Bilkent University

Department of Computer Engineering

Senior Design Project

HelPet

High Level Design Report

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1. Introduction

For the maintenance of a balanced ecosystem, we cannot consider a world without animals. However, as the cities becomes bigger and wider, some of the animal species such as dogs, cats, birds, etc. start to live in the cities with us 'humans'. Some of us prefer to live with the animals and own them as pets but some of us do not prefer that. For the pet owners, having pet requires too much responsibility and attention. In other respects, without any human support, a lot of animals try to live in the crowded and dangerous cities. To help both pet owners about their pets and the stray city animals, we will develop an android application HelPet.

According to American Veterinary Medical Association, only in U.S.A. there are almost 44 million of household dog owning, 36 million of household cat owning and 3 million of household bird owning [1]. For each household, veterinary visits per year is almost 3[1]. Thus, there is a huge need and market for pets and their care. By the help of HelPet, pet owners can easily manage their pets care. An android application HelPet can be reached by anybody who have the Internet access and smart phones to get help for their pets. By the help of the HelPet, pet owners can see the top rated veterinary services near their current location and rate the veterinary services regarding their performance. HelPet send notifications to the pet owners about their pets' veterinary service appointments, vaccine dates and feeding times. Also HelPet users can have a profile for their pets if they want to breed their pets with others which they want to pair according to their profile. In addition, according to statistics of American Society for the Prevention of Cruelty to Animals, the %15 of the pets gets lost [2]. Thus, as a solution for that issue, HelPet users also can find their lost pets by sending their photo and location where pet is lost and receive the photo and the location of the suspicious lost animal by the other users. Pet owners also can find a temporary caretaker for their pets if they have to leave their pets for a while and report the caretakers' performance by rating them. Lastly, HelPet users can ask question about animals, get answers about users and get tips about the animal care as notification.

On the other hand, there are numerous city animals which have not got any house or owner who support them to live a healthy and happy life. According to presentation of Prof. Dr. Tamer Dodurka, there is no information about the number of pet dogs and stray dogs in Turkey [3]. However, according to Dodurka, in the world %75 of the dog population consists of the stray dogs and only in Italy, %25 of the pet dogs is abandoned by their owners into the city streets [3]. To help the stray animals, animal lovers can report an animal which needs any

help by taking the photo of it, specify the location and send it to the HelPet. This reporting will be sent to the nearby animal care volunteers as a notification and make them to be aware of the animals that need help. Also users can report the dangerous animals to protect people and also the other animals.

In this report, we will give a detailed discussion of the architecture and high-level design of our system. In the first part of the report, we will discuss the purpose of the system and design goals. Then, existing architectures will be examined. Furthermore, our system's detailed architecture will be presented. Then decomposed subsystems and hardware/software mapping are illustrated with detailed information. Furthermore, this report will discuss data management, access control and security, global software control and boundary conditions.

1.1. Purpose of the System

With HelPet, we would like to deliver a product that helps people who has lost their pets or provide a social platform for animal lovers. HelPet send notifications to the pet owners about their pets' veterinary service appointments, vaccine dates and feeding times. Also HelPet users can have a profile for their pets if they want to breed their pets with others which they want to pair according to their profile.

1.2. Design Goals

1.2.1. Reliability

Application has to keep its reliability for every condition. Users will be informed with proper error messages if something doesn't go the way it was meant to be. That means, for example, if internet connection is lost, HelPet will notify the user there is a connection error and not let user use the application.

1.2.2. Maintainability

In order to increase the maintainability, HelPet will use Firebase DB to keep track of the information that belongs to users, posts, etc.

1.2.3. Security

Application uses some personal information which are required to make some processes. In order to that, application will ask required permissions for some

operations. For example, when the user wants to upload a stray dog picture from his gallery, the application will ask the user permission to use the person's photo gallery. Also, user's personal information will not be shared with third party tools. Furthermore, user passwords will be encrypted by some hashing functions.

1.2.4. User Friendliness

Application will have simple interface in order to make it easy to navigate in the application. By doing that, user makes interactions with the app easier, and total time required will decrease to understand the concept of the application.

1.2.5. Portability

Application will run on Android OS. We will try to make sure that application can run any Android based platform.

1.2.6. Supportability

The system should be adaptable to the future updates in data sources, APIs, and platforms. It is very important for the system to be flexible to the changes in these platforms

1.3. Definitions, Acronyms, and Abbreviation

API: Application Programming Interface

DB: Database

GUI: Graphical User Interface

SDK: Standard Development Kit, tools and libraries provided by Android Studio

1.4. Overview

HelPet is a mobile application that targets to animal lovers. It can be considered as a platform that provides help, consulting to owner of pets and animals that is wounded or lost. When people encounter an animal that is wounded or indigent, even they want to help them they may not help in some cases. Because they may be in a situation that they have to go somewhere else or do not have enough time or equipment. With the help of HelPet they have a

chance to notify people by sharing the picture and location of the animal. This feature does not require registration.

