ALEXA ENABLED PET FEEDER

Divide and Conquer 1.0

Group No. 18:

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Customer:

Pet Owners

Motivation:

The Alexa Enabled Pet Feeder is a device that dispenses food for your pet. The feeder will be set up to dispense food whenever the user wants it to through the Alexa application or through an Alexa enabled speaker (for example an echo dot). The motivation for this project is that it can be very frustrating to leave your home only to realize that you forgot to feed your pet. This will allow you to keep your pets happy easily and conveniently. Since COVID started, users are often times staying at home and can feed their pets whenever it is time for them to eat. As the government begins lifting restrictions and people start to return to their workplace, their pets will once again be left at home alone. Along with this, we as students will be graduating soon and entering the work force, leaving our pets, and wanting a solution to provide optimum care for our furry friends. This project could help save time and make it stress free.

Project Narrative/Goal:

The main goal of this project is to create an Alexa enabled pet feeder. The objectives are to allow users to easily feed their pets when they are at home, or on the go. We are going to utilize a scale to know how much food to give at one time. Additionally, we would like to incorporate a camera that will allow the user to see if their dog is eating, or if it has already eaten. The camera will also act as a safety feature incase that the scale that we are going to implements fails. We want this device to be easy to use, low cost, and run-on low power.

Easy to use is crucial for our project. We want the user to be able to easily integrate our device with their Alexa account. Moreover, we want it to be easy for the user to set the desired food quantity and dispense said amount. On ease of use another important factor is cleanliness. We want our feeder to incorporate a bowl that can be easily interchangeable and be removed for cleaning. Preferably the bowl will be waterproof, so that it can easily be cleaned in the sink. The main food container should also be easily removed and cleaned, to make sure that the device does not smell bad or is significantly dirty after weeks of use. We will include a bowl to make sure that the scale reading is accurate to how much food is going to be dispensed.

Low cost is also an important factor. There are solutions in the market for automatic pet feeders, but they are very expensive at over $80. Not only that, but they are not Alexa enabled. We want our device to offer great value to our customer and offer more functionality than the devices currently in the market.

Another important aspect of this project is RFID identification. The plan for this is to attach an RFID tag to the pet and once they are hungry and go over to the pet feeder. The RFID will be close enough to the reader and if enough time has passed, it will dispense food for the pet. This is another fail safe plan for the project incase nobody is home, and the Alexa does not have the automated feeder schedule turned on.

An aspect of this project is to have some sort of ultrasonic sensor that is inside the housing unit to alert the user when the unit is running low on food. This will be very important because the user would want to know when the feeder is running low on food in case, they are leaving the house for a period of time.

This project should also have a weight sensor that the bowl will sit on and once the user inputs a certain weight, the feeder will dispense food until that weight is reached on the sensor and will then shut off the motor. We choose to implement this idea into our project, because we

wanted something to control the amount of food that is being given to the pet. Since we have multiple ways to dispense food in the project, we want it where no matter which method is chosen to dispense food, it will always dispense the same amount, so we are not over/under feeding the animal.

The idea is to make our pet feeder extremely low power. Some of the devices on the market must be plugged in, which is very inconvenient. By making our device battery power, it will make it easier to install, since the user can install it wherever they want without worrying about power. Since the device will be operated by batteries, there will be an indicator that will tell the battery level. The battery will not be some special component that you need to buy but instead will be AA batteries that you can find around the house.

There will be simple to use app that will allow the user to be able to dispense whenever they want. If the user dispenses food manually then the timer for the next automatic dispensing will refreshing to their desired time so the user does not have to worry about having too much food out. The app can give notification to the user like when to clean the bowl, battery level, and when the food level is running low.

Stretch Goals:

Some stretch goals of this project include:

- Machine learning to recognize a specified pet (dog or cat) and dispense only when that pet approaches the unit. This would serve as an alternative for RFID sensing to operate the dispenser.
    - Constraints on this would-be budget. It will cost more to buy a processor capable of preforming machine learning. A quality camera will also be more expensive.
- Accommodating food storage to match the battery life goal of 7 days.
    - Constraints include having to increase the size of the storage container and possibly the whole unit. May need to provide an external food hopper to accomplish this.
- Solar powered battery charging. This would be helpful so that we do not have to worry about batteries dying and therefore we can stay away from home for a longer period of time if needed.
    - Constraints include budget and light source in the user's home.

