A SOCIAL-BASED GAMING SYSTEM TO MOTIVATE THE DOG WALKING AND COMMUNITY USING INTERNET-OF-THINGS (IOT) AND AI

Ruize Yu[1] and Yu Sun[2]

[1]Santa Margarita Catholic High School, Rancho Santa Margarita, USA
[2]California State Polytechnic University, Pomona, CA, 91768

ABSTRACT

In recent years, society has shown an increase in pet ownership, however, only a few companies exist to help pet owners keep track of their pet's health. This paper designs a tool to help track pet owners measure the amount of steps their dogs have taken to measure their pet's health. We applied our application to our dogs and conducted a qualitative evaluation of the approach. The results show that the tool indeed works and will track the pet's steps taken, location, and provides a fun and engaging way to interact with the app.

KEYWORDS

IoT, Gaming System, Machine Learning.

1. INTRODUCTION

The device is made solely for the purpose of tracking the steps and locations of a dog. The owner attachesthe device to the dog when they are out on a walk, the device tracks the steps and location of the dog then draws a path and counts how many steps they have taken. The owner can then open up the pawdometer app to see how many steps the dog has taken.

Some similar techniques and systems have been proposed to track the human's steps taken then convert them into their dog's steps, which allows the user to have a less range of error.[10] However, these proposals assume that dogs' steps are always proportional to the user's step, which is rarely the case in practice. Their implementations are also limited in scale. Other techniques, such as tracking the dog's GPS location and drawing a path to convert it into dog steps, have shown to be ineffective.[11] This is because the method used is inaccurate and often results in calculation errors. A second practical problem is that some users find it hard to understand the interaction between the GPS location and the steps taken.

In this paper, our goal is to test out different methods and tools that exist and compare it with each other to see the features and strengths of each. There are some good features of Pawdometer. First, the device shows the gps location of its pet. Second, it uses the motion of the dog to track the amount of steps taken. Third, the app uses a fun way of interaction between the user and the device. Therefore, we believe that our device will be on par with some of the better devices on the market.

David C. Wyld et al. (Eds): SOFEA, CTCM, BIBC, SIPR, NCWC, CSEN, EDTECH - 2021
pp. 117-123, 2021. CS & IT - CSCP 2021 DOI: 10.5121/csit.2021.111610

In two application scenarios, we demonstrate how the use of both the device and app collects data from the user and the dog.[12] First, we show the usefulness of our approach by a comprehensive case study of the device being used on different dog breeds. Second, we analyze the data and compile a result of what the device excels at and what it does not.[13]

The rest of the paper is organized as follows: Section 2 gives the details on the challenges that we met during the experiment and designing the sample; Section 3 focuses on the details of our solutions corresponding to the challenges that we mentioned in Section 2; Section 4 presents the relevant details about the experiment we did, following by presenting the related work in Section 5. Finally, Section 6 gives the conclusion remarks, as well as pointing out the future work of this project.

2. CHALLENGES

In order to build the tracking system, a few challenges have been identified as follows.

2.1. Organizing Ideas

When creating a new device, there are many factors to consider, some of which are device features, app features, and ways to implement the system. This process usually takes a couple of weeks and is sometimes hard to finalize, since there are no limitations or requirements to make when developing an app and device from scratch.

2.2. Creating the Device

Development of the device will often run into problems, one of many problems is the placement of the GPS and batteries to make sure the device is as compact as possible. The device also needs to be coded from scratch to ensure that everything will work.

2.3. Creating the App

The Pawdometer app needs to interact with a online database, meaning that the database needs to be created somehow. Additionally, the app needs a way to activate the device to track its steps. It will also need features such as a way to display the amount of steps taken, and a leaderboard to show who has the most steps taken.

3. SOLUTION

In order to fulfill all the challenges met above and provide an interactive way to use the app, the Pawdometer has 3 major parts, the tracking app, the game, and the tracking device. The three apps interact with each other to form a working system that allows the user to track their dog. The process of how this system works comprises 3 major steps. The tracking device first records the steps taken and flashes (sends out a signal containing the steps) every couple minutes. The tracking app then receives the signal, then stores it in the database. The app then displays the steps shown in the database to the app itself, allowing the user to see how many steps the dog has taken. The tracking device has three major components: the battery, the motherboard, and the gyroscope. The gyroscope's sensitivity is modified where it can track dogs' steps, in addition. The battery powers the motherboard, which powers the gyroscope. The motherboard has an additional function, which is to send out signals to the device.