Pet owners have difficulties about finding proper partner for their animals to mate. But HelPet offers a feature to solve this problem. Pet owners add their pet and its features to their profile. Users could make their search by filtering the features of pet according to their wishes. Then users are able to contact with the owner of the pet they want to mate with their pet.

Pet owners may forget their pets' vaccine time. While adding a pet to their profile, they may add time periods of vaccine of their pets. HelPet can remind pet owner on the vaccine time.

Also people who cannot be able to look after their pet anymore need to find a safe place to give their pet. HelPet has a category which people can add their animals with their features and location for adoption. People who want to adopt a pet can search an animal from that category by filtering according to their personal demand. Hence adaptation is very sensitive issue for both who gives the pet and who adopt the pet, HelPet provides an opportunity user to see and communicate with candidate owner of their pets.

It is very difficult to take pets to everywhere. For example, people who need to travel for two weeks may not be able to take their pets with themselves. Therefore, they need to leave their pets to private pet hotels but they may not be affordable or suitable. Via HelPet users can find people easily to look after their pet. Because HelPet includes a category which consists of announcements from people who want to be a host to pets for a limited time. Also hosts declare which animal tend which time period they can host so that people who search for a host can find the proper caretaker and they can communicate with host. In addition, at the end of the time period of take care, pet owner can rate the host and comment to his/her profile.

Searching lost pets is really challenging issue even in our times. There is no easy way to find a pet but HelPet supports a category for lost animal announcements. People can post their lost animals with their picture and probable province. If someone sees the picture of any lost animal, they can communicate with the owner of announcement owner. Also they can check the category that shows indigent animals with their picture and location, and they can be absolutely sure from the picture.

In addition, HelPet includes a forum that users can ask questions, share information and consult each other about their pets.

Furthermore, the pictures are out of purpose will be reported by users and then admin can remove the picture or ban the user if it is essential.

2. Current Software Architecture

- **Petsbook** is a mobile application that helps pet owners in various ways [4].
    - Petsbook is multi-platform application. It is available in both IOS and Android.
    - It lets you create a profile for your pet.
    - In includes animal adoption system.
    - It lets user watch expert videos about their pets.
    - It also includes pet-guides, where useful information can be read by users.
- **PiP** is designed to help pet owners to find their lost animals [5].
    - The PiP is a mobile application for iPhone and Android.
    - Application uses facial recognition technology to re-unite lost pets with their families.
    - However, the score of the PiP in Google Play Store is 2,3.
    - According to comments in Google Play Store, some essential functions of application does not work properly.
- **11pets**
    - It has 2 major functionalities which are *Remember*, *Monitor*.
    - It has reminders on major aspects of the pet such as food tracking, medication, internal de-worming, bathing, nail clipping, ear cleaning, etc.
    - It also allows the pet owners to keep track of pet's height, weight, temperature, pet allergies, genetic tests, lab documents, etc. [6]

- **Pati Birliği:** Another application that's dedicated to the street animals. [7]
    - It is available for both iOS and Android users
    - It has 3 main functionalities which are adoption, help the animal and check the location of the animal. Users are directed to the social media profiles for the help and adopt options.
    - Users can visualize the animals that are currently helped at their own profile page

Every system has beneficial features. However, all applications have different specific aspects for pets. PetsBook is interested in social features for pet owners, 11pets cares about health of pet and PiP has one single focus on finding lost animals via image processing.

This project aims to be a comprehensive application composed of the features above and some additional features. Moreover, one essential part of the project is finding lost animals. Even there is an application (PiP) for this purpose, current application does not work properly and did not updated since 2015. Therefore, current application is not able to satisfy the need.

3. Proposed Software Architecture

In this section information on the high level design of our system, specifically the software architecture is given.

3.1. Overview

In this section HelPet's proposed architecture will be explained in detail. The first section includes the subsystem decomposition. Second section will be about hardware and software mapping. Then, persistent data management is explained using an ER diagram. And lastly, HelPet's access control and security, global software control and boundary conditions are explained.

