**Pete the Pirate Parrot**

**Team 4**

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Abstract

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Introduction

In celebration of Canada’s 150th Anniversary, the Aviation and Space Museum in the nation’s capital was to host a Gala where it would showcase many of Canada’s great inventions. The challenge for our team was to create a steampunk themed innovation in the area of robotics which would compete with many other great innovations and inventions on Design Day at the University of Ottawa. If successful, finalists would be invited to the Gala to showcase their creation.

The aim of the project was to design, build and program a robot based on the Steampunk theme. We were to consider creativity, functionality of the robot, the technology that we were going to use, the user experience and how it was to interact with users as well as how we were going to convey our idea to the panel of judges that determined if we had what it took to be invited to the Gala.

As such, after much thought and effort, we built a Pez Dispensing, Light up, Pirate Parrot. Our thought process was that we wanted to do something that was fun and interactive for the user and would be a great addition to the Gala. We wanted to have the robot parrot on a pirate’s shoulder who would walk around the gala and as people came to pet the parrot would be gifted a Pez candy. Furthermore, our sound activated lights would keep the parrot glowing as it responded to the sounds at the gala.

Needs Identification and Problem Statement

Our first objective was to determine the needs and constraints that our customer had. This is summarized in table 1.

Table 1: Customer Needs

|  |  |
| --- | --- |
| Need | Description |
| Steam punk themed look and feel | Gears  Brown Leather fabric  Old fashioned lights  Copper and rust  Intricate design (all/most moving parts should be displayed) |
| Robotic Elements | Various motors and sensors controlling numerous moving parts  Code to run instructions that the robot will follow |
| Interactive with the User | The user can control the robot either with a physical controller or motion detectors  Useful and relevant for the occasion |
| Attracts People | Programmed sequenced lights  Music  Artistically creative |

Although we had many ideas, we also had many constraints to keep in mind. The size of our product was to be between 15 to 20 feet. The cost of materials was to be 100 dollars max as that was what would be reimbursed by the school. Furthermore, the deadline for our project was March 27th as that was Design Day.

Once we had our needs and constraints, we decided to organize and prioritize the customer needs. There were 2 main aspects, first our product was to be robotic as to fulfil the requirement for the course, and second, our product was to have a steampunk theme and aesthetic so that it could qualify to compete in the Museum Design Challenge.

*Problem Statement*

The customer wants our team to create a robot that performs a certain task in accordance to what is required in our class while having a steampunk inspired theme and design and being interactive and creative enough to attract people at the museum.

Design Criteria

**Functional Requirements**

* *PEZ Dispenser*

When Ultrasonic Sensor detected an object close to the parrot, the mouth of parrot will open and Spit out an Austrian candy.

* Movement of the Wings

The motion within five centimeters.will be prompted by a motion sensor , then Servo motor will switch on and the wings of parrot will lift up.

* *LED lights*

The microphone will collect the volume of noise and shows different colour.

**Non-Functional Requirements**

* Incorporates a SteamPunk theme

**Constraints**

* The size of the build should be less than 20ft.
* The Price of materials should be less than 100 dollars.
* The Deadline is 17th March.
* A SteamPunk theme should be incorporated.
* Limited number of materials that can be found for free to use.

**Metrics of Pete the Pirate Parrot:**

* Height:
* Wingspan:
* Approximate weight:

