Design Document

Walrus the Oyster Eater

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Revision Record

Date	**Author**	**Comments**
Nov 9, 2022	Team	Document Created
Nov 11, 2022	Pate	Update User Interface sub-system, add Electronics Design
Nov 12, 2022	Anastasia	Add Mechanical Design, update Schedule
Nov 13, 2022	Diana	Update Integration and Conclusion, check the document on errors

Project Description

Walrus the Oyster Eater is a robot that recreates the scene from the *Alice in Wonderland* movie. The robot can perform the arm rotation motion confined in the x-y plane to "consume" a baby oyster. The LED lights in his eyes blink to make him look crazy, while the audio generates the lines from the movie sent by the director.

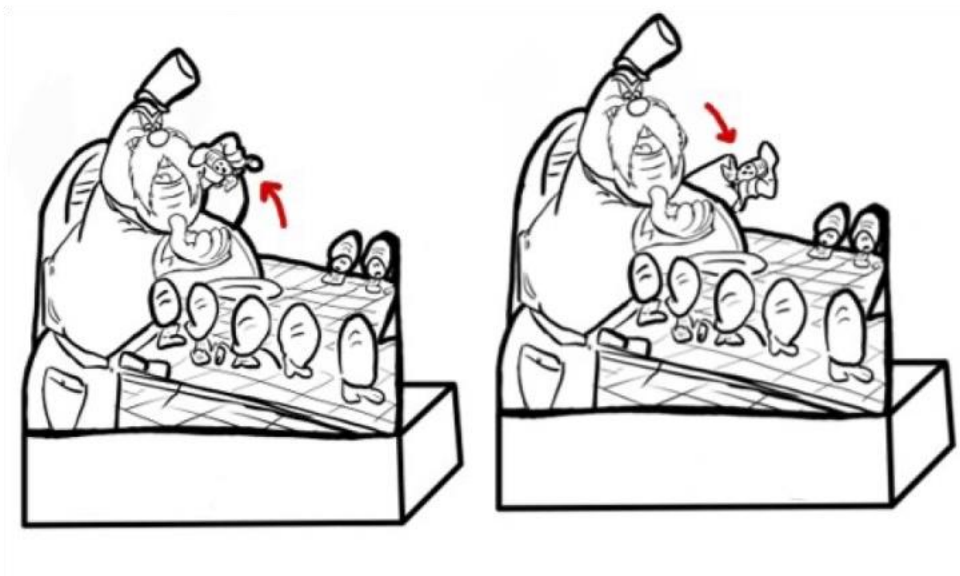

Figure 1: Our initial rendering of Walrus the Oyster Eater

System Design

Our system is divided into six different sub-systems. Specifically, one can see the block diagram for the sub-systems below, with each sub-system name and its interfaces, as well as the table with more detailed description. Each team member will be responsible for the design and development of the chosen sub-systems.