Requirements and Specifications:

#	Requirement	Specification
1	Battery Life	The battery shall last a minimum of 1 week.
2	RFID	The RFID shall only turn on the stepper motor once every 5 hours so the pet will not overeat.
3	RFID Range	The RFID shall be able to read from at least 1 meter.
4	Power	The microcontroller shall be able to accept at least +5V
5	Wi-Fi Range	The range of the Wi-Fi/Bluetooth module shall cover all of the home or at least 100ft.
6	Cost	The cost of this project shall not exceed $400 total or equivalent to $100 per person.
7	Housing Unit	The housing unit shall hold 3 days' worth of food or the equivalent of 6 total meals.
8	Food Measurement Sensing	Utilizing a calibrated pressure sensor, the user should be able to set a desired amount of food (such as 1 cup) and no matter which method is chosen to feed the pet, the feeder will dispense food with no less than 80% accuracy.
9	Scheduling	The user shall be able to set the time when the food should be dispensed through the app.
10	Food Supply Level Sensing	The unit will have an internal sensor to alert the user when the food supply is running low, with approximately 2 servings (1 days' worth) of food is left.

Table 1: Requirements and Specifications

Housing Unit/Hardware Specifications:

- The enclosure shall be built so that the electronics of it will not be able to be seen from the outside.
- The electronics will be safe from pet interference, tampering and slobber from eating.
- The removable bowl and dispenser shall allow for easy cleaning.
- The feeding bowl shall be interchangeable to accommodate pet preferred bowl types.
- The food hopper will be easily accessible for cleaning and refilling.
- The food dispensing control will be done using an auger type driver to release the food.

Electrical Specifications:

- The microcontroller shall have enough pins to be able to support all the features of our project.
- The microcontroller shall be able to be controlled through an app, Alexa, and RFID tags.
- The pet feeder shall have Bluetooth/Wi-Fi communication so that the motor can be controlled through an Amazon Echo (Alexa).
- The bowl shall incorporate a scale to enable users to easily set a desired amount of food.
- The stepper motor shall allow for accurate food dispensing and enough torque to hold food that is in the dispenser.
- The battery will be large enough to power the unit for 1 week.
- The combined electrical hardware will be efficient enough to operate the unit for 1 week from the selected internal battery.
- The built-in battery will be rechargeable using an AC wall plug.

Software Requirements:

- The stepper motor shall only turn on till the desired weight is reached and the stop and not dispense anymore food.
- The application shall be able to turn on the feeder as well.
- The stepper motor shall have a voice activated feature which will be hooked up through Amazon Echo.
- The software shall be able to extract the weight from the pressure plate to ensure correct amount of food is dispensed.

