Woof: Social Media Application for Dogs and Their Owners

Nafis Abeer, Justin Lam, Chase Maivald, Rajiv Ramroop and Daniel Shimon

Abstract—Woof is an ideal cross-platform social media applicaion for dog owners. Rather than relying on individual owners to actively maintain dog friends, we propose a Mapbox interface to display locations of "friends" added by the user. To cater the application for dogs' preferences, we require owners to purchase a dog-tag fitted with a GPS tracker, an accelerometer, and a microphone. We are implementing a recommender system based on the owner's dog's interactions with other dogs wearing the tag. This recommender system will leverage features such as the dog-tag's proximity to other tags, the length of tag-to-tag interactions, behavior analysis from movement measured by accelerometer, and volume of the dog's barks. Woof is expected to deliver accurate suggestions for "friends" whenever the dog has a positive interaction with another dog. Users will be provided a profile page, instant messaging, "friends" page, interaction-history page along with a Dogmaps screen.

1 Need for this Project

THE Woof app aims to bridge the disconnect in communication between humans and their pet dogs. Dogs are unable to tell their human when they would like to go for walks, and it is up to the human to incentivize themselves to take their pets out. Additionally, dogs cannot tell their humans that they like hanging out with another dog. Unless the owner is attentive to every interaction their dog has, they miss most of the positive interactions their dog experiences. These positive interactions are benefitial for dogs, and repeated interactions with the same dog are great for reinforcing behavior learned during previous exchanges.

Studies have shown that dogs can greately benefit from long term friendships and playtime outdoors. In fact, "if deprived of the opportunity to play with other dogs, they have no other choice but to direct play behaviour towards humans" [1], meaning repeated dog-to-dog interaction could reduce responsibilities for owners. Dogs tend to show more brain activity when shown other dogs [2], indicating that they enjoy the presense of their companions. Furthermore, playtime for dogs could serve the following functions: 1) developing motor skills; 2) training for the unexpected; 3) social cohesion; and 4) play as a by-product of biological processes [3]. These benefits are enough to show why its important for owners to let their dogs make friends, or at least take them out for walks.

But what incentivizes owners to take their dogs out? What if humans were too lazy to play with their dog for a day, but their dog still needs the daily social interaction? We humans love coordinating activities, for the most parts, but what mediums do dog owners have for coordinating park visits? Upon discussion with our client, we came to realize that there are no specific large-scale applications geared towards the dog community. As she had put it "we like using instagram to show off our dogs, but we don't really collect Instagram tags of dog owners we meet in the park. We like knowing when our friends are out, but we don't really have strangers on our Snapmaps." That is a fair assessment seeing how it could be awkward to ask people you just met for Instagram and Snapchat handles. It would be much better if those people popped up on your "app" as a suggestion. Even better would be if the suggestion was mutual and both parties agree to add eachother as friends without verbally communicating the exchange. This takes away the social awkwardness for owners to add friends. Without verbally communicating a time to meet at the park, they could simply look at a map to see when its time for park-visits. We make verbal communication possible through instant messaging, in the case that users do want that direct communication medium. In fact, we are offering an application that serves as a medium to combine Snapmaps with Dog profiles.

2 Problem Statement and Deliverables

2.1 Problem Statement

We humans have plenty of Social Media applications to interact with and connect on, while dogs cannot say the same. Dogs are constantly interacting with other dogs while on their daily walks, and these interactions could either be positive, negative, or neutral. Our solution, Woof, is going to help foster dogs' relationships with each other, allowing them to connect more frequently. We are proposing a social media platform to allow owners to connect with other friendly dogs, as well as recognize other dogs which aren't too friendly with your own dog. The next time one's dog is playing around with another dog in the park for hours, there will be an easy way to connect and keep in touch with the other owner.

The idea is simple. Dogs that seem friendly with each other and play together during their encounters, will be recommended to become friends. Their owners will then be able to follow up with other owners to ensure that a future meet-up is possible. On the other hand, dogs that aren't super friendly with each other will be able to stay clear of one another, avoiding those negative interactions dog owners dread while on their walks.