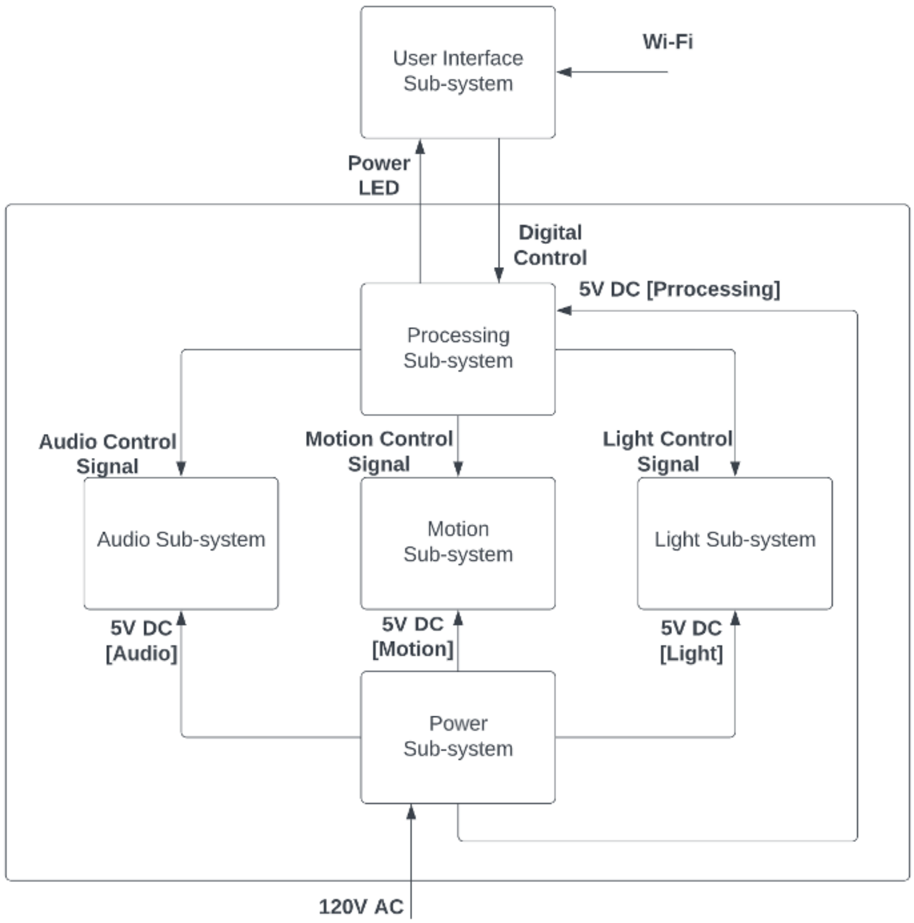

Figure 2: System Diagram

Table 1: Sub-system inputs and outputs

Interface	***Source***	***Destination***	***Description***
120V AC	System Input	Power	120V AC Input
5V DC	Power	Audio	5V DC to power Speaker
		Light	5V DC to power LEDs
		Motion	5V DC to power Motor
		Processing	5V DC to power RPi
Audio Control Signal	Processing	Audio	Signals to control Audio
Light Control Signal	Processing	Light	Signals to control Light
Motion Control Signal	Processing	Motion	Signals to control Motion

Digital Control	User Interface	Processing	User Input
Power LED	Processing	User Interface	LED indicator light

Sub-System Designs

Our design incorporates the following sub-systems: user interface, light, processing, motion, audio, and power. The power converts 120V AC to 5V DC, the processing integrates all sub-systems, and the user interface connects to the processing sub-system for the testing purposes. The motor moves the robotic arm by 45 degrees back and forth in a plane, the light is responsible for the eye blinking, and the audio plays the director's script.

User Interface Sub-System

The user input sub-system is made up of five switches. The first switch, switch 0, is used as an on/off switch. Switches 1-4 are used to activate each sub-system. Switch 1 activates the orchestra mode which is all the sub-systems together. Switch 2 is for the arm, switch 3 is for the lights, and switch 4 is for the audio.

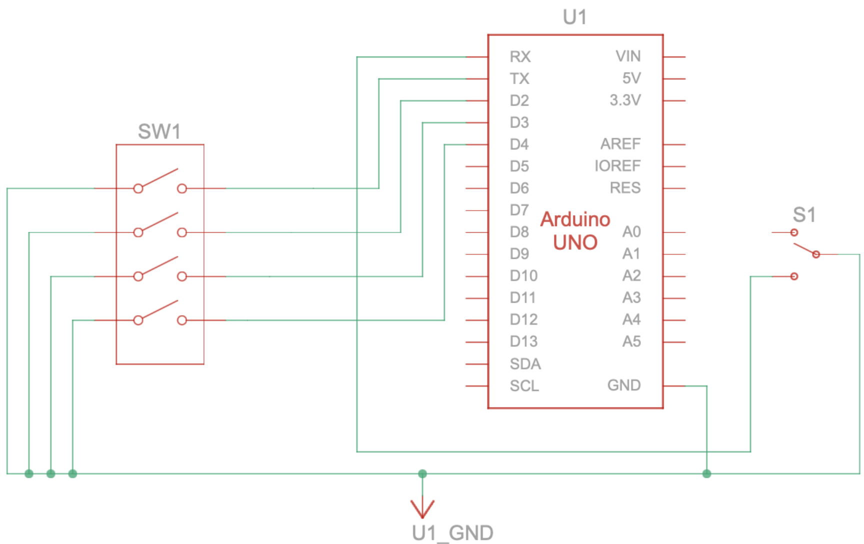

Figure 3: User Interface Sub-system Schematic

Audio Sub-System

The audio subsystem will take in 5V DC from the power subsystem and receives signals from the processing subsystem. Once a signal is received to the MicroSD Reader from the processing system, the MicroSD Reader will transmit the Speaker Signal to the Amplifier. The Amplifier sends the Amp Signal to the Potentiometer. The Potentiometer will then send the Volume Signal to the Speaker to produce audio.

