ME102B – Fall 2020
Final Project

-The Dog Bell

By Matthew Blanchard

Description of Product:

I have a dog (Muncho) that loves to be outside laying in the sun all day long. This usually is not a problem however because COVID-19 I had to move into a house where I cannot see the door that my dog uses to get into the backyard. Often, I would find her standing at the door waiting for it to open so that she can enjoy the sun. Therefore, I created a device that monitors the area surrounding the door and makes an audible tone anytime my dog stands at the door waiting to go outside. Prior to having this device, I would have to constantly monitor the door from my office to see if my dog was there. Now that I have this device, I can remain in my office working on schoolwork until I hear the beeping notifying me that my dog wants to go outside. I was able to make two identical devices one that monitors outside the house (for when Muncho wants to come inside) and one that monitors inside the house (for when Muncho wants to go outside).

Figure 1: Muncho waiting at the door to go outside

Electromechanical Details:

Operation of sensor: The device consists of an ultra-sonic sensor as well as a miniature loudspeaker. The ultra-sonic sensor is a combination transmitter and receiver that measures the time a sound wave takes to transmit and reflect to the receiver. The sound wave is transmitted out, bounces off and object (Muncho), and then is received and analyzed by the micro controller. The loudspeaker remains silent

until it receives a signal from the micro controller which forces the speaker to emit a tone notifying people in the room. A stand was attached to allow the device to be angled up as to detect the body of the dog rather than her paws as it is a larger target.

Figure 2: The device is shown from the left, front, and right sides. The ultra-sonic sensor and speaker can be seen protruding from the housing. The stand is deployed as to angle the sensor higher to detect the body of the dog rather than the paws.

Circuit:

There are four main components to the dog bell device: (1) the micro controller, (2) the ultra-sonic sensor, (3) the mini loudspeaker, (4) the AC/DC power adapter.

(1) Micro controller: The micro controller used for this device is an Arduino Uno which can provide 5v power to the ultrasonic sensor and loud speaking by using a standard AC/DC wall power adapter.
(2) Ultra-sonic sensor: The ultra-sonic sensor is equipped with and onboard transmitter and receiver. It was programed to have a detection range of 31 inches which is the average width of a household door. This detection range would ensure that Muncho would be detected no matter where she was positioned in relation to the door. By knowing the duration, it takes the soundwave to leave the sensor, reflect off an object, and be detected by the receiver, a calculation can be made to determine the distance between the object and sensor.
(3) Mini Loudspeaker: The mini loudspeaker was chosen for this device as it produces a tone that is loud enough to be heard from far away without being too loud as to be disruptive to people nearby.
(4) The AC/DC wall power adapter allows the device to be utilized with any wall outlet in the house. This adapter also ensures that the device is not dependent on batteries which have the potential to die over time.

As an additional configuration this device can be utilized with any battery pack that is compatible with the Arduino Uno. This configuration would be a more portable solution but temporary configuration as the batteries will eventually need to be recharged using wall power.