The first component is the pedometer device. For this project, I used particle.io's hardware, which

is very similar to a raspberry pi 4. The hardware consists of a motherboard, a pedometer, GPS tracker, and a lithium battery pack. The device has a small antenna that sends out data to the particle.io server, which is retrieved by the pawdometer app.

The second component is the pawdometer app, which receives the data sent by the device and displays it on the app screen. The app has many features, including the man screen, sign up page, log in page, leaderboard, gps location of the device (if the device is online), and a graph that shows the progress of how far a dog has walked.

The last component is the pawdometer game. This game is a simple match-3 mobile game on a different app, it uses the data stored in a google firebase to verify if the user exists or not, the app features a leaderboard, login page, and the main game itself. Currently, we are attempting to connect the game to the main app, which allows the conversion of steps into points, and these points can be multiplied by playing the game.

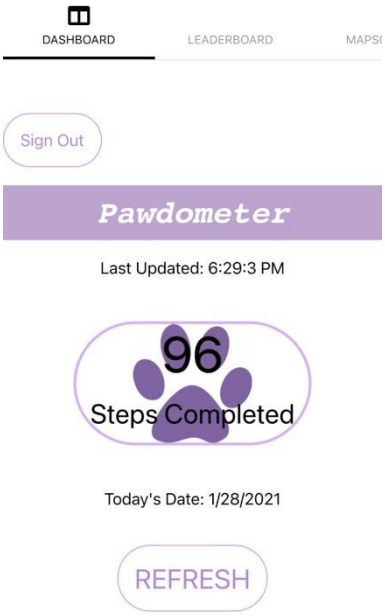

Figure 1

Figure 2

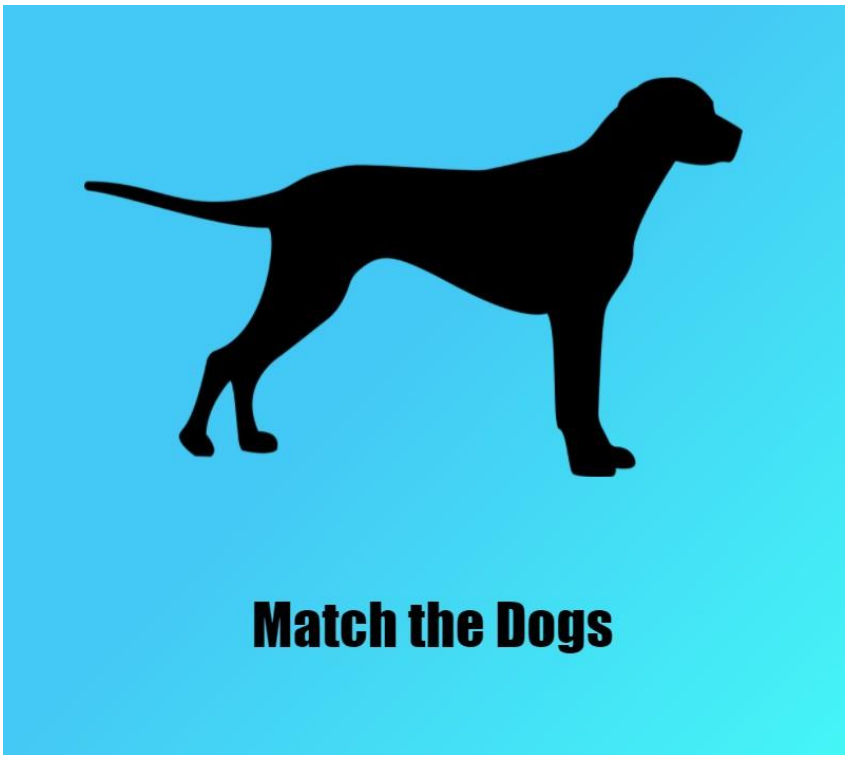

Figure 3

4. EXPERIMENT

Experiment 1

For the first experiment, I attached my device to different dog breeds. For each dog breed, I will count theamount of steps taken while the device also tracks. The device should show little to no error from the manually counted steps.

Table 1

Dog Breed	Steps Tracked	Steps Taken
Golden Retriever	15	15
Poodle	50	50
Golden Retriever	106	100
Poodle	97	100
Dachshund	30	30
Dachshund	100	100

The same breeds were tested for different amounts of steps. As the table shows, the device works fine with smaller breeds, however, the device will show a bit of error for larger breeds.

Experiment 2

In this experiment, I used the tracking device on the same dog on different days to check the consistency of the device. The tracked steps should not differ much from the actual steps taken.