First and foremost, we will create a base model based on a multitude of videos of dogs interacting with other doga using an AI computer vision product, such as YOLOv3. The model will narrow down the factors that decide whether these dogs are being friendly with one another, or if they are fighting by extracting features from videos. These features will initially include the

- *Nafis Abeer CE'22. E-mail: nafis@bu.edu*
- *Justin Lam CE'22. E-mail: jlam8080@bu.edu*
- *Chase Maival CE'22. E-mail: chase1@bu.edu*
- *Rajiv Ramroop CE'22. E-mail: raj19@bu.edu*
- *Daniel Shimon CE'22. E-mail: dshimon@bu.edu*

time of play, and relative proximity of dogs to eachother, as well as audio of the dogs barking. Furthermore, we collect data from a dog-tag worn by each dog. The dog-tag is fitted with an accelerometer, GPS tracker, and microphone, telling us the dog's motion, proximity to other tags and bark-volume, repectively. The tags will send back data to users' phones using built-in modems. We will further train the base model using these new features to cater each product to its respective dogs' behavior. Based on how friendly the two dogs are with one another, Woof will provide the respective dog owners the opportunity to connect with the other owner through accurately trained recommendations. This will foster relationships with these dogs' friends and allow owners to easily arrange common walk times. A potential addition would be to suggest future walks and play time with friends, as well as send warnings when previously met hostile agents are likely to be around an area.

2.2 Deliverables

A social media platform consisting of the following:

1. Dog-Map screen showing both your dog's location and their friends' locations
2. History screen containing your dog's previous interactions with others and whether they were positive, negative, or neutral
3. Friends screen with a suggestions section
4. Profile page including a bio introducing yourselves and plugins to Instagram for pictures of your dog
5. Messenger or other social media applications plugin page for instant messagin features

The functions of the dog-tag include:

1. Always locating your dog and displaying his/her location on the aforementioned Dog-Map screen. Location also used for tuning recommender system
2. Tracking your dog's motion with an accelerometer, also to tune recommender system
3. Recording dogs' barks through a microphone, to adjust recommender system audio recognition features for individual dogs
4. Reliably sending data back to server or hand-held devices for new information to be processed as features

Machine Learning trained recommender system includes:

1. A pre-trained base model utilizing ComputerVision on videos of dogs interacting with one another
2. Runtime model uadjusting SVM by leveraging added features such as directinonal values from accelerometer, volume in decibals of dogs' barks, location proximity to other tags and user input to analyze dogs' interactions in real-time

3 VISUALIZATION

3.1 Problem Statement

The User Interface for our mobile application will have a load-in screen featuring a custom-designed logo of our product. The UI will incorporate a profile page featuring photos of your dog with a bio-option to introduce yourself and your dog. The app will also include a friend page, where a list of your dog's friends as well as suggestions for new friends are available. Another screen will be dedicated for an interactive map, displaying your dog's location as well as locations of added friends. Users will have the option of enabling or disabling their location visibility to others. Additionally, the app will provide a history page with a log of your dog's previous interactions around other dogs and how positive or negative they were.

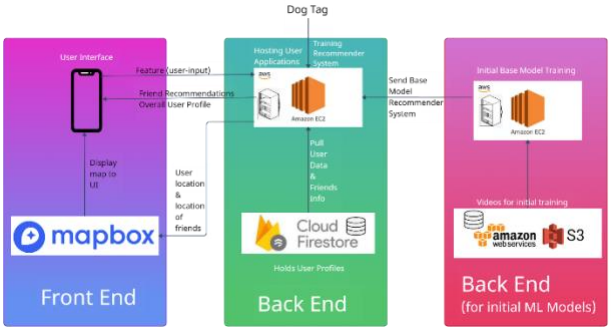

Fig 1. This image details the overall architecture of the application

3.2 Project Architecture

The main architecture of the mobile application will be cloud native. It consists of a React Native frontend that is extremely compatible with Mapbox, a Map API with an extensive library and tools for handling tags and pop-ups. Our backend will be utilizing Amazon's AWS E2C servers to host our application, and all the information that needs to be stored will be sent to Cloud Firestore Database, which is Free and easy to use. Before our product release, we will need to train a base model using Computer Vision. We will either utilize BU's Shared Computing cluster or another AWS server/database as a separate backend for training.

4 COMPETING TECHNOLOGIES

There are several other companies that have implemented similar dog-social-media applications that are effective in mapping dogs in a user-friendly environment. The most significant of these companies are Patch Pets, and Petzbe.

4.1 Patch Pet's

Patch Pets' application includes a discover page that allows users to find nearby dogs via their location. There is also a business directory that gives users the option to interact with local dog friendly businesses. Additionally, there are dog park maps, which allow users to find nearby dog parks and "check in" to a park. There is also a chat feature that allows users to interact with others on the app, given that they create a social profile. This social profile is customizable, which allows users to upload pictures of their dogs and create posts. However, there are limitations on how many photos can be added to one's profile. The final notable feature is dog park notice boards, which allows users to provide information and updates about a given dog park.

4.2 Petzbe

The Petzbe application is more of a social media implementation for all pets. It takes Patch Pets' social profile and allows users to see a feed of other users' posts. Its layout is similar to Instagram in its simplicity and style. There are more social events that occur on Petzbe, including various challenges

and contests that allow users to compete with others and interact. There are also virtual celebrations where users can throw an online chat party for their pet on the app, where other users can join in.

