailed display of the desired contents. The class contains FindHostView and MyPetsView that users can choose. If the user chooses the FindHostView, then the list of available hosts will be displayed in a menu format and the same case will happen to the pets of the user if the user chooses MyPetsView.

4.1.4 DashboardView

The DashboardView class is responsible for the hosting experience of the hosts. The class contains HostedPetsView and HostView subsystems. The hosts can edit/modify their current hosted pets in the HostedPetsView and check their host accounts on HostView. The HostView will have the orders, host information and comments displayed for the host.

4.2.1 HostingManager

The HostingManager class is responsible for the events of regular users. The class consists of GoogleMapsAPI, BookingManager, PetsManager and OrderManager. The GoogleMapsAPI is responsible for placing the possible hosts on the map. BookingManager is in charge of any booking action of the user. If the booking from the BookingManager turns into

an order, then the OrderManager handles the request using the information from the PetsManager.

4.2.2 HostManager

The HostingManager of the system consists of HostedPetsManager, OrderManager, HostInformationManager and RatingEngine. The subsystems HostedPetsManager, OrderManager and HostInformationManager is there to generally edit the current information about the host. However, the RatingEngine is used to adjust the rating of the host in accordance with his/her ratings.

4.2.2 PaymentsManager

This subsystem is used together with both HostManager and HostingManager to ensure that the transactions are completed safely. The transactions must be applied from both ends in order to prevent any conflicts about the bookings.

4.3.1 Repositories

The Repositories subsystem consists of models of data of the system. The class has Pet, Host, Payment, User, Order, Hosting subsystems to record the data of the events. The recorded data are accessed by the application tier of the system whenever they are requested.

4.3.2 FeedbackManager

The FeedbackManager subsystem is separated from the repositories to ensure that a different type of classification is applied on the ratings. Each rating of a host must be carefully examined to motivate both successful and unsuccessful hosts to perform better in their hosting experiences. The key part of the rating system is to prevent lower rated hosts from becoming invisible to the users while the high rated hosts dominate the environment.

5. Consideration of Various Factors in Engineering Design

Public Health

The human interaction in Petriam is limited to dropping off pets and getting them back from their hosts. The remaining functionalities of the application can be performed on the app which does not pose any dangers to public health. However, considering the very small window of human interaction in Petriam, there are possible threats to public health. The first and main concern is the situation created by the pandemic. A host or a user may cause the spread of the virus if they continue to use the application when they need to be quarantined. Petriam will solve this problem by requiring mandatory HES code [6] from all of its users whether they are hosts or regular users. The collected HES codes will be used to check the user's Covid-19 risk status that will decide if a user is eligible to be a part of the services given in Petriam. There exists one other risk involving pets and humans. The guest pet or the pets belonging to the hosts may contain diseases that could cause the spread of various diseases. In Petriam, the health of the users and the pets are prioritized to ensure a healthy environment for everyone. In order to prevent any diseases among the pets, we have come up with two solutions: Mandatory submission of vaccination cards of the pets or a signed document from a veterinary that confirms the pet's availability to travel.

Public Safety

Since most of the application's services are available online, the only possible public safety concern is the human interaction which is described above. Possible public safety scenarios might occur when a user with a criminal background or mental disorders becomes a host. Although indication of such a scenario is less likely, Petriam will be requiring criminal and health reports from its users to become hosts. Users with any sort of criminal records or violent mental disorders will not be accepted to become hosts to lower the chances of having unpleasant situations. The rating system in the app will provide a competitive environment for the hosts that will promote good service among the hosts. Any host with unpleasant behavior

can easily be rated or even reported if the behavior of the host was not acceptable. If the reports are found to be accurate and risk posing, the hosts will no longer be allowed to use the app to ensure public safety.

Public Welfare

Petriam will be a free to use application for everyone. The users will only be charged when they want to use the services of a host. Although Petriam does not decide on the host prices, since it is an open market, the prices are expected to be reasonable due to the competition between the hosts. Global Factors The application will be developed according to the global set of standards imposed to every application on Google Play Store and Apple App Store. The nature of the application requires personal information such as name, address, telephone number to be collected and we will be abiding to General Data Protection Regulations [7] which are standardized by the European Union to ensure data protection. Petriam will not share or use the data of its users under any circumstances.

