P2 Assignment

Team Name - AniSight

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Overview

- Blind animals struggle to navigate freely or have a normal experience. The devices available to combat this issue include a plastic tube attached to the dog's vest that protrudes out and ahead of the dog's muzzle, preventing it from colliding with the obstacle. However, repeated collisions can easily disfigure this device, and it cannot be used without a vest. This causes animal handlers to exercise extra caution to ensure their pet's well-being and may also reduce their physical activity by confining them in a safe, familiar environment. A good alternate solution could be one which does not vary with the size of the pet or gets deformed with usage.
- Our solution is to create an assistive tech system equipped with ultrasonic sensors which are efficiently placed to detect any obstacle in maximum view of the field. Data from the sensor is sent in real-time to the microprocessor and this alerts the blind animal through a vibration.

Prototype

Hardware Required:

- Raspberry Pi 3B+
- HC-SR04 Ultrasonic Module
- Dog collar / Vest / Harness
- Breadboard for testing,
  PCB for actual prototype
- 2K and 1K ohm resistor
- Micro SD Card
- Connecting Wires
- Vibration Motor
- Rechargeable batteries

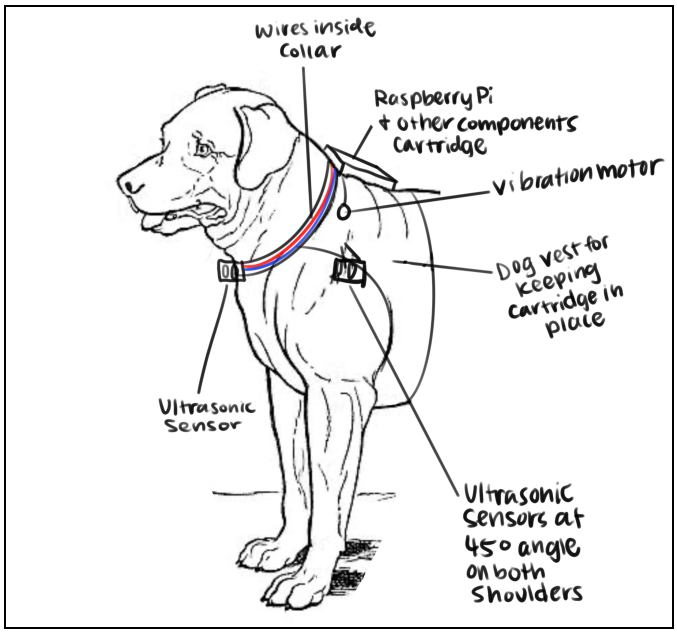
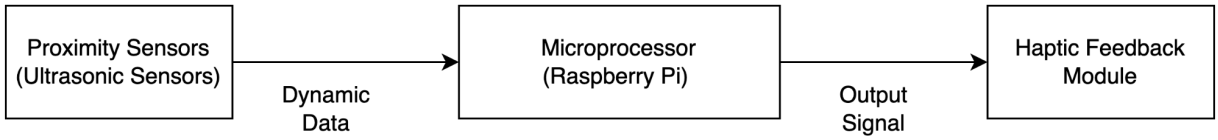


Figure 1

Ultrasonic sensors are attached to the dog collar facing the front and the wires are concealed inside the lining of the collar to ensure comfort to the dog. The Raspberry Pi and other components are placed at the back of the dog just behind the collar. Two more ultrasonic sensors are placed at a 45-degree angle on both sides of the dog and are attached to the dog vest. There are numerous vibrating motors branching out inside the vest in all directions near the Raspberry Pi cartridge.



Reasons to choose Raspberry Pi over any other microprocessors available:

- Raspberry Pi has the qualities of a computer compared to Arduino, which is only a microcontroller. This means Raspberry Pis can do more tasks than Arduinos and can support Bluetooth and Wifi. Arduinos can only support Bluetooth or Wifi if special types of Arduino boards are bought. This makes Pi more convenient if we want to collect data.
- Arduinos just execute code written in C/C++, while Raspberry Pi can process Python code, which is an easier programming language to use.
- Pi can support a large number of sensors so if we want to expand our design at all, Pi has that capability.

Design Alternatives

Hardware Design Alternatives

Without having built the prototype, we do not have enough data to know what design will be the safest, most comfortable, or even possible for the dog. Therefore, we have multiple hardware placement alternatives that use the same required materials of our chosen prototype.