4.3 Woof in comparison:

Our product is similar to our competitors in that we are creating a platform for pets and pet owners to interact. In contrast with Petzbe, we will not be including all pets in our application, and similar to Patch Pets, we will focus on dogs. Like Patch Pets, our application will include dog maps for users to arrange park visits. We also plan on creating a social media type of interface that is like Petzbe's, in which our users can share and post any content and similarly access this content by swiping down. Our product, however, differs from all competitors in that we will include a physical hardware device -a dog tag- that interacts with other dog tags to form new connections. We will use machine learning concepts to create a robust recommendation system that gives users an option to add friends that their dog interacts well with. The tag's functionality further sets us apart in that we will implement a tracker, which allows users to always know where their dog is with just a click of a button on the application- while being non-invasive and comfortable for any dog.

5 Engineering Requirements

This section gives an overview of each feature of the product, use case of each component and why it needs to meet said specifications.

5.1 Hardware:

1. Reliable high-gain GNSS GPS antenna accurate to within two meters of actual subject
2. Watchdog timer to recover system data if needed because of loss of cellular signal, device battery dying, or if the device is otherwise stuck
3. Battery indicator so users will know to charge the device before it dies
4. Accelerometer to monitor 3-axis acceleration, deceleration, or rotation of the dog (roll, pitch and yaw)
5. Microphone to measure volume of dog barks
6. Network modem to track the GPS in real time
7. Ports to add sensors to detect any necessary features in the future, e.g: hreat rate, acceleration, etc.

5.2 Front End:

1. 24/7 App reliability for mobile React Native application
2. Mapbox API free to use for up to 25 thousand users, separate SDK for IOS/Android, full application may only have IOS compatability

5.3 Back End:

1. Firebase Firestore to store user profile data, it supports about ten thousand users on the Spark plan with up to 20K writes, 50K reads to the database per day, its scalable to the Blaze plan for unlimited but pay as you go usage if there are enough users to generate revenue
2. Amazon Elastic Compute Cloud (EC2) allows creation of a virtual machine for machine learning training and usage of the recommender system in the cloud. It is ~$0.10 per hour for up to 8 GB of memory for m4.large.
3. Amazon S3 database may be easier to integrate with EC2 than Firestore. We will use it separately for storage of videos for base model training. For the first 50 TB of storage, it is $.023 per GB.
4. Once a user begins interacting with the application, consuming map data and accessing their user profile is ~2.6 MB per minute. Spending an hour on social media per day increases data usage to up to 2.7 GB per month.

5.4 Recommender System:

1. Base Model trains on video of dogs playing or fighting; it learns to time how long the dogs are interacting with each other.
2. Run time learning model is a binary classifier added onto the base model, deciding when the dogs are playing or fighting, so they can potentially be suggested as a friend.
3. If the classifier is between deciding whether the dogs were fighting or playing, the user is prompted to rate whether it was a positive or negative interaction.
4. User prompts and accelerometer values are the user validation set which the models will train on. [4]
5. Audio and location of the dog are supplementary features for the training set

ACKNOWLEDGMENT

The authors wish to thank Professor Osama Alshaykh for his support in formulating a plan for the recommender system, as well for his support throughout all other parts of the project.

REFERENCES

[1] Rooney, Nicola J, John W.S Bradshaw, and Ian H Robinson. "A Comparison of Dog–Dog and Dog–Human Play Behaviour." Applied Animal Behaviour Science. Elsevier, January 17, 2000. https://www.sciencedirect.com/science/article/pii/S0168159199000787.

[2] Carroll, Linda. "Your Dog May Love You, but Doesn't Love the Sight of Your Face, Study Finds." NBCNews.com. NBCUniversal News Group, October 5, 2020. https://www.nbcnews.com/health/health-news/your-dog-may-love-you-doesn-t-love-sight-your-n1242079.

[3] Sommerville, Rebecca, Emily A. O'Connor, and Lucy Asher. "Why Do Dogs Play? Function and Welfare Implications of Play in the Domestic Dog." Applied Animal Behaviour Science. Elsevier, September 20, 2017. https://www.sciencedirect.com/science/article/pii/S0168159117302575.

[4] Chambers, Robert D., Nathanael C. Yoder, Aletha B. Carson, Christian Junge, David E. Allen, Laura M. Prescott, Sophie Bradley, Garrett Wymore, Kevin Lloyd, andScott Lyle. "Deep Learning Classification of Canine Behavior Using a Single Collar-Mounted Accelerometer: Real-World Validation." bioRxiv. Cold Spring Harbor Laboratory, January 1, 2020. https://www.biorxiv.org/ content/10.1101/2020.12.14.422660v1.full