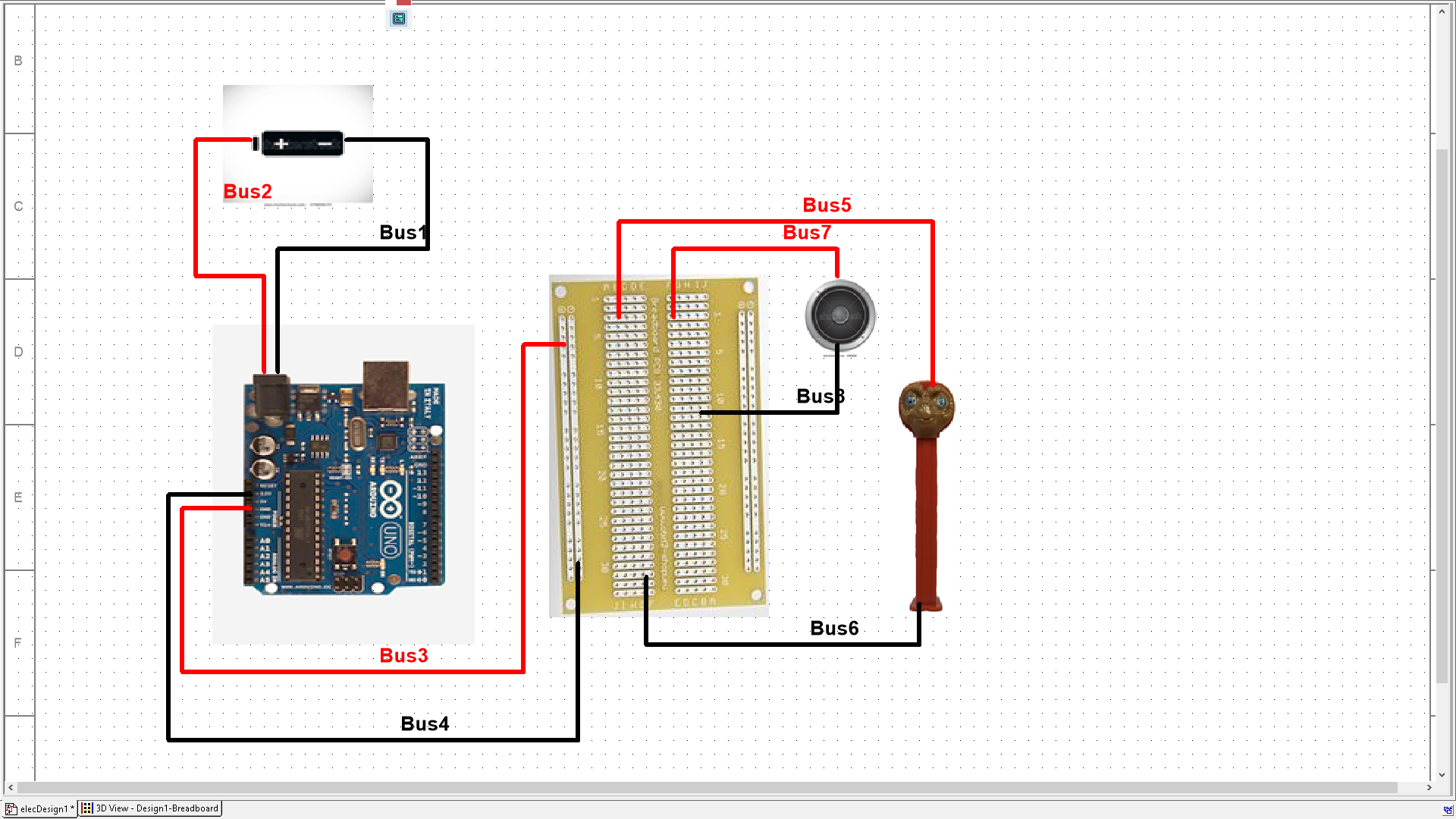
**Benchmarking:**

Table #: Benchmarking for Various of the Parts Required to Fulfill our Design

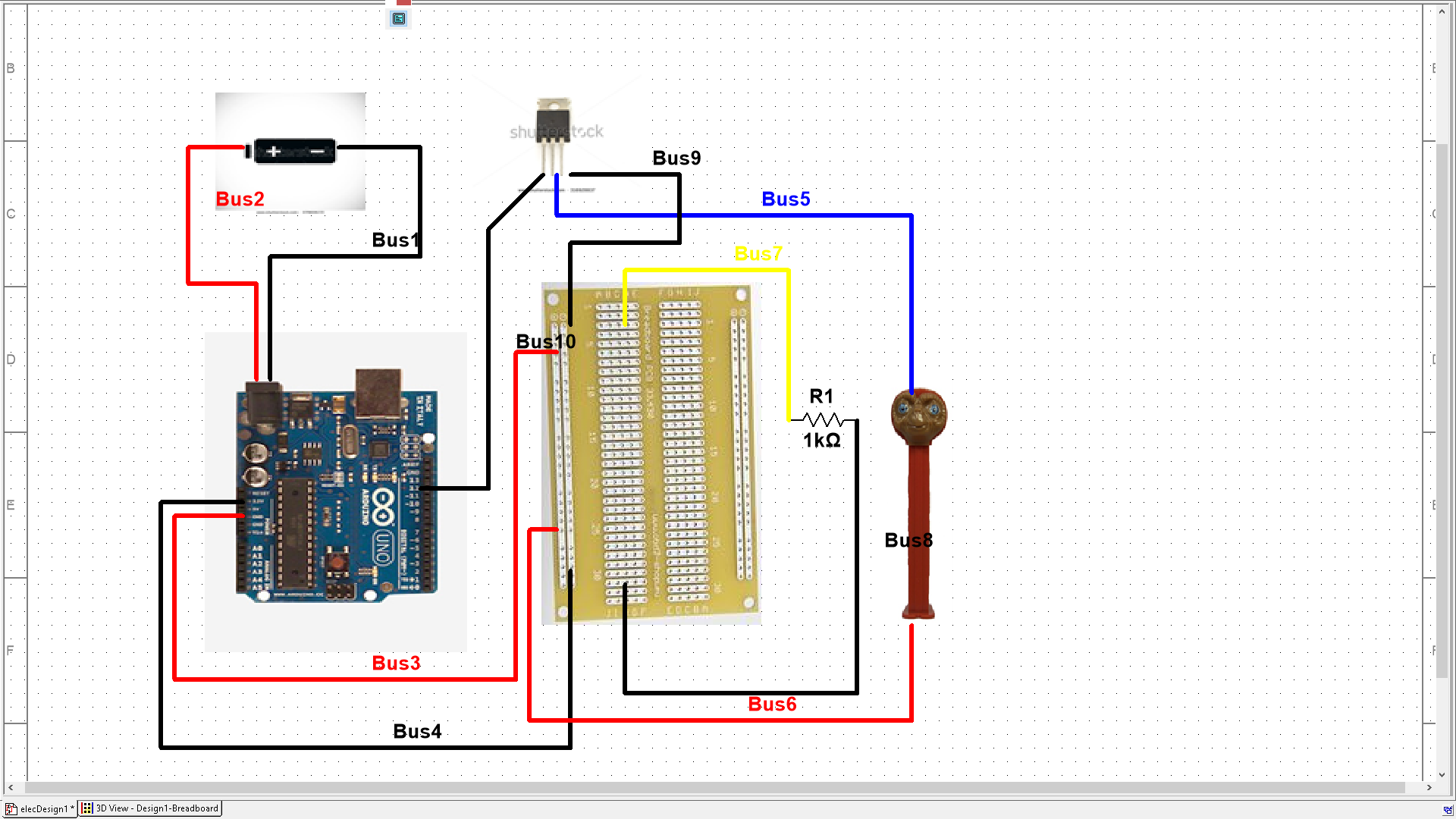
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Component Number | PEZ Dispencer | PEZ Pellets | Arduino UNO | 7.4V LiPo battery | Ultrasonic sensor HC-SR04 | RC servo micro: |
| 1 | Previously Owned | Previously Owned | Previously Owned | 1500MAH 2S 7.4V 20C LIPO, 13AWG: EC3 ($23.95) | HC-SR04 Ultrasonic Range Finder ($3.52) | J-Deal® 2x SG90 Micro Servo Motor 9G RC Robot Helicopter Airplane Boat Controls (2 pack) ($4.45) |
| 2 | N/A | N/A | N/A | Polymer Lithium Ion Battery - 2200mAh 7.4v  ($21.53) | niceEshop(TM) HC SR04 Ultrasonic Distance Measuring Sensor Module  ($4.28) | MG995 Micro Servo Motor 360 Degree 55g Metal Gear High Speed Digital for RC Car ($7.81) |
| 3 | N/A | N/A | N/A | Power Cell LiPo Battery 2200mAh 7.4V 25C 2S iD ($29.77) | Sainsmart HC-SR04 Ranging Detector Mod Distance Sensor, Blue  ($3.45) | Towerpro MG90S Metal Gear RC Micro Servo For RC Model  ($22.52) |
| 4 | N/A | N/A | N/A | 7.4V 2000mAh 2S 1C Receiver LiPo Battery ($18.49) | Dcolor HC-SR04 Distance Measuring Transducer Sensor Ultrasonic Module for Arduino ($2.54) | Savox SH-0255MG Micro Metal Gear Digital Servo  ($31.98) |