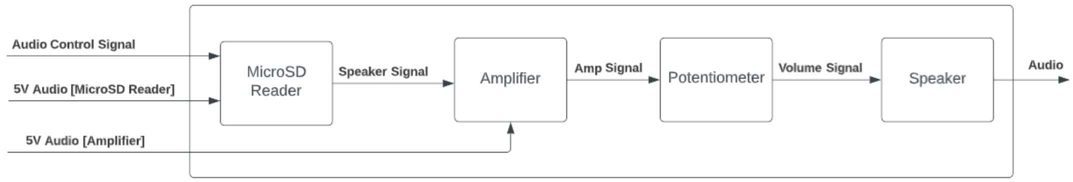

Figure 4: Audio Sub-System

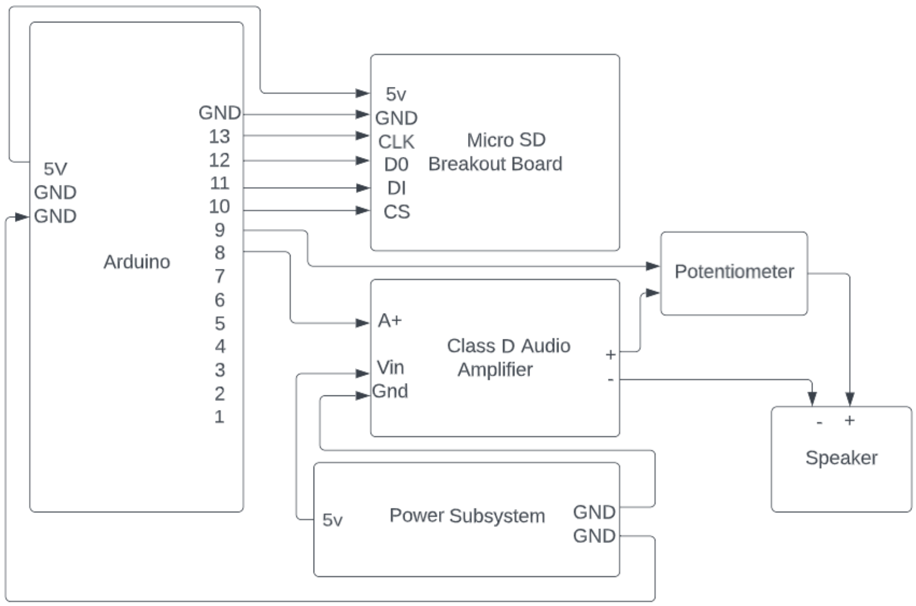

Figure 5: Audio Sub-System Schematic

Motion Sub-System

The motion sub-system will take 5V DC from the power sub-system and receive the control signals from the processing sub-system to change the robotic arm position with the servo motor.

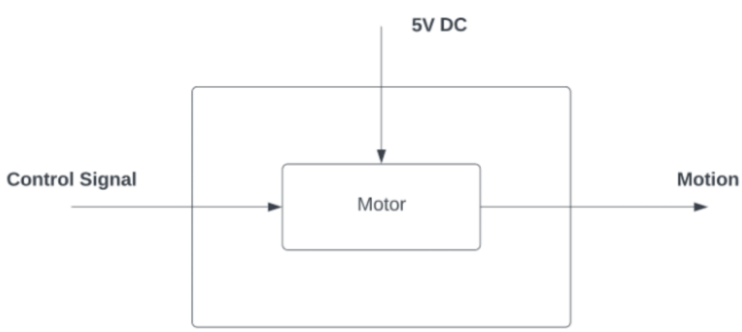

Figure 6: Motion Sub-System

Light Sub-System

The light sub-system will receive the control signals from the processing sub-system through an analog circuit connected to two LEDs in the robot's eyes.

