P3 Assignment

Team Name - AniSight
Team Members - Rina Yoo, Sridevi Kashinath Alawandi, Yeonsoo Chang

Prototype Detailed Description

Our prototype design will mainly be using the Raspberry Pi, ultrasonic sensors, and vibration motors in order to assist navigation for blind dogs. For the temporary prototype, one ultrasonic sensor will be tied to the front of the dog's collar using thread. We will put the raspberry pi, portable charger, and other necessary components in one cloth sleeve and attach this sleeve on the back of the dog's vest using velcro or simply hand-sewing it on. The wires attached to the front ultrasonic sensor will wrap alongside one side of the collar until it reaches the raspberry pi sleeve. The 2 vibrating motors will come out of the sleeve and branch out under the dog's vest. It will be attached securely by also hand-sewing it or taping it. We will also have an LED light, attached from the raspberry pi, on top of the vest or cartridge. The light should light up when the vibrating motor is triggered and is meant to help owners see when a vibrating motor goes off. This will also allow us to make sure the motors and the device itself is working correctly while it is on the dog's body.

Required hardware: Raspberry Pi 3B+, HC-SR04 Ultrasonic Module, Dog collar / Vest / Harness, Breadboard, 1.2K and 2.2K ohm resistor, Micro SD Card, Connecting Wires, Vibration Motor, Portable battery

Experimental design: Method And Protocol To Test It

Our objective is to ensure our device can aid in the navigation of blind dogs.

Interview:
We would like to conduct our experiment in a participatory manner. We'll start by conducting a brief interview with the dog owners/handlers. The purpose of this interview is to learn about the methods they use to train their dogs. This is crucial to our experiment to understand how the dog should be trained to understand and take instructions from the device. We need to identify the sensitive body part of the dog because we use vibrating motors to send feedback on when to halt motion. The ideal location for vibrating motors will depend on the individual dog and will require research into the anatomy of that dog as well as input from the owner. If the participating dog is not blind, the owner's consent is required before the dog can be blindfolded. We would also need feedback from owners after each round of research to ensure that we are correctly interpreting the dog.

Manual testing of hardware:
Before the dog is strapped in the dog vest equipped with the cloth pouch of hardware and sensors. A manual testing to ensure all components are working is crucial to the experiment. The device setup will be tested by simulating a situation where there is an obstacle in the way to ensure that the sensors and motors are working as expected.

Performance review:
In a controlled environment of the lab, we will then allow the blind dog to wander around. We want to see if the dog recognizes what the device is doing (vibrating in response to external stimuli nearby) and what to do in response to the vibration (avoid nearby obstacles). We will have to change the frequency of the vibrating motors and the placement of the sensors based on the feedback provided by the dog. The performance of the dog will be recorded both in and out of the presence of the dog handler. We also intend to test the dog on three different paths to ensure that the dog is not responding based on any other distraction or memory of the previous path.

Metrics And Data To Be Collected

- From the interviews, we aim to gather data of average time required to train the dog, the length of each training session require to get the dog to understand the device's function.
- From the manual testing of hardware, we gather data on the battery life and consumption for each trail round.
- From the performance review, the dog's reaction to the device is gathered over time. We would observe the dog's confidence, speed of haulting after receiving the instructions.
- How many obstacles bumped into before realizing what the device's vibration signal means
- How long it takes to train the dog to realize what the device's purpose is
- How many obstacles bumped into despite knowing what the device's vibration signal means
- False negatives (obstacles not detected by the device) and false positives (vibrations triggered without an obstacle present)

Limitations Of Our Experimental Method

There are a few limitations to the method we have adopted:

- We are conducting the experiment with a very small sample size. The results of this experiment are not applicable to all blind dogs and may not benefit all dogs.
- The study is brief so determining whether the device alone caused the changes in the dog's behavior is difficult. Other factors may also be present.
- Because each dog is unique and has distinct behavioral characteristics, it is difficult to determine whether the dog is responding to the device or to other factors.

- Our strategy is to blindfold the dog if we can't find a blind dog. We're not sure how accurate the findings are in this case when applied to a real blind dog.

Analysis Methodologies

Both Qualitative and quantitative analysis techniques is being used.

The information gathered during the initial interview with dog owners/handlers will be analyzed qualitatively. We will carefully listen to and transcribe the interviews in order to identify common themes and patterns related to dog training methods and the best placement of the vibrating motors on the dog's vest. We will also identify any potential biases or confounding factors that may influence the experiment's results. The structure on how to train the dog, treat timing and the required time can be analyzed.

Manual hardware testing will involve simulating a situation in which there is an obstacle in the way to ensure that the sensors and motors are working as expected. The performance of the hardware will be quantified by measuring the sensor response times and the accuracy of the vibrations sent to the dog.

During the performance review phase, both qualitative and quantitative data will be collected. The dog's performance will be recorded both in and out of the dog handler's presence. This phase's data will be analyzed to identify patterns in the dog's behavior and responses to the device. Based on the dog's feedback, the frequency of the vibrating motors and the placement of the sensors will be adjusted, and the performance data will be analyzed to determine the effectiveness of these modifications.

All of this data can be used in the next phase, which will involve testing this device on multiple dogs. This information can also help us understand how well the haptic system performs in providing instructions to dogs when compared to the speech commands that most dog owners use.