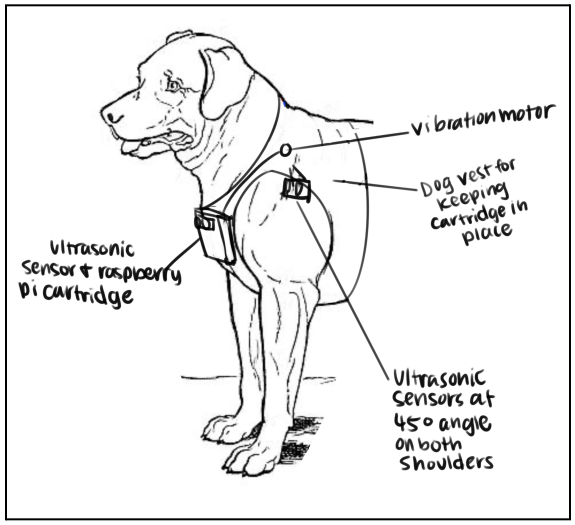


Figure 2

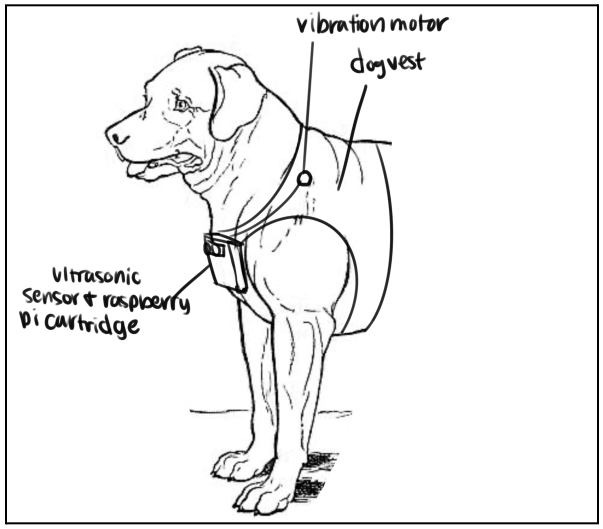


Figure 3

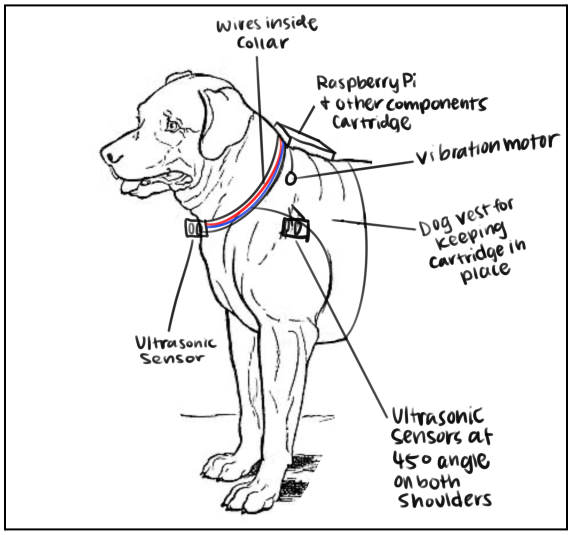


Figure 4

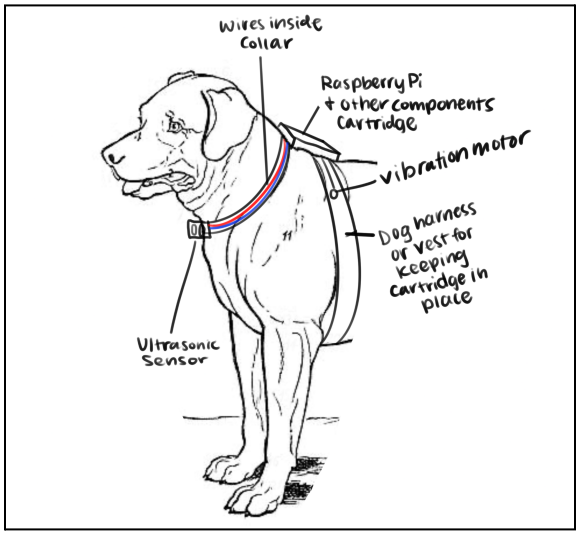


Figure 5

Halo + Tech Design Alternative

This prototype concept was inspired by the previous project research. The Halo ring is currently the most widely available product on the market for blind animals. Our alternative strategy was created to counteract the negative feedback received by the majority of Halo ring owners. The ring does not accommodate different shapes and sizes and only comes in a standard range of sizes. In addition, with repeated use and damage, the ring changes shape. As a result, we decided to outfit the ring with proximity sensors, such as ultrasonic sensors, to alert the animal via a buzzer alarm or vibration. This would keep the dog from colliding with the obstacle and would also address the size issue. Because these sensors have a wide enough range of sensitivity, even if there exists a size mismatch, we can detect it with high accuracy.

Materials required:

- Dog Vest with Halo ring
- Microcontroller: Arduino Uno
- Proximity sensor: Ultrasonic sensor
- Haptic Feedback Module: Vibration motors
- Audio Feedback Module: Piezo buzzer