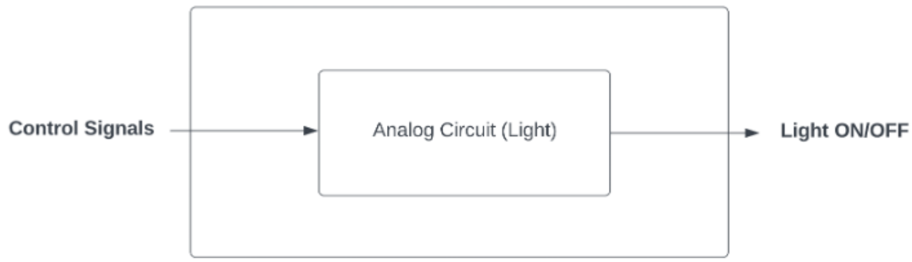

Figure 7: Light Sub-System

Power Sub-System

The power sub-system supplies the power directly to the Arduino boards. The power can be supplied to a component by activating 5V DC with a signal from an Arduino. However, the final project did not make use of the transistors and was instead used to ground or power components that needed it directly. In the schematic below, JP1 is the 5V Power supply that powers the board, JP2-6 power the components, and JP7 is the input block for the control signals from the control board.

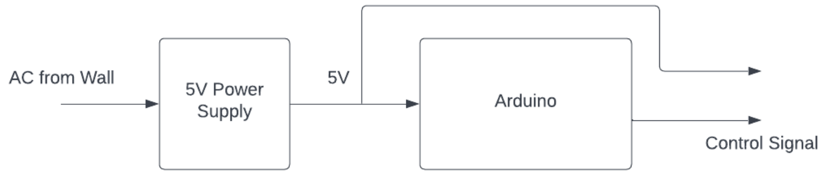

Figure 8: Power Sub-System

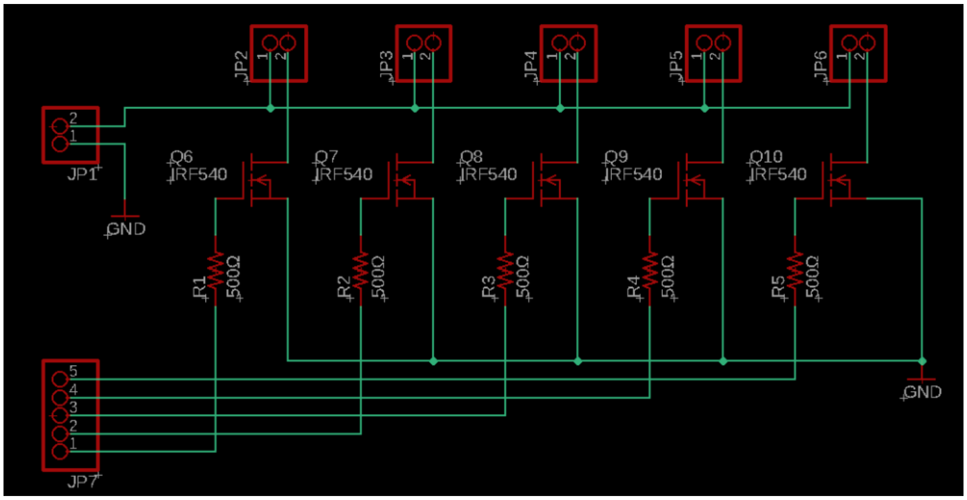

Figure 9: Power Sub-System Schematic

Processing Sub-System

The processing sub-system uses two Arduino boards that receive power from the power sub-system and the input from the user input sub-system. It processes the information and outputs a control signal. One arduino is for lights and motor, and the other is for audio.

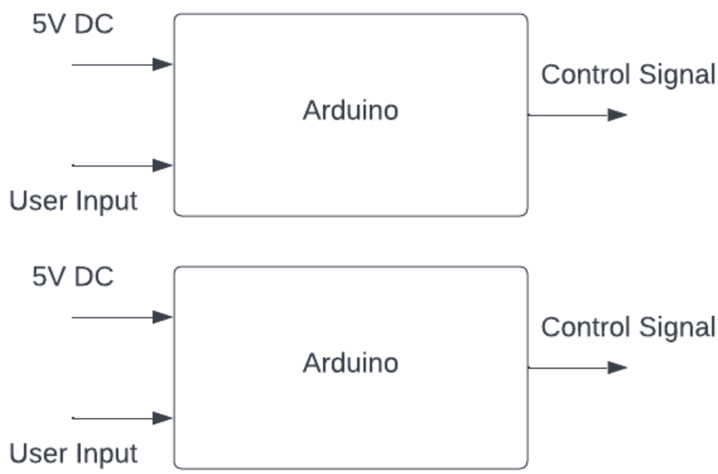

Figure 10: Processor Sub-System

Electronics Design

The electrical design for the project takes the circuit for each subsystem and combines them into one circuit. In the screenshot of the tinker cad simulation below, the audio subsystem is represented by an LED on the right. The same switches used to control the main Arduino are also used to control the Arduino for audio. A more in-depth view of the overall audio circuit can be viewed in the audio subsystem.