3.2. Subsystem Decomposition

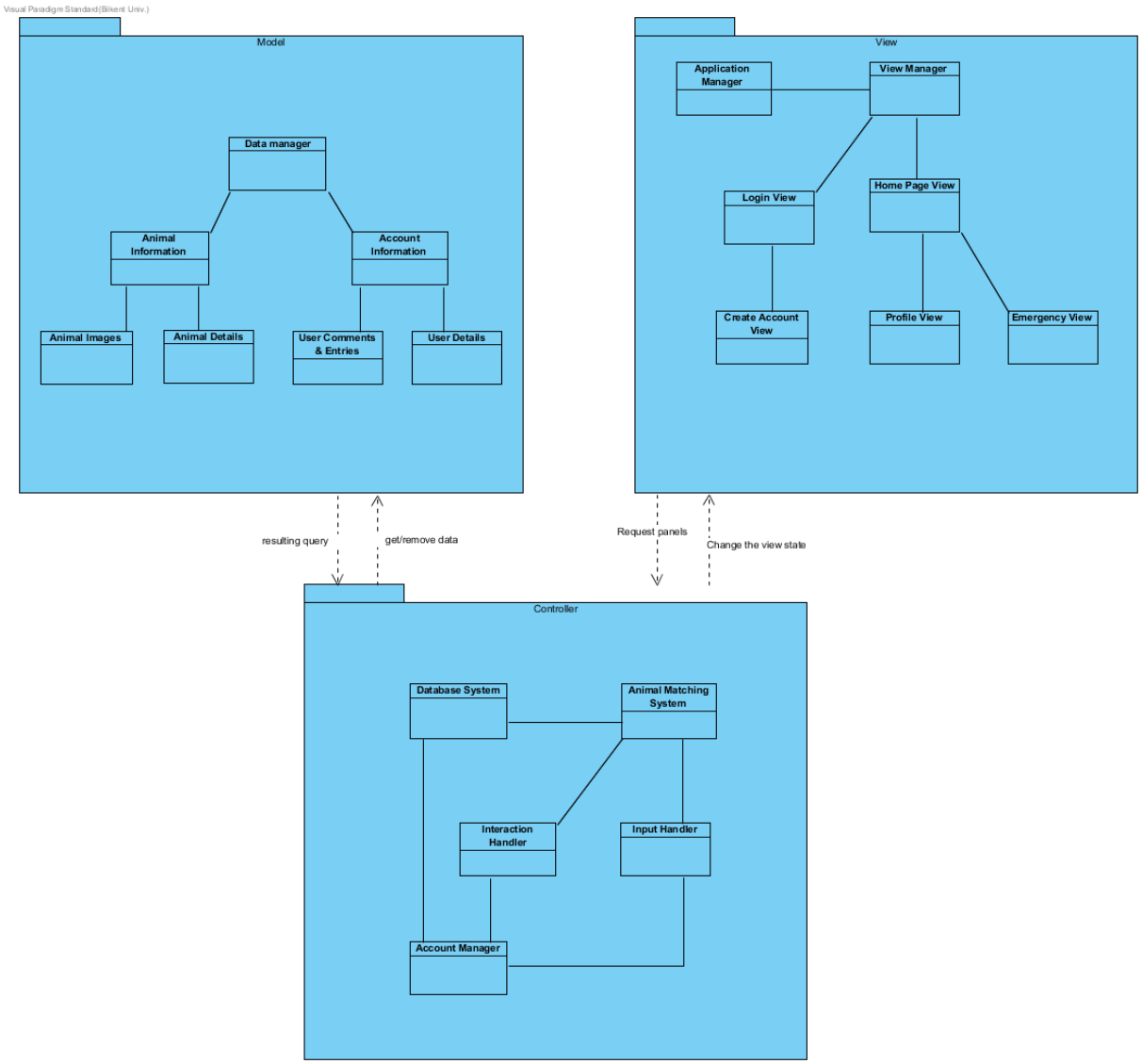


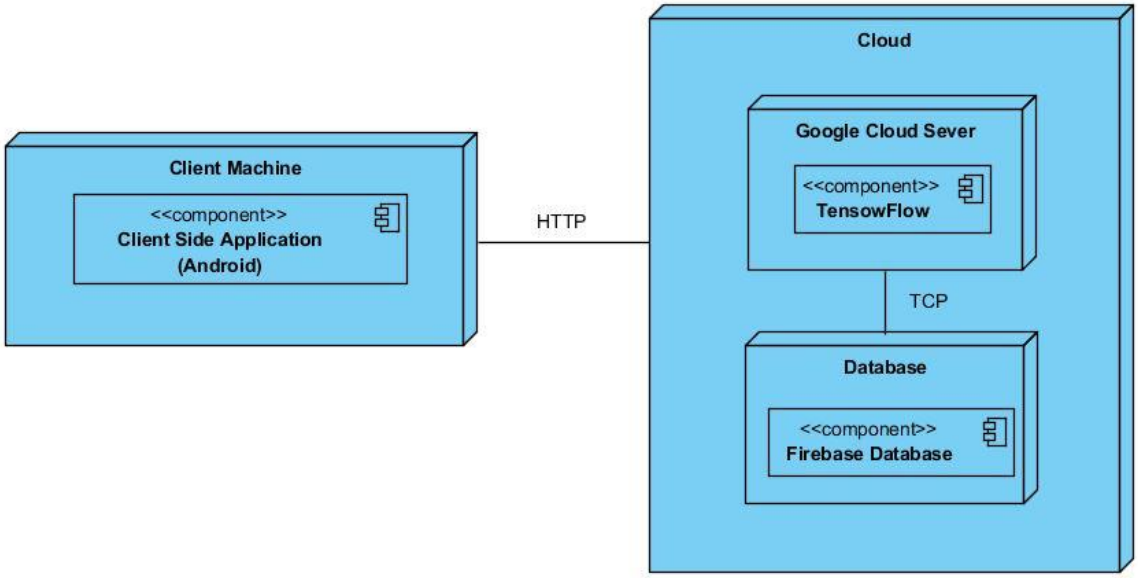
Figure 1:Subsystem Decomposition represented with MVC

For Helpet, the chosen architectural pattern is Model-View-Controller(MVC). This pattern separates and classifies the software to three main components that are UI elements to be visualized, data to be hold and requested, and control elements that will pull/push requests to the other components in order to ensure the data flow [1]. MVC pattern provides a sufficient and genuine features and it's in a harmony with the design decisions made by us, developers. The application's model-view-controller model is represented with the image denoted as *Figure 1*.

Model package serves as a beholder of the application's database entries. It allows queries run by the controller package to access the related animal or user data. Another package

View manages the user interface elements. It allows user to navigate through the application by providing the related page views for each panel requested by the user. The third package controller provides the system's main functionality with a collection of the subsystems. Controller acts as a bridge between model and view packages, getting the data from model, processing it, and demonstrating the results with the view package functionalities.

3.3. Hardware/Software Mapping



Client side of HelPet will run on an Android based platform. The application will use screen, camera, of the smart phone while it does not consume any extra from internal memory. Instead, all data is stored on Google Real-time Firebase Database platform. App requires the internet connection in order to make request to cloud server.

Client side communicates with Private Cloud via HTTP requests. Cloud component consist of two parts, which are Google Cloud Server and Firebase Real-time Database. These two parts will communicate with each other via TCP.

3.4. Persistent Data Management

The data of our application can be separated into two group. The data that includes information of user, pets, messages and comments will be stored in Firebase Real-time Database. The storage and synchronization of data is provided with NoSQL database and the