Conceptual Design

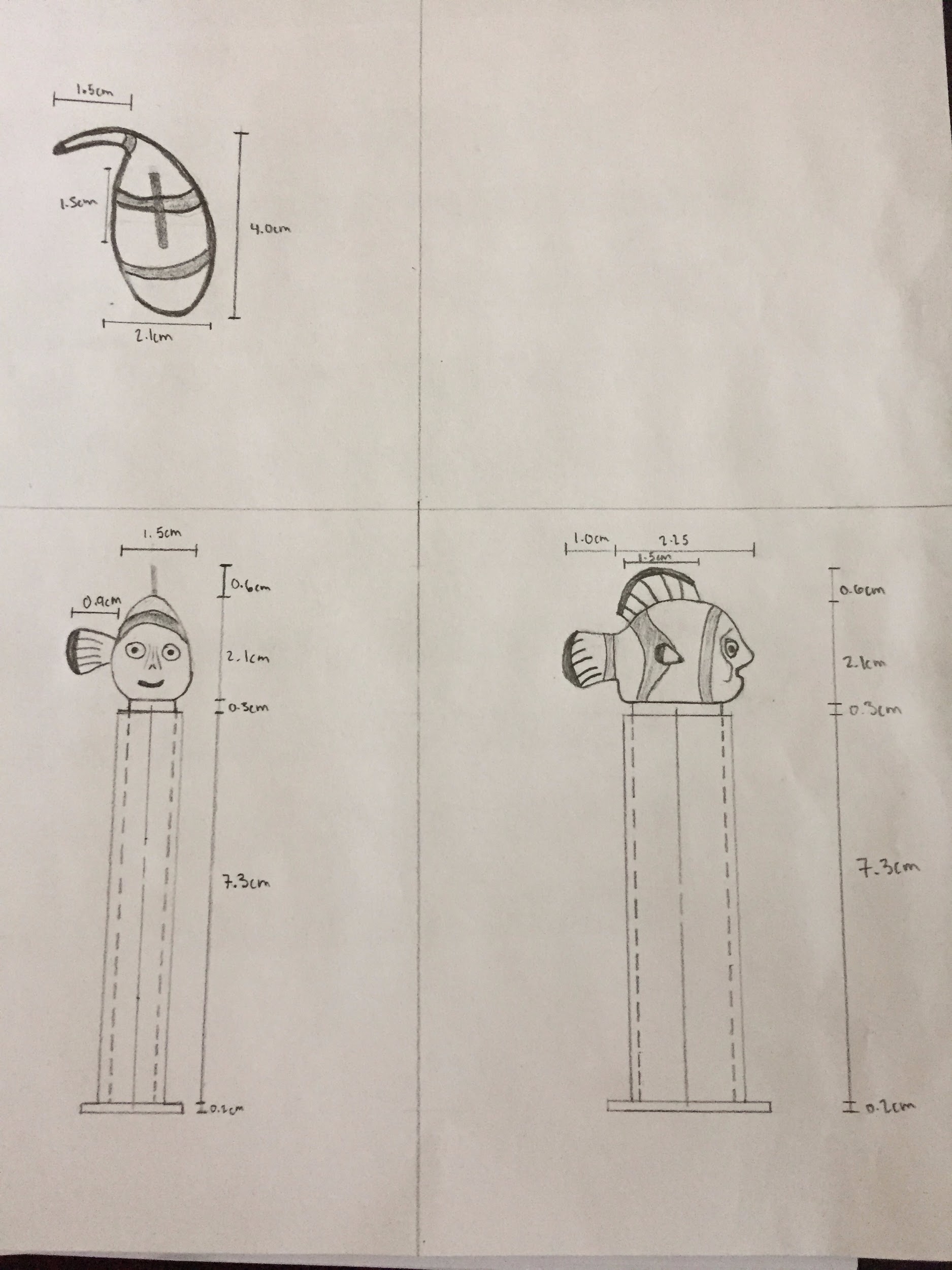
**Figure #**:



**Figure #**:



**Figure #**:



Project Plan and Cost Estimate

Prototype 1 and Customer Feedback

*Prototype*

For our first prototype, our main focus was to get our first feature working correctly. This was the Pez Dispenser that was to operate whenever an Ultrasonic Sensor detected someone near it. Our first step was to gather the materials that we needed for this prototype, this included, an Arduino Uno, breadboard, Pez Dispenser as shown in Figure 1, wires and a 9V battery.

We hooked our servo to the Arduino first. The servo was hooked into the 5 V and ground port of the Arduino for power and PIN 10 to control the servo. Next we hooked up the PING sensor using the 3.3V and ground ports and PIN 9 for it to communicate back and forth with the Arduino.