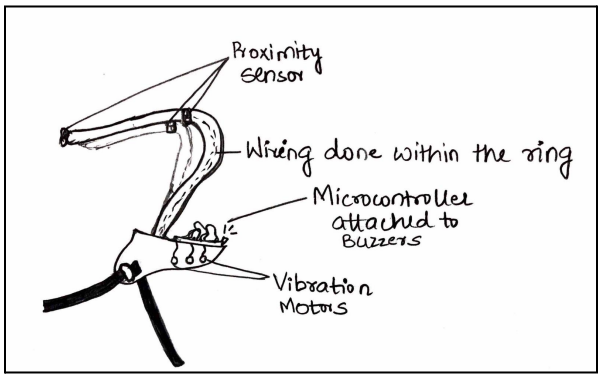


Figure 6

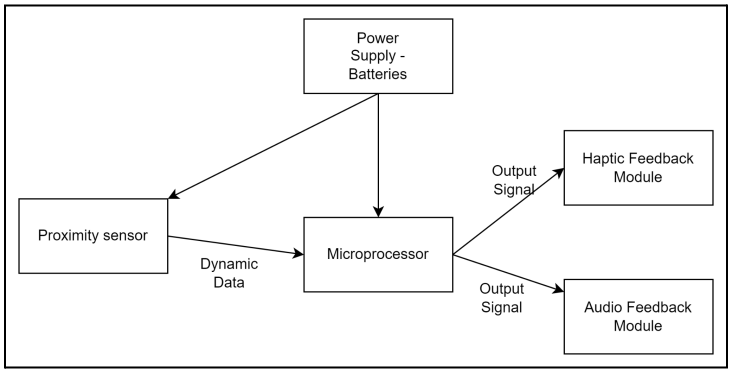


Figure 7

Dog leash Hardware Design Alternative

This prototype's hardware design uses a collar that is familiar to dogs. Due to the nature of dogs, their aggressive movements and a lot of activity can reduce the accuracy of measurements by preventing devices such as proximity sensors and microcontroller/microprocessor from not being fixed. In addition, blind dogs are very sensitive to other senses and may feel anxious about unfamiliar contacts as they cannot use their sight. To make up for this, we can use a collar that is familiar to dogs to reduce inconvenience and make the device more easily worn on them. Red dots in Figure 8 represent the ultrasonic sensors. There is one in the front, 2 on the sides, and one in the back. The back ultrasonic sensor could help prevent the dog from bumping into obstacles above the dog, such as chairs and tables.

Materials required:

- Dog collar
- Microprocessor/Microcontroller: Raspberry Pi/Arduino Uno
- Proximity sensor: Ultrasonic sensor
- Haptic Feedback Module: Vibration motors

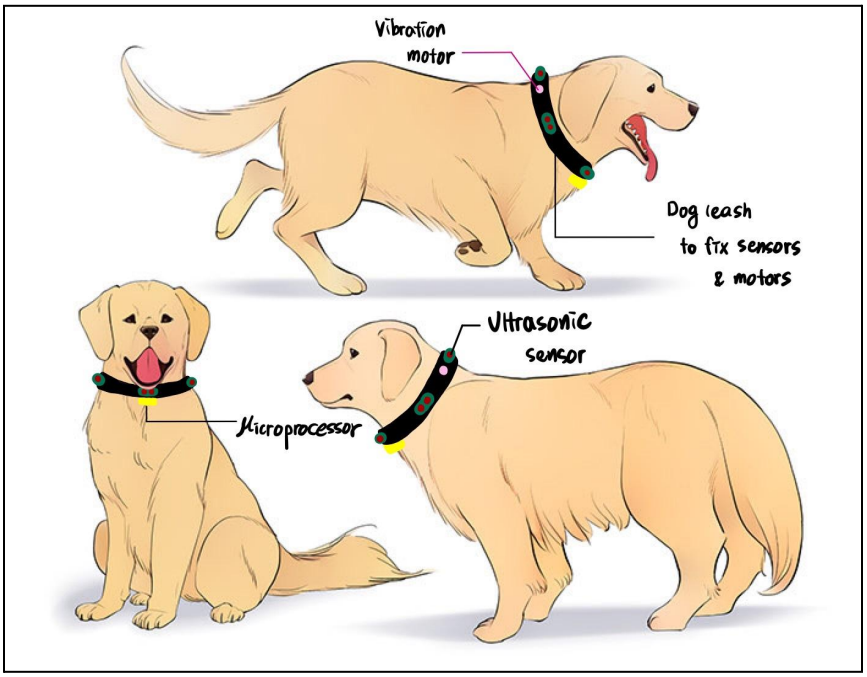


Figure 8

Our Prototype decision

We chose to move forward with Figure 1's design because the hardware placement seems the safest and most comfortable, and having the extra ultrasonic sensors can give the dog more information that can keep the dog safe. We have a description of specific design decisions below:

- Raspberry Pi Cartridge on the back: If the cartridge was not on the back and was on the prosternum instead, small dogs or dogs with short prosternum would have difficulty using our device. Additionally, it may be uncomfortable for dogs to lie down. Instead, it is easier to place the cartridge on the back where the dog has the most surface area, regardless of the size of the dog.
- Ultrasonic sensor in the front: If we want to avoid the cartridge being placed on the prosternum, we still need to make sure we have a forward-facing ultrasonic sensor.
- 45-degree Ultrasonic sensors: The HC-SR04 sensors only have a 30-degree cone, which is narrow and could miss obstacles that are slight to the left or right of the dog. Smaller dogs may not have this problem, but the sensor might catch too little for larger dogs with wider bodies and maybe shorter snouts. Therefore, extra sensors on the dog's shoulders could catch more data on obstacles nearby.

We aim to determine the right placement of multiple components during the testing period to understand what holds the device in place better and what is convenient for a dog to respond to.