changes reflects on the applications. The other group of the data consists of the data sets that includes in order to increase the accuracy of comparison among the images of pets, we need to make a search in a big data set of images, more than 10,000. The data set will be stored in Simple Cloud Storage Service at a massive scale. It must be provided performance and reliability we need to use Amazon S3. Because it provides developers to access to the same highly scalable, reliable, fast, inexpensive data storage infrastructure that Amazon uses to run its own global network of web sites. [8]

3.5. Access Control and Security

Except the use of emergence mode of HelPet all users of the application should be register the system. Users should sign up with their name, surname, email and password. The authentication is provided by Google and Facebook. The contents and the authorization of changing information is provided only when the users log in the system. The image data set is not accessible to modify in order to maintain the accuracy rate of the comparison.

3.6. Global Software Control

HelPet is an event-driven software. The flow of the program is determined by the user of the actions and it responds the actions the generated by user. HelPet is a software that uses Model View Controller design pattern. The requests are received by the Controller for the application and the data is returned to display by the View. The model part of the system is responsible for maintaining the data, information of users and pets. The model part responds to requests and the instructions. The requests that come from the view part is responded. Also through the instructions that is coming from controller, data is updated. The controller responds the user input and perform the operations on the data. It controls the interactions between the View and Model parts. The View part is responsible for the presentation of information in a particular format. The UI elements are included in the View package. The change in user and pet information, maintaining the comments, locations, messages, images and information, removing, adding information is provided by the system. When the image of a pet is loaded by the user, in the controller part, through Animal Matching System the images are compared and checks if the image is matched.

