Quantifying Behaviors of Canines Based On Distance

1 Introduction

In recent years, dog has become one major part of people's life. According to statistics, Canine companions play an integral part in the lives 40% of American households. Pet dogs' behavior impacts a quality of human animal bond. However, because owner's lifestyle and home environments vary widely, little is known on how canine behavior is affected by changes in owner proximity. The goal of the research is to develop technology to continuously monitor human animal interactions and behaviors in natural environments that meet usability requirements for both canine and human users. There are two specific aims for this semester, the first one is to design sensor for tracking distance between human and dog. The second one is to design and prototype wearable for canine users and resistant to damage for typical dog behaviors.

2 Methods

Engineering Equipment:

The positional sensor Pozyx contains 4 tags 4 anchors 4 micro USB power adapters. There are 2 main parts using in this research. In Figure 1 is Arduino Uno compatible, STM32F4 microcontroller, with I2C for serial communication. In Figure 2 is 12g Tag with size 6cm x 5.3cm,10000mAh Power Bank with output 5V / 1A and 5V / 2A.

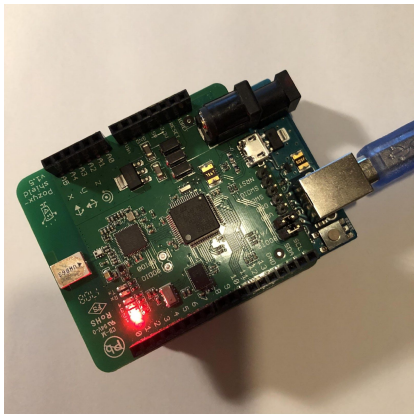

Figure 1: Arduino

Figure 2: Tag

Positional sensor Pozyx:

1. Custom Arduino code was developed to control and record data during the semester.
2. In the meanwhile, custom visual basic code interface device was implemented with Arduino to analyze exported data.
3. Validation tests were conducted to test sensor accuracy by systematically varying distance. The tests were mainly conducted in various home environments.
4. Two tags were put on two different moving objects and ran for short term, 10 minutes, also for long term,more than 12 hours. Then, collecting the valid data through Arduino and exporting them to excel for analyzing.

Wearable:

1. Interviewed the Subject Matter Experts were conducted to identify wearable requirements and potential dog behaviors that will impact device use.

2. Methods were applied included low-fidelity prototyping with 3D paper models, 3D modeling and autoCAD for 3D wearable.

3 Results

As Figure 3, sample distance was collected in around 8 min in house environment. As distance between 2 moving objects increase over 3500mm, increase measurement variability is observed.The sensor is also tested in 12 hours which can give valid output in the range around 6-10 meters in length, width, height distance.

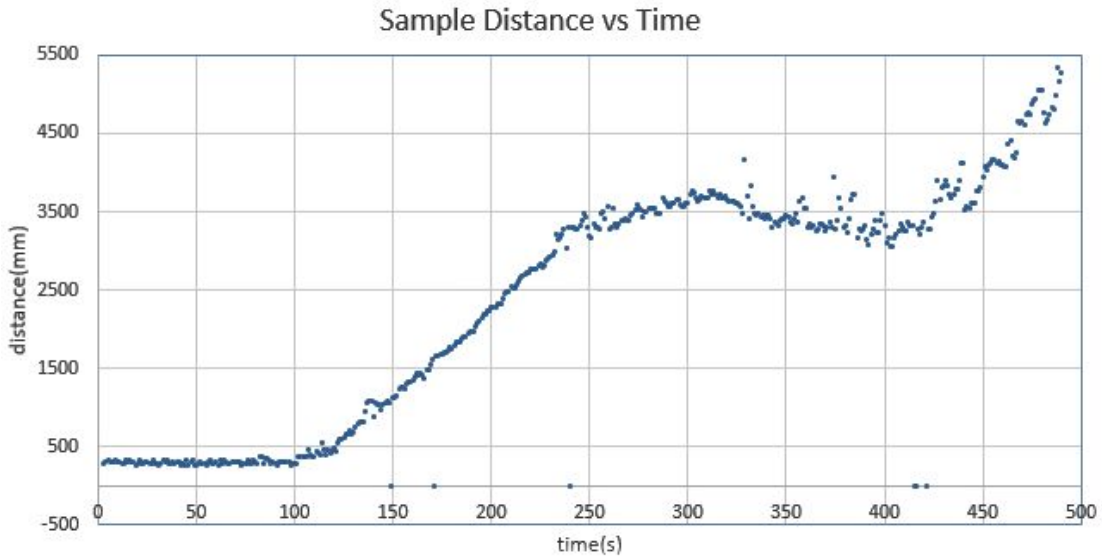

Figure 3: Sample test

As Figure 4 shows the 4 requirements (size, weight, material and stability) for the wearable:

Considerations	Requirements	Result
Size	Contains sensor tag and power bank	Suitable size for mid- to large-size dogs was specified as I-phone 7 size
Weight	Restricted by the size of the dog	100 g (light)
Material	Ensure sensor/battery does not overheat nor transfer heat to dog wearer	Plastic
Stability	Need to be stable on dog	Wearable will be compatible with current dog harnesses

Figure 4: Wearable Design Requirements

The outlook of the wearable are in Figure 5-6 , and dimensions of the box are in Figure 7-8. Besides filling the requirements above, the ventilation holes were made and the angles of the box also be rounded in order to protect the dog.