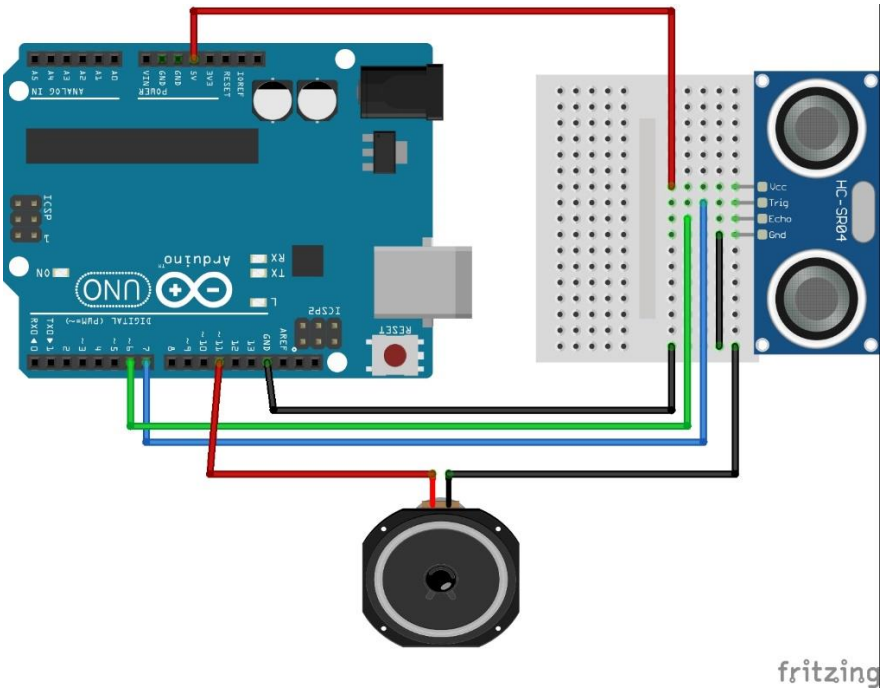

Figure 3: Circuit Diagram of Dog Bell

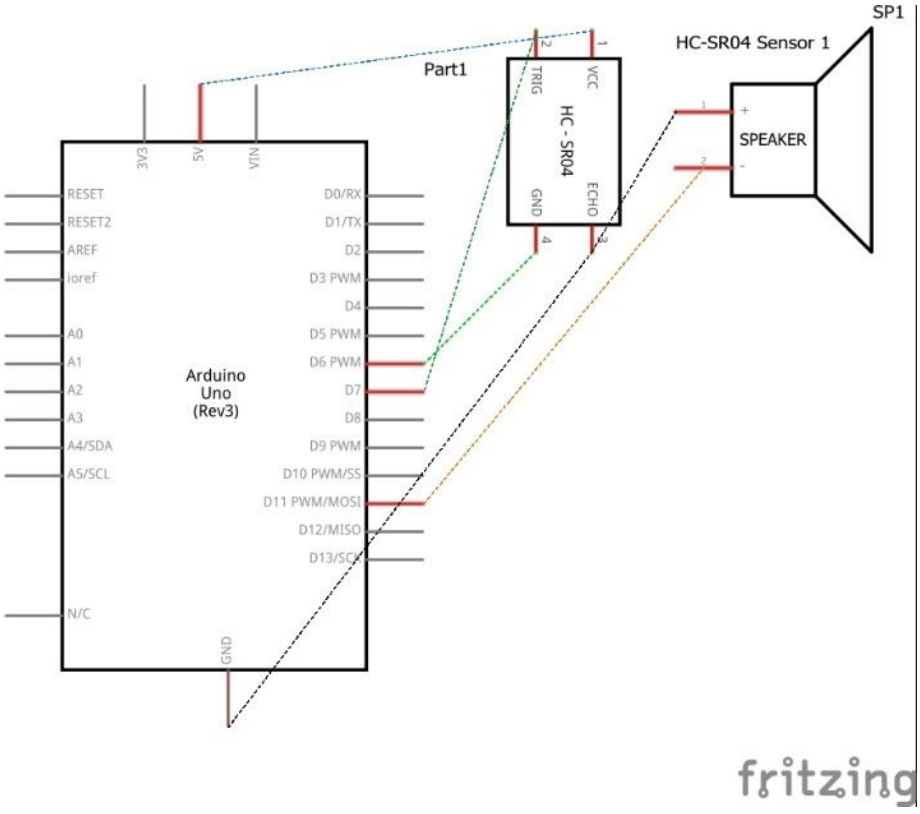

Figure 4: Schematic of Dog Bell

Finite State Machine:

The dog bell has a simple operation cycle, once it is plugged into wall power can be defined by an “ON” and “OFF” finite state machine as seen in figure 5. The device will be in the “OFF” position until any object is within its defined detection range of 31 inches. At that point, the system changes to the “ON” position which is defined by the loudspeaker generating an audible tone.