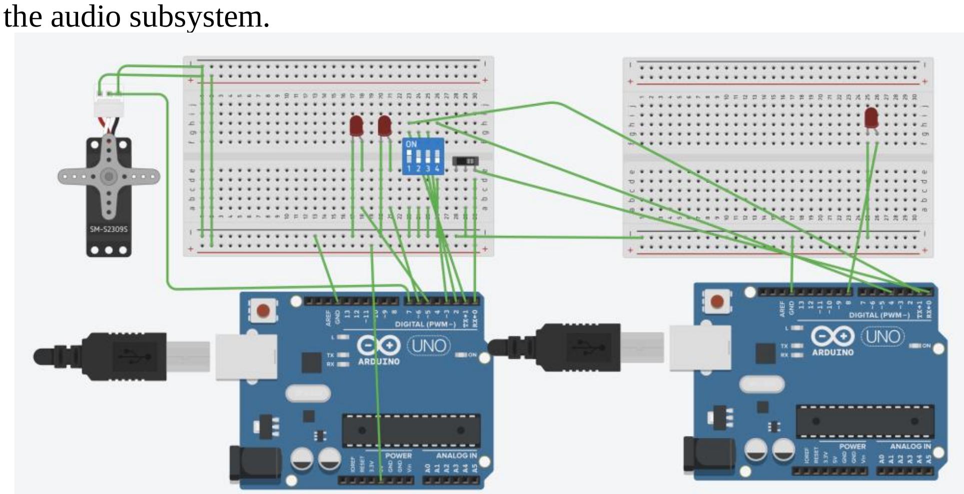

Figure 11: Electronics integration in Tinkercad

Mechanical Design

The mechanical design is comprised of a box, Walrus, and baby-oysters sitting at the table. The box, as well as the figures of characters, were laser-cut out of plywood (30x30 cm) and later glued together.