Hardware Block Diagram

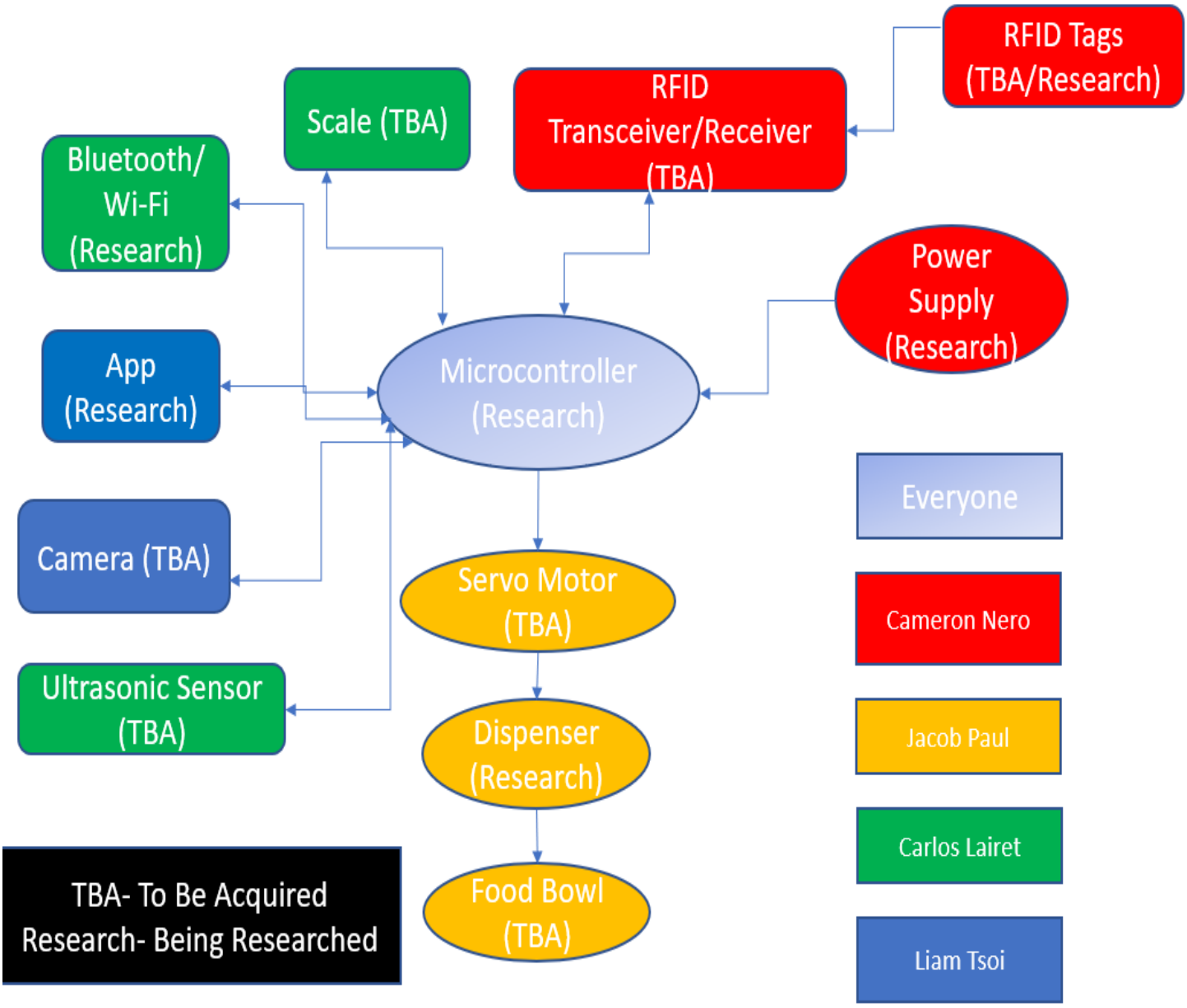

Figure 1: Hardware Block Diagram

Software Block Diagram

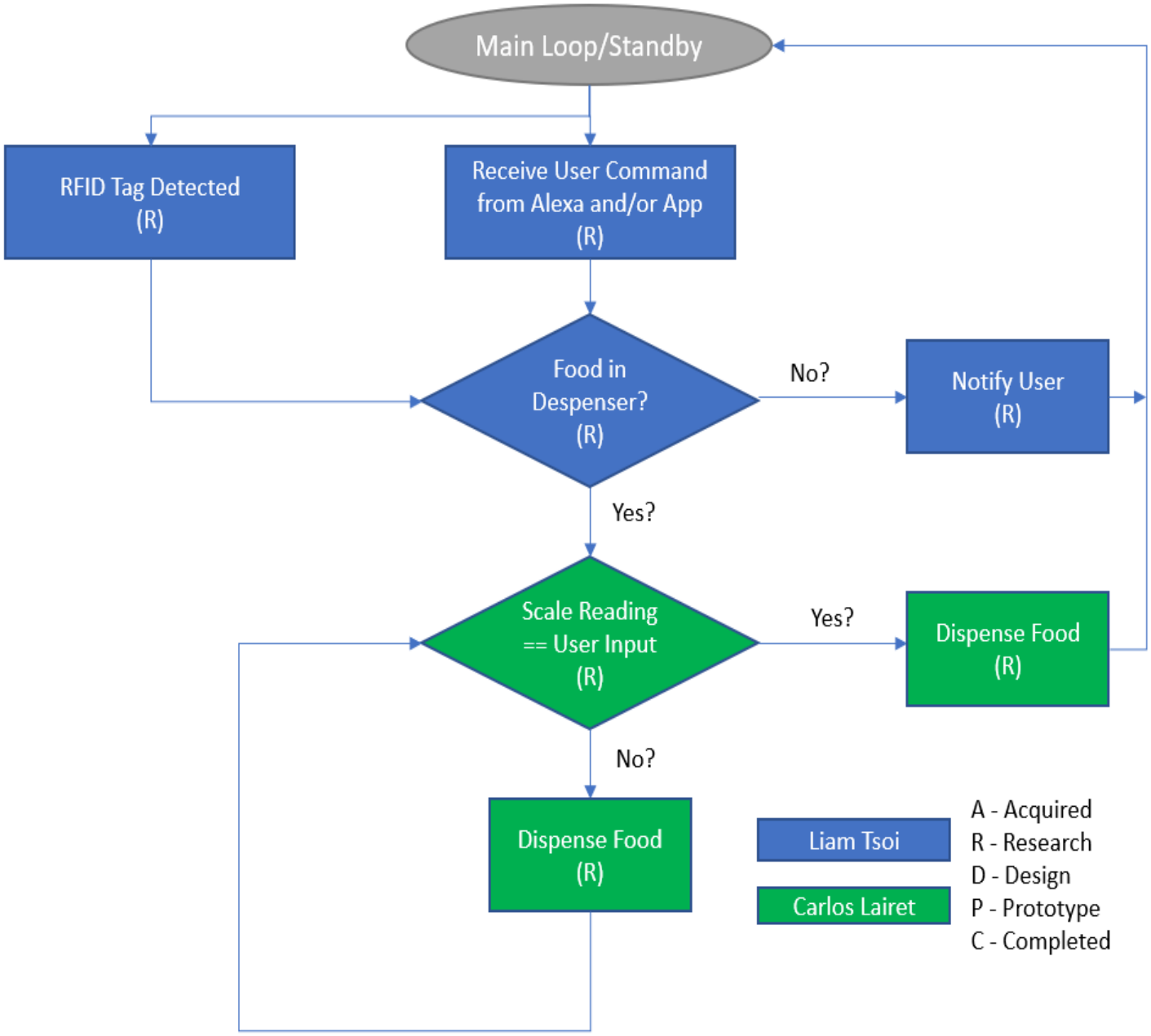

Figure 2: Software Block Diagram

House of Quality

The house of quality shown below (Figure 3) shows the customer and engineering requirements and specifications and their correlation to one another whether that be a positive or a negative correlation.