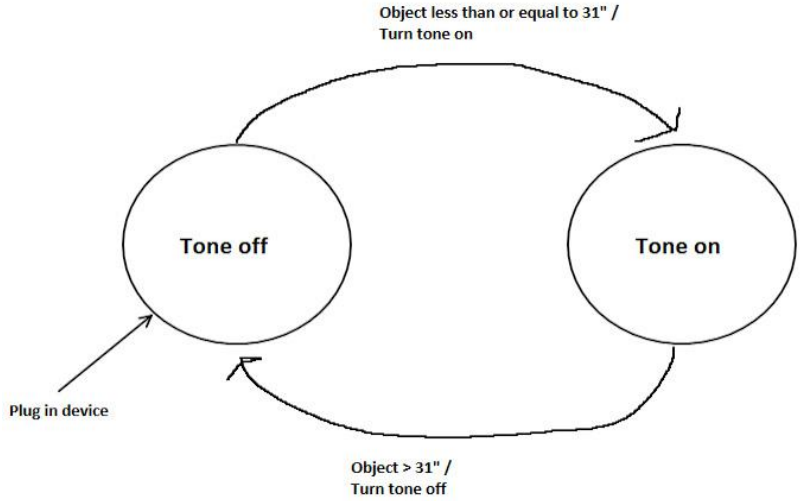

Figure 5: Finite state machine of Dog Bell

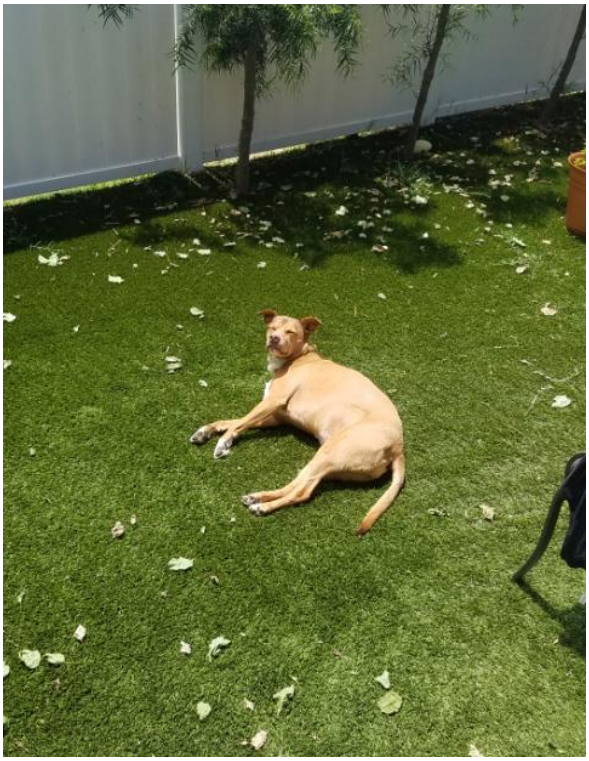

Figure 6: Muncho enjoying the outdoors now that she has a Dog Bell

Appendix I: Dog Bell Arduino Code

Dog Bell

Matt Blanchard

```
1   const byte switchPin = 12;
2   int sysBehav;
3
4   // Sonar:
5   const int pingPin = 7; // Trigger Pin of Ultrasonic Sensor
6   const int echoPin = 6; // Echo Pin of Ultrasonic Sensor
7   long duration, inches;
8   int range = 31; // Inches
9
10  // Buzzer:
11  int buzzer = 11;
12  unsigned char i;
13
14  void setup ()
15    {
16    Serial.begin (9600);
17
18    // Pins:
19    pinMode(buzzer,OUTPUT);//initialize the buzzer pin as an output
20
21    // Sonar:
22    pinMode(pingPin, OUTPUT);
23    pinMode(echoPin, INPUT);
24    }
25
26  void loop ()
27    {
28    // Sonar:
29    scan();
30
31    if (inches < range){
32      sysBehav = 0;
33    }
34    else {
35      sysBehav = 1;
36    }
37
38    switch(sysBehav) {
39      case 0:
40        for(i=0;i<80;i++)
41        {
42          digitalWrite(buzzer,HIGH);
43          delay(1);//wait for 1ms
44          digitalWrite(buzzer,LOW);
45          delay(1);//wait for 1ms
46        }
47      break; // end case 0
48
49      case 1:
50        Serial.println("No Dog");
51      break;
52
53    } // end switch*/
54   }
55
56
57  long scan () {
```

```
58    // inital scan
59    digitalWrite(pingPin, LOW);
60    delayMicroseconds(2);
61    digitalWrite(pingPin, HIGH);
62    delayMicroseconds(10);
63    digitalWrite(pingPin, LOW);
64
65    // time to distance conversion
66    duration = pulseIn(echoPin, HIGH);
67    //inches = microsecondsToInches(duration);
68    inches = duration / 74 /2;
69
70    return inches;
71  }
```