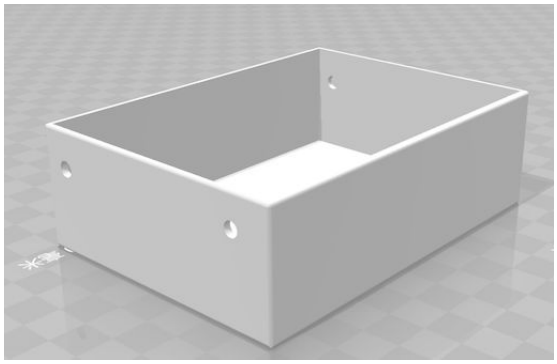

Figure 5: The bottom of the weable

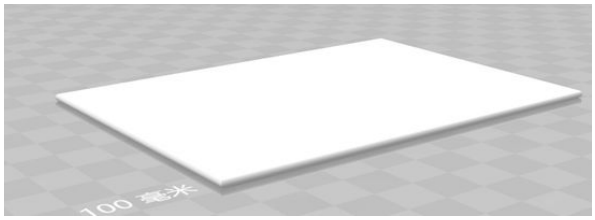

Figure 6: The top of the wearable

Figure 7: Dimensions of Box (mm)

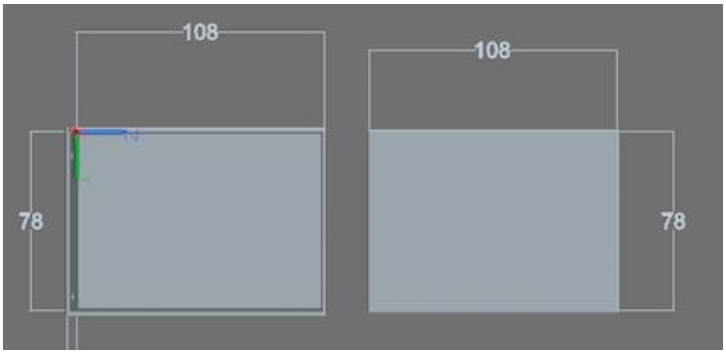

Figure 8: Dimensions of Box (mm)

The inside of box is in Figure 9. There is tag and a power bank inside for charging. Based on the users' need, different size (weight) of the power bank will be chosen. The draft wearable on dog is in Figure 10-12. The wearable is put on the dog's back with the harness and the tape to make it stable.

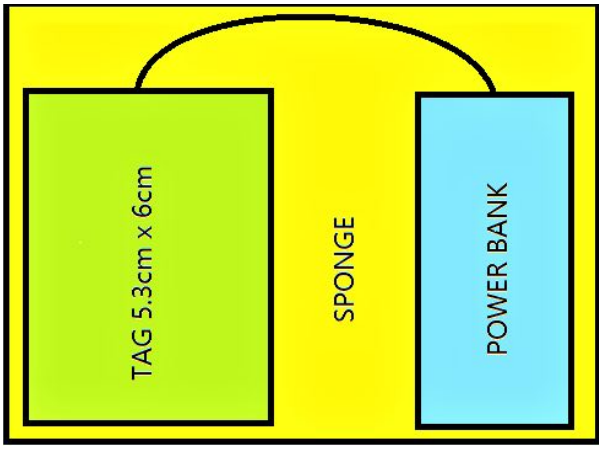

Figure 9: Inside of box


Figure 10: Wearable on dog

Figure 11: Inside of box

Figure 12: Wearable on dog

4 Discussion

The sensor is ready to collect data. It can be used in 6-10 meters length, width, height environment. It can be run for 12 hours and give valid output for analyzing.

2 options can be used during the data collection process. Based on different objects, different wearable could be utilized:

1. For small dog and people stay at home around 6h (lighter power bank, around 100g). People might need to charge during the process. This decrease the weight on dog.
2. For big dog and people stay at home longer (8-12 h), use heavier power bank, around 156g.

Based on the tests on dog during the data collection process, the design of the wearable need to be slightly changed. The material of the box need to be soft and bendable. The wearable can be put in harness with pocket, so that it is stable and easy to track. In order to monitor the human-dog behavior, video recording might be added somewhere on harness.

In the future, data collection can be started to investigate human-dog interactions on pilot object. In total, 30-50 pairs of data will be collected in the end for analyzation.