Once we had done this, the next part relied on our code to program the servo to continually scan for anything in front of it and to trigger the servo to move if anything came close. Initially, we were not sure how close we wanted the sensor to be activated but decided that 5 cm was a good distance.

Once we had finished programming everything, we realized that we needed to be able to check in this first prototype that the ultrasonic sensor was working correctly and was sensing the correct

**Figure 2: Part 1 of the Servo Control Prototype**

**Figure 3: Part 2 of the Servo Control Prototype**

**Figure 4: Part 3 of the Servo Control Prototype**

*Customer Feedback*

Prototype 2 and Customer Feedback

*Prototype*

For our second prototype, our main focus was to get the lighting aspect of the project working properly. At the start of the Prototype 2, the lights consisted of 3 LEDs: 1 green, 1 yellow and 1 red; we later upgraded the lighting circuit to accommodate 8 LEDs: 2 green, 2 blue, 2 yellow and 2 red. The lights were sound activated, where the different coloured lights would turn on with certain decibel levels - programmed in the Arduino board as sound thresholds.

Note: The wiring for the 3-LED-Implementation had a lot in common with the 8-LED-Implementation, hence, this section will only describe one of the two implementations - the one that uses 8 LEDs.

The new components necessary to the completion of this prototype included: an Arduino Uno R3 board, 8 Gikfun Bright LEDs, 8 220Ω resistors (1 resistor for each LED), an Elctret Microphone Amplifier MAX4466 and another 9V Battery; of course, the breadboard and wires were also used.

Before starting to hook-up all the LEDs, we performed some preliminary tests; ie. We tested three types of resistors: 10kΩ, 1kΩ, 220Ω. We established that the latter was more suitable for our design since the 10kΩ and 1kΩ resistors, attached in series with the arduino output and the LED, restricted the voltage. (We also tested a circuit which did not use a resistor and this unfortunately burnt one of the LEDs.)