3.7. Boundary Conditions

Initialization

First of all, user needs to download the application from the Google Play Store because our application is running in Android OS. HelPet will require internet connection to be used since it needs to get the required data and send any data in some cases such as uploading a picture, sending a post, etc. Also, user needs to either sign up with his/her credentials, Facebook, Google account or anonymously, meaning that s/he can starts using application without uploading any personal information to the system.

Termination

Program will continue running unless users decides to close it. However, even if application is closed, system will be able to send push notifications in some cases. Also, user can log out of the program by simply clicking Log-out button located at the navigation menu.

Failure

The application will be unable to use if there no internet connection. If the user changes his/her profile settings for example, this information will not have any affect in case of internet loss.

4. Subsystem Services

4.1. Model

This package hosts the system data which is requested by controller. Both animal and user data are stored with the help of this package.

Data Mana ger: Classifies the data as two main parts which are animal and account data for user. Responses to queries run by the controller package.

Animal Information: Holds the information of pets and lost animals enlisted to the system by the registered or unregistered users.

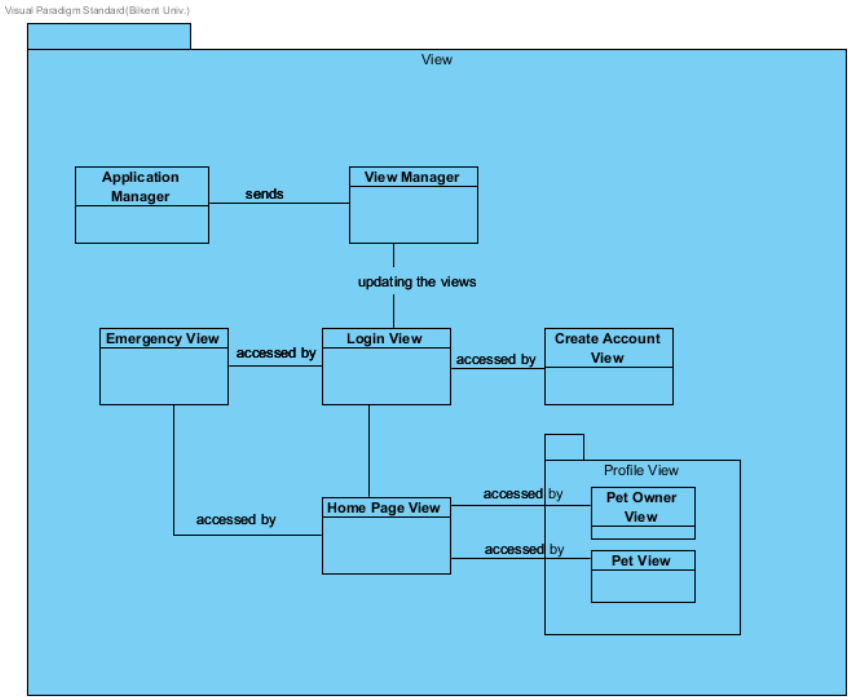
Animal Images: The image data kept for the animal matching algorithm which is dedicated to find the lost animals. Beside, animal images are used by the pet owners, allowing them to show them in their animals' profile page.

Account Information: Information which belongs to the registered users are stored in the database of the application.

Users Comments & Entries: Each entry or comment posted by the application users are stored in the database system.

User Details: Personal information of the users are stored in the system as well. This information is available in the profile view of any user.

4.2. View



UI elements are collected under the package called *View*.

Application Manager: Linking the controller package to the view package as the main functionality, in addition, controls the element called view manager that directs two distinctive views referred as *Login View* and *Home Page View.*

Login View: The first page that user comes across. Allows user to enter the system by evaluating the username and password inputs of the user. It's bound to the *Create Account View.*

Create Account View: Navigates an unregistered user, allowing the user to register in system.

Home Page View: Hosts the *Profile View* and *Emergency View*, which direct the user through event driven functions.

Profile View: Gives characteristic information about pet owner and his/her pets. Can be accessed by the other users.

Emergency View: Allows both registered and unregistered users to access Animal in need and I found a lost animal functions. The second function relies on the image and location inputs fed to the system by the user.

View Manager: Works in correlation with application manager. Grants access to the of views listed above.

4.3. Controller

Apart from other packages, there is also a controller package which is reserved for main software functionalities. In this package the components are described below:

Animal Matching System: Serves the main purpose of the program. Once the animal images are taken from database system, their matching with user taken images are evaluated with deep learning.

Database System: Manages the queries for getting/removing the data related to both animals and users in view package.

Interaction Handler: User interaction is validated by this handler. Event driven functions are interpreted.

Input Handler: Fetches the account related data and directs it to the matching algorithm.

Account Manager: Allows user to practice the functionalities described above, correlating with database and the handlers.

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