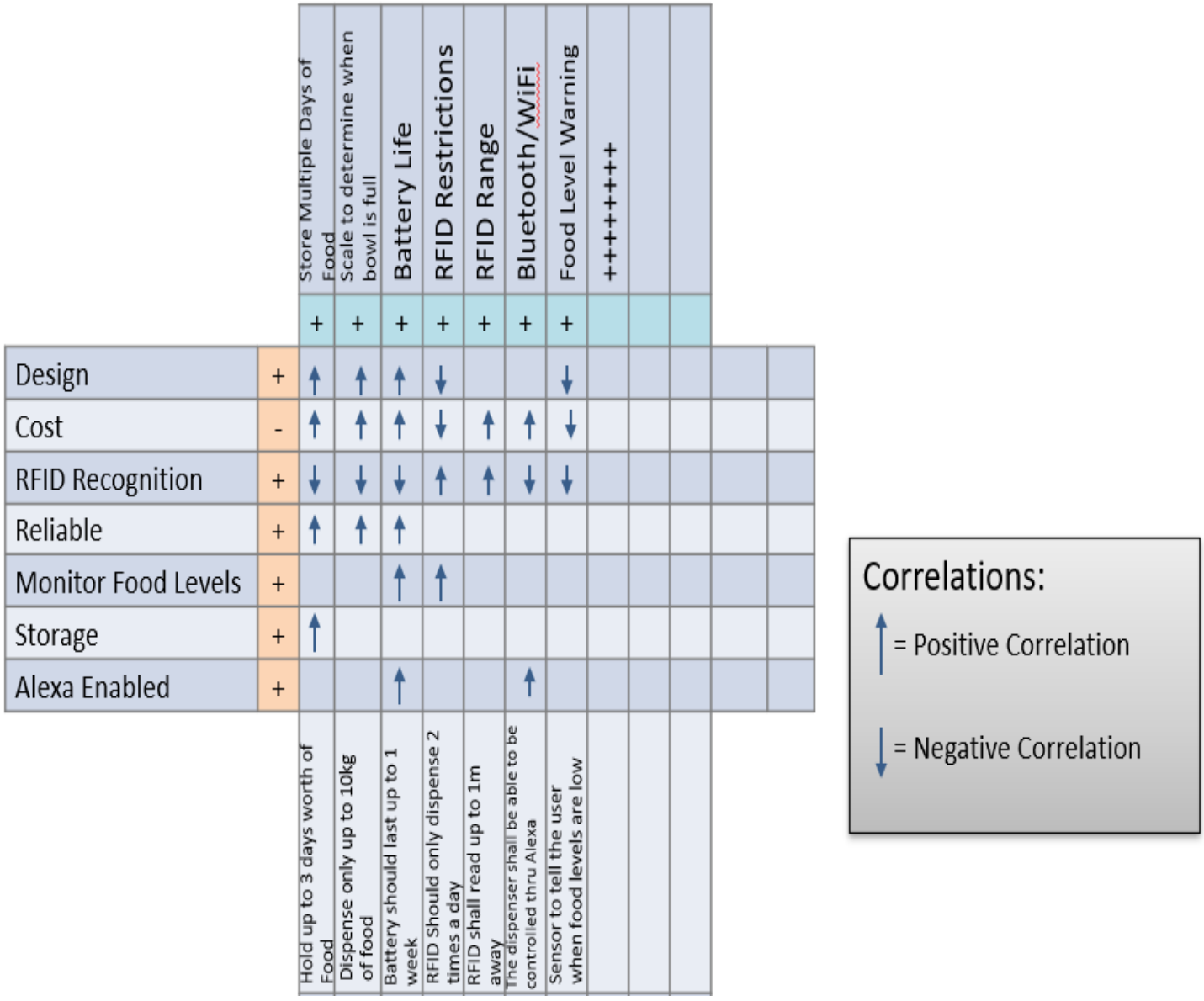

Figure 3: House of Quality

Finances (Some prices are Tentative)

The funds for this project will be provided by all four team members and will be split evenly.

Materials	**Cost**
MCU	$10
Housing	$50
Amazon Alexa	N/A (owned)
PCB	$100
Servo motor(s)	$20
Camera (analog w/ built in swivel or accompanying servo)	$10
Ultrasonic Sensor	$5
Pressure sensor	$10
Bluetooth module	$10
3D printed parts	$20/KG (one spool)
Display screen	$6
Wi-Fi module	$16
Breadboard, wiring, LEDs	$18
Bowl	$5
Food Holding Hopper	$10
Auger (possibly 3D printed)	$17
Batteries	$50
Miscellaneous	$41
Total	$395

Table 2: Materials and Cost

Milestones

Spring 2021			
Week(s)	Milestone	Start	End
1 & 2	Come up with project ideas	1/11/2021	1/21/2021
3	Finish Divide and Conquer 1.0	1/22/2021	1/29/2021
4 & 5	Start Research and Update Divide & Conquer 2.0	1/30/2021	2/12/2021
6-8	Research Power Consumption and Constraints	2/13/2021	2/27/21
8-11	Research on Programming Microcontrollers	2/28/21	3/26/2021
12	Work and Finish 60 Page Draft	2/13/2021	4/2/2021
13 & 14	Continue Research and Finish 100 Page Report	4/2/2021	4/16/2021
15	Start to Order Materials/Components	4/16/2021	4/23/2021
16	Finish Final Document and Submit	4/16/2021	4/27/2021

Table 3: Spring 2021 Milestones

Summer 2021			
Week(s)	Milestone	Start	End
1 & 2	Start to build Housing Unit/ Prototype	5/17/2021	5/28/2021
3	Begin to test Components/Hardware /Software	5/28/2021	6/4/2021
4	Fix/Fine Tune Documents & Continue to Test	6/4/2021	6/11/2021
5	Finish Prototype	6/11/2021	6/18/2021
6	Make Adjustments/Continue to Test	6/18/2021	6/25/2021
7	Final Testing	6/25/2021	7/2/2021
8	Final Adjustments to Document	7/2/2021	7/9/2021
9	Finalize Project & Documentation	7/9/2021	7/16/2021
10, 11 & 12	Final Demonstration/Documentation	7/16/2021	8/6/2021

Table 4: Summer 2021 Milestones