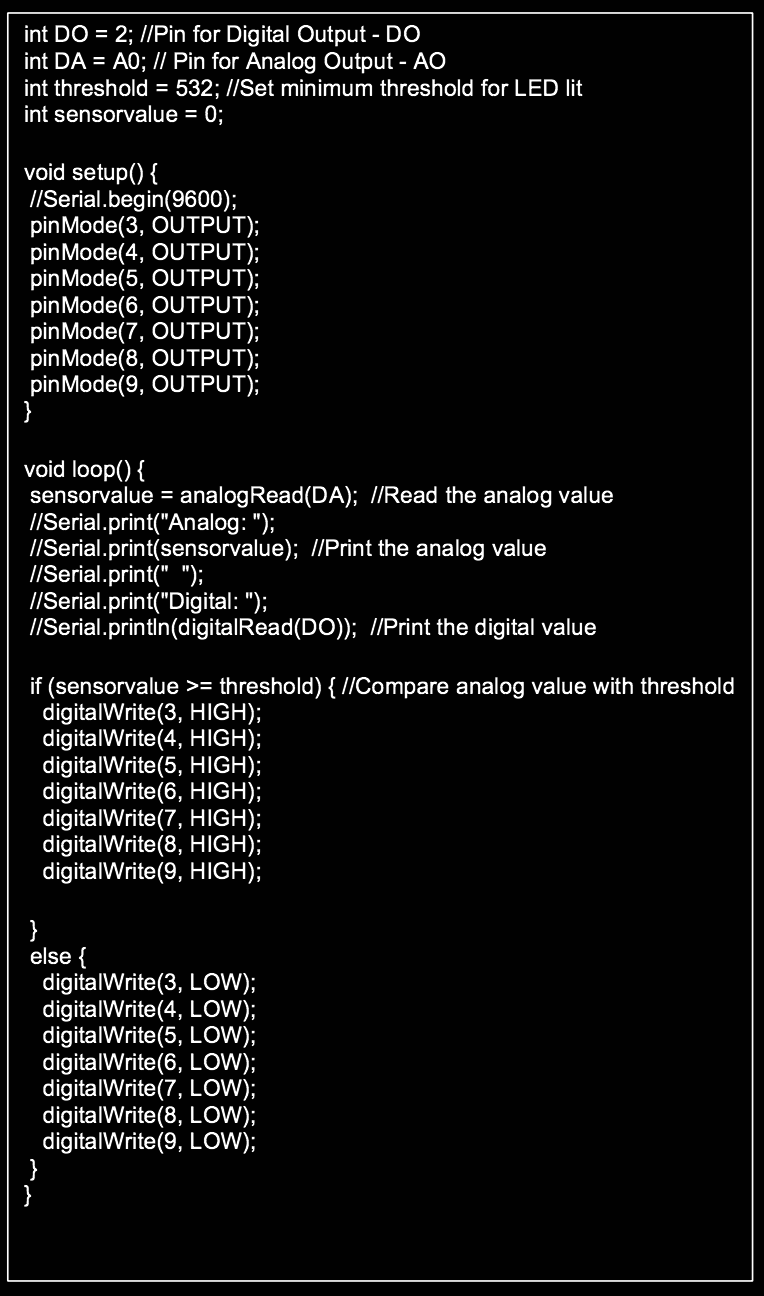
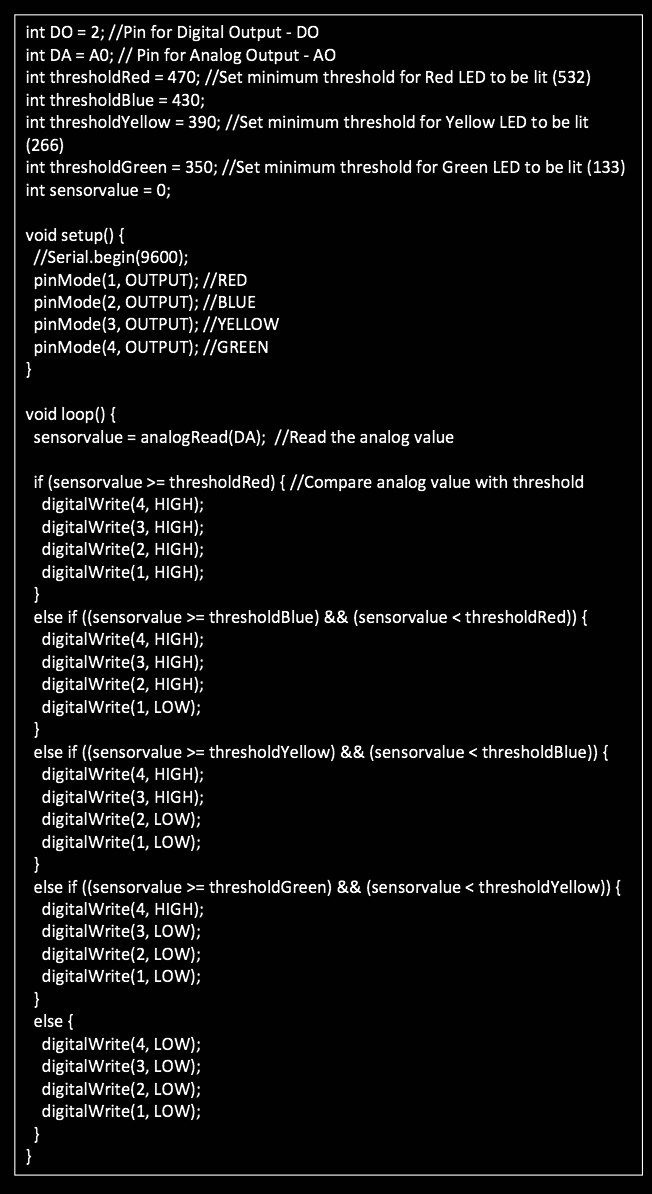
To begin the installation of the light circuit containing 8 LEDs, we first connected a light in series with a 220Ω resistors (using the breadboard as our platform) then we connected one end of the circuit to one of the arduino OUTPUTs and the other end to the common (return -) on the breadboard which was also connected to one of the arduino GROUNDs. This same circuit was constructed for all of the LEDs, although we connected the same coloured LEDs to the same arduino OUTPUTs; this meant that there was a total of 4 outputs used on the Arduino. The 4 Arduino OUTPUTs for the LEDs were the DIGITAL PINS: **D1, D2, D3, and D4**.

Next, we wired the microphone to the Arduino; we decided to use the ANALOG INPUT **A0** of the Arduino to receive the audio signal from the mic. We also connected the microphone to the 3.3V POWER and to one of the GROUNDs of the Arduino.