Table 2

Day	Steps tracked	Stepstaken
1	15	15
2	18	15
3	15	15
4	14	15
5	13	15
6	15	15

The table has shown that the tracking device is sometimes accurate, other times it will show inaccuracies that are not too large.

The experiment result has shown that the tracking device works better on small dogs over long distances, it also shows that the device will track differently each time depending on the day. I believe this is because the device is put in different positions each day. However, despite it showing a little bit of error, the device works up to my expectation.

5. RELATED WORK

Related Work 1

In a study conducted by Bassett DR Jr and his team, a total of 96 men and women wore pedometers for 7 days, and at the end of the week, data was collected from both the estimation made by the participants and the actual data from the pedometer. This research is similar to the experiment part of this paper, as different subjects from both papers wore a pedometer device and were tracked on different days.

Related Work 2

In the second research conducted by Tudor-Locke C and his team, an experiment was conducted on two different types of sensors. In the research, data were analyzed from 52 participants, who wore both motion sensors for 7 consecutive days. Locke's experiment is similar to this paper's experiment in that both were tested on different days on different subjects. However, Locke's experiment is more sophisticated as different motion sensors are used.

Related Work 3

In the third research conducted by Patrick L. Schneider, multiple brands of pedometers were used to track10 males and 10 females over a 24 hour period. The experiment shows that out of the 13

pedometers used in the experiment, five show mean values that were not significantly different from the actual value. While the difference between this paper's experiment and Schneider's research is minimal, there are some comparisons worth noting. One of them is that Schneider's experiment is conducted on humans and for human use, while this paper's research is conducted on different dog breeds. Schneider's experiment differs from this experiment, in his experiment, the pedometers are from different successful brands.

6. CONCLUSIONS

In this research, I developed a device and an app to track the amount of steps a dog has taken. I applied the device to dogs of different kinds in an experiment to track if it is accurate in tracking the steps of dogs.[14] The experiment indicates that the device is somewhat effective in tracking the steps, and solves the problem of not knowing how much the dog has walked and whether if it is healthy or not.

The current limitations of this device is in its limited battery lifetime, the rather big size of the device when compared to a small dog, and its limited accuracy as shown in experiment one. The device is optimized for small dogs but is still a bit large.

In the future, I plan to change the code in order to track the steps of larger dogs more accurately, in addition, I plan to change the hardware in order for it to be smaller while retaining the same function and possibly more battery life.[15]

REFERENCES

[1] Jordan, Michael I., and Tom M. Mitchell. "Machine learning: Trends, perspectives, and prospects." Science 349.6245 (2015): 255-260.

[2] Mohri, Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar. Foundations of machine learning. MIT press, 2018.

[3] Harrington, Peter. Machine learning in action. Simon and Schuster, 2012.

[4] Liu, Kun, and Long-jiang Dong. "Research on cloud data storage technology and its architecture implementation." Procedia Engineering 29 (2012): 133-137.

[5] Schneider, Patrick L., SCOTT E. Crouter, and DAVID R. Bassett. "Pedometer measures of free-livingphysical activity: comparison of 13 models." Medicine and science in sports and exercise 36.2 (2004): 331-335.

[6] Gao, Jim. "Machine learning applications for data center optimization." (2014).

[7] Michael, Katina, Andrew McNamee, and Michael G. Michael. "The emerging ethics of humancentric GPS tracking and monitoring." 2006 International Conference on Mobile Business. IEEE, 2006.

[8] Tudor-Locke, Catrine, et al. "Comparison of pedometer and accelerometer measures of free-living physical activity." Medicine and science in sports and exercise 34.12 (2002): 2045-2051.

[9] Bassett Jr, David R., Andra L. Cureton, and Barbara E. Ainsworth. "Measurement of daily walking distance-questionnaire versus pedometer." Medicine and science in sports and exercise 32.5 (2000): 1018-1023.

[10] Bahl, Victor, and Venkat Padmanabhan. "Enhancements to the RADAR user location and tracking system." (2000).

[11] Wells, David, et al. "Guide to GPS positioning." Canadian GPS Assoc. 1987.

[12] Reips, Ulf-Dietrich. "Using the Internet to collect data." (2012).

[13] Fitz-Gibbon, Carol T., et al. How to analyze data. No. 8. Sage, 1987.

[14] La Scala, Barbara F., and Robin J. Evans. "Minimum necessary data rates for accurate track fusion." Proceedings of the 44th IEEE Conference on Decision and Control. IEEE, 2005.

[15] Zhang, Pei, et al. "Hardware design experiences in ZebraNet." Proceedings of the 2nd international conference on Embedded networked sensor systems. 2004.