Cultural Factors

The cultural factors have nearly no effect on Petriam as the main focus is on animals. Considering the fact that culture is a trait specific to people and not to animals, Petriam is open to use for people from every possible national and cultural background.

Social Factors

The social interactions in the application are limited by the interaction between the users and the hosts. In order to provide an equal social environment to all users, the application will come in English and Turkish language options. The social factors could be analyzed from the pets' point of view where certain pets might require social interaction to prevent any negative psychological effects on the pets. This requirement could be indicated by the pet owners while they are negotiating with the hosts.

Factor	Importance	Possible Negative Scenario
Public Health	High	Effect on health due to spread of diseases
Public Safety	High	Physical and psychological threat to users due to lacking background check
Public Welfare	Moderate	High host prices
Global	Moderate	Leak of personal data
Cultural	Low	Threat to highly specific cultural backgrounds
Social	Moderate	Indirect phycological threat to pets

Table 1: Summary of Various Factors and Their Status

6. Teamwork Details

6.1 Contributing and functioning effectively on the team

In order to ensure that everyone is contributing and functioning effectively on the team, we have made a detailed division of work and enabled communication in every possible channel to make sure the efficiency of the team was maximized. The mentioned “division of work” and “communication channels” will be talked in detail in the following sections.

6.2 Helping creating a collaborative and inclusive environment

Apart from the unofficial meetings conducted at school, we conduct official weekly meetings online to check each other’s work and plan ahead. To provide the communication between the team members, we benefit from a variety of online tools which are:

- Zoom & Discord for Visual and Verbal Meetings
- WhatsApp for unofficial Meetings and Scheduling for Planned Meetings
- Slack for Planning
- Google Docs for Collaborated Written Work
- GitHub for Collaborated Coding Work

The listed communication channels made sure that everyone was on top of the subject rather than being left out. By allowing everyone to check in and being a part of the project, we have made sure a collaborative and inclusive environment.

6.3 Taking lead role and sharing leadership on the team

In order to promote efficient team work, we have appointed sub-teams with their own leaders to ensure the quality of the work done in each of the sections. The appointment of the leaders was based on past experience and proficiency in each of the respected fields.

- Front-End Development: Osman Buğra Aydın (L), Doğancan Yılmazoğlu
- Back-End Development: Alperen Yalçın (L), Oğuzhan Angın, Ertuğrul Aktaş
- Database Integration: Ertuğrul Aktaş (L), Alperen Yalçın
- Documentation and Reports: Ertuğrul Aktaş (L) and everyone
- Architectural Design: Osman Buğra Aydın (L), Alperen Yalçın, Oğuzhan Angın
- Visual Design: Doğancan Yılmazoğlu

The above-mentioned teams have their own respected leaders that make sures everyone who is willing to lead in the team gets the opportunity to lead in their provided sections.

7. References

- [1] W. Coy, "How Much Does Dog Boarding Cost?," The Dog People, [Online]. Available: <https://www.rover.com/blog/how-much-does-dog-boarding-cost/>.
- [2] "About Node.js," OpenJS Foundation, [Online]. Available: <https://nodejs.org/en/about/>.
- [3] "What is JSON Web Token?," JWT, [Online]. Available: <https://jwt.io/introduction>.
- [4] "What Is MongoDB?," MongoDB, [Online]. Available: <https://www.mongodb.com/what-is-mongodb>.
- [5] "Google Authenticator," Wikipedia, [Online]. Available: https://en.wikipedia.org/wiki/Google_Authenticator.
- [6] Ministry of Health, "What is HES Code?," [Online]. Available: <https://hayatevesigar.saglik.gov.tr/hes-eng.html>.
- [7] "General Data Protection Regulation," intersoft consulting, [Online]. Available: <https://gdpr-info.eu/>.