Having established that the lighting circuit as a whole would be using:

* Input: **A0**; and
* Outputs: **D1, D2, D3, and D4**;

we begined programming the functionality. We started by doing some research to find out if there was any code online that would function in a similar fashion to what we desired. We found the code in *Figure* ***#*** on the website PrinceTronics.com and we edited this code to work with 4 different thresholds of sound, this can be seen in *Figure* ***##***.

Figure **#**: Original Code Taken from PrinceTronics Figure **##**: Modified Code

The program works as follows:

When the volume of the sound sensed is :

* less than “thresholdGreen” → all LEDs are OFF;
* greater than “thresholdGreen” → the green LEDs are ON and the rest are OFF ;
* greater than “thresholdYellow” → the green and yellow LEDs are ON and the blue and red LEDs are OFF ;
* greater than “thresholdBlue” → the green, yellow and blue LEDs are ON and the red LED is OFF ; and
* greater than “thresholdRed” → all LEDs are ON;

One of the biggest challenges in this prototype was insuring that the thresholds were set at the proper levels; as in, insuring that the volume of sound necessary to activate the lights was not too loud but also not to quiet. We wanted the green lights to be active most of the time -flickering with ambient sounds- and the red lights to only be active when there would be a loud peek of sound.

Prototype 3 and Customer Feedback

*Prototype*

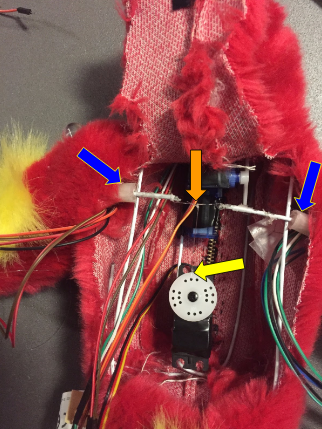
After reviewing our previous two prototypes, as a group we knew that we could improve our design of Pete the Pirate Parrot, thus incorporating movement of the wings. The very first idea consisted of a pulley system that was manually operated. This idea progressed to a similar pulley system that was operated by a servo motor. The movement of the wings would be prompted by an ultrasonic motion sensor that would detect motion no further than five centimeters away. Due to the absence of space that was available for the pulleys, we collectively decided that we must change the modify the design. This lead to our final concept of this mechanism. There is one six centimeter string attached to the servo motor illustrated by the yellow arrow in **FIGURE #**. The six centimeter string then extends upwards where it attaches to another piece of fishing line which is 3.75 centimeters long as shown in **FIGURE #**  by the orange arrow. The 3.75 centimeter string has coat hangers attached on either end of the string. The coat hangers then extend into the wings, providing their structure. The coat hangers have tape near the top of the wire illustrated by the blue arrows in **FIGURE #**. This tape is placed in the outside of the structure of the parrot which prevents the coat hangers from moving inwards. This simple addition is one of the most important parts in this particular mechanism.

A small circle of radius 1.5 centimeters is fastened to the servo motor. As displayed in **FIGURE #** one end of the six centimeter string is tied to the circle. An Arduino was programmed to allow the servo motor to rotate the circle 180 degrees. When the motor is activated, the connection point between the two strings is pulled downwards, in turn lifting the coat hangers located in the wings, thus lifting the wings upwards.

Continually for our third and final prototype we added all the other components from prototypes one and two. Due the the inadequacy of space we created a wooden box to hide the wires and Arduino boards.

**Figure #**: This figure illustrates the mechanism created

that allow the wings to move when motion is detected



The greatest issue that we encountered for this prototype was trying to fit all the components into the small frame of the parrot. When we combined all our sub-systems we did not realize that there would be so many wires for the LED’s. After a short time of trying to find a way of combining all our components we came up with an alternative idea. We built a box that Pete the Parrot would stand on and we placed the breadboard and Arduino Boards in the box, not making it visible for the user to see. For the future we would like to utilize a larger bird so we do not have to use the box.

*Customer Feedback*

Our third and final prototype was on display for many to witness and interact with during Design Day on March 29th, 2017. Participating in this event allowed our team to meet many individuals that offered us feedback on Pete the Pirate Parrot. Here are some of their comments:

“It would be nice to see the wings move up higher”

**– Design Day Judge**

“I really like your design it’s funny and is a cool idea”

**– Design Day Competitor**

“What about if the PEZ dispenser shot out the PEZ candy rather than just having it placed there for the user”

**– Design Day Judge**

Conclusion

Bibliography