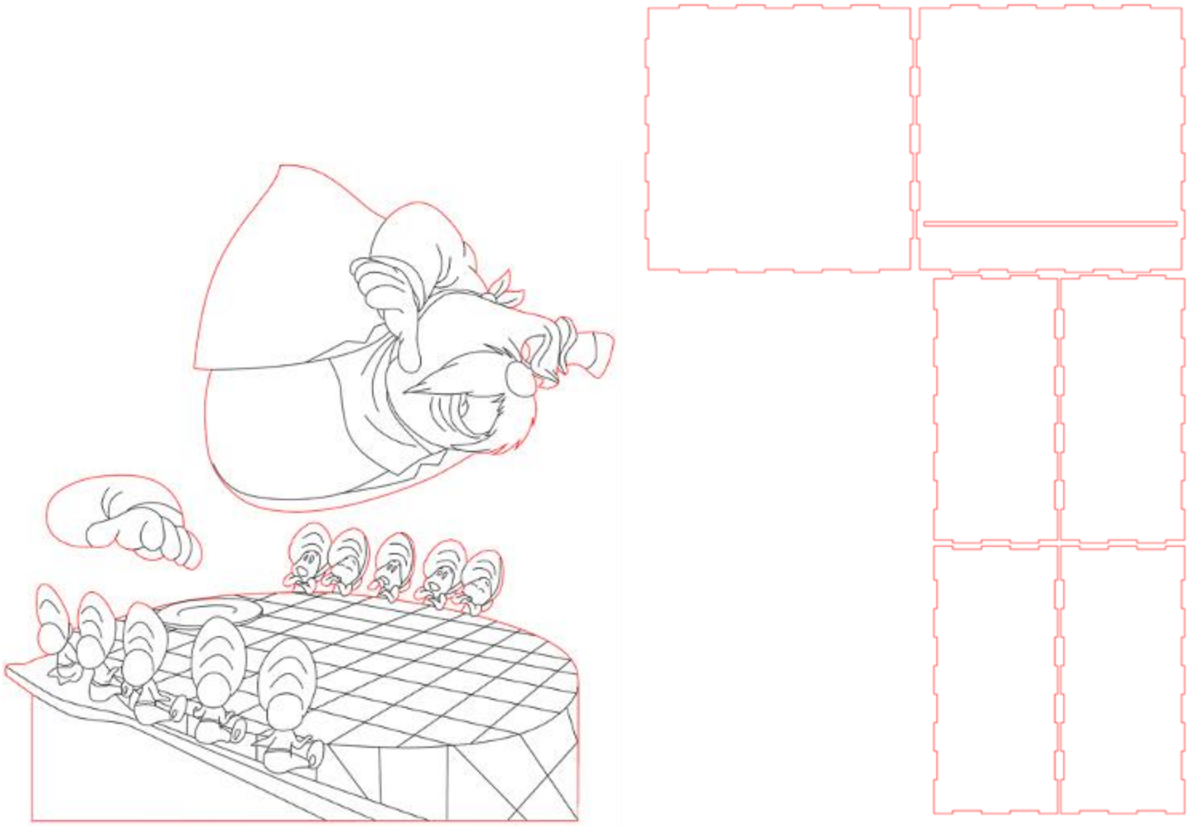

Figure 12: Illustrator .svg files of the initial designs of Walrus

The acrylic gouache was used to paint the figures, as it is perfectly suited for woodwork. The colors were chosen from the original scene in the *Alice in Wonderland* movie but stylized to make it look more distinctive.

Figure 13: First attempt to color Walrus

The product is easy to navigate. On the side of the box, one can find the user interface, with buttons and switches for the test modes and orchestra mode of operation. The back of the box is made from acrylic to see all the inner components through it.

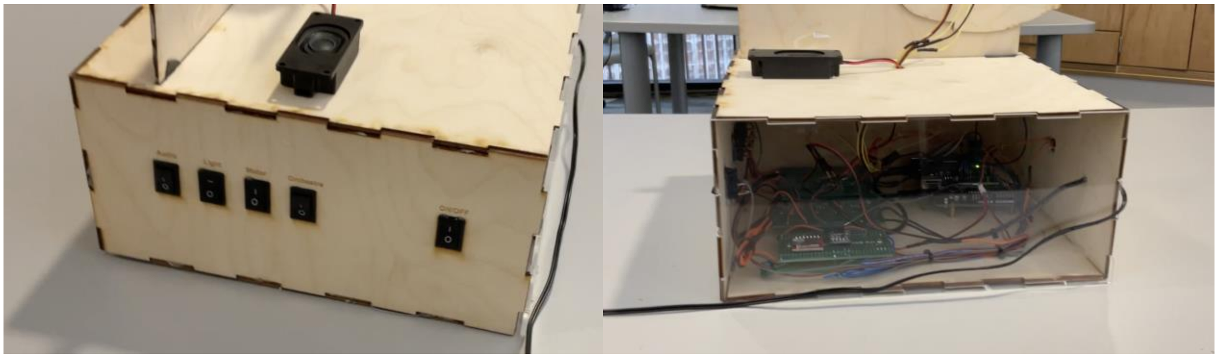

Figure 14: The side and back of the box

On the top of the box, there's a long hole for the table with baby oysters to be inserted and glued in, as well as the box for the wire management. The figure of Walrus is attached on the back of the table, with its hand attached to the servo motor on the Walrus' back.

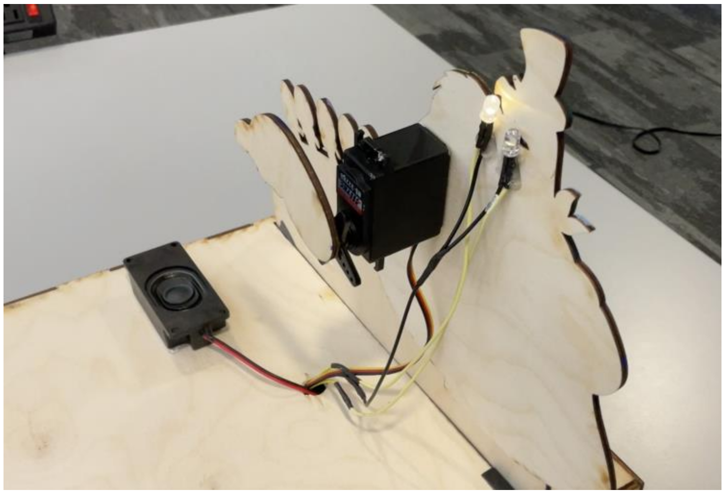

Figure 15: The top view

Figure 16: Final mechanical built of Walrus

Schedule

The tasks for the project have been divided up into thirteen weeks to ensure that the project is following a timely manner and will be completed by the deadline. In addition to dividing the tasks, the schedule is also divided into the Proposal, PDR, CDR, and Final Inspection and Demonstration.

	Week Number												
Task	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Brainstorm	Diana												
Design Top Level Block Diagram	Anastasia												
Design Software Block Diagram	Anastasia												
Proposal													
Structure Documentation		Diana											
Preliminary Processing Design		Pate											
Preliminary Light Design		Anastasia											
Preliminary Audio Design			Diana										
Preliminary Mechanical Design			Anastasia										
Preliminary Power Design			Pate										
Preliminary User Input Design				Sufiyan									
Make Parts List					Diana								
PDR													
Processing Design					Pate								
Light Design: Analog Circuit					Anastasia								
Light Design with LEDs					Anastasia								
Audio Design: Amplifier					Diana								
Audio Design: Speaker						Diana							
Mechanical Design: Box				Anastasia									
Mechanical Design: Motor						Anastasia							
Power Design					Pate								
User Input Design: Physical part					Sufiyan								
User Input Design: Software part						Sufiyan							
Processing simulation: Circuit						Pate							
Processing Simulation: Code							Pate						
Light Simulation: PCB Circuit							Anastasia						
Light Simulation with LEDs						Anastasia							
Audio Simulation: Amplifier						Diana							
Audio Simulation: Speaker						Diana							
Audio Simulation with Amplifer & Speaker							Diana						
Mechanical Simulation						Anastasia							
Power Simulation						Pate							
User Input Simulation						Sufiyan							
Aquire Parts							Diana						
Laser Cut Box							Anastasia						
CDR													
Processing Build									Pate				
Processing Code								Pate					
Processing: Wifi support								Sufiyan					
Light Build with LEDs									Anastasia				
Audio Build: Poteniometer & Speaker								Diana					
Mechanical Build: Build Box & Color Walrus								Anastasia					
Mechanical Build: Motor								Anastasia					
Power Build								Pate					
User Input Build									Pate				
Processing Test									Pate				
Light Test										Anastasia			
Audio Test									Diana				
Mechanical Test										Anastasia			
Power Test									Pate				
User Input Test										Pate			
System Intergation											Group		
System Test												Group	
Final Inspection and Demonstration													
Refine/Repair Documentation										Group	Group	Group	
Refine/Repair Design											Group	Group	
Final Demonstration													Group

Assigned Tasks	Owner
Team Leader	Diana
Processing	Sufiyan
Light	Anastasia
Audio	Diana
Mechanical	Anastasia
Power	Pate
User Input	Pate

Table 2: Schedule to complete Walrus the Oyster Eater

Integration

For the integration, after each subsystem was completed on its own. The subsystem must be designed, simulated, documented, built, and tested. Once in the testing stage, the subsystem underwent a series of tests to verify that the subsystem worked properly and as expected even under unusual circumstances. After the subsystem was completed, the subsystem was then integrated. For the first part of integration, each subsystem was connected to the power subsystem and then its outputs were tested to ensure that the components were working from the voltage provided. If the subsystem did not pass these second set of tests, debugging mode was entered and completed before continuing to the next step. After testing the previous part and the component was working, the next main connection can be made from the processing subsystem to each subsystem. After this, the rest of the connections were connected until it was all connected and working. Once integration was complete a series of tests were conducted to ensure the project was successful according to the requirements. Integration went from power to motor, to lights, to audio, etc.

Conclusion

Over the 13 weeks, Team 10A successfully completed our project “Walrus the Oyster Eater.” We successfully completed this project by following and updating our schedule to keep us on track. All our progress, struggles, and successes can be found in our Teams notebook. With the combined group effort were able to complete the projects requirements as established by the customer.