



S.P.I.C.E.

Critical Design Review (CDR)

A creative solution for assisted cooking



Salty Seniors

The Problem

01

61 Million
Americans Live
with Disabilities

02

37 Million
Americans are
Motor Impaired

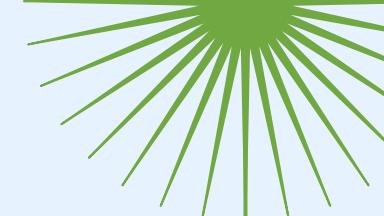
03

27% of
Americans over
60 live alone

04

100% of People
need to eat

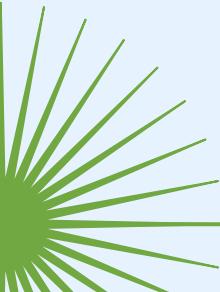
Goals and Objectives



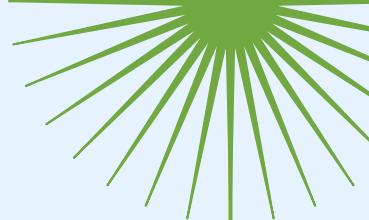
01 Accessibility

02 Convenience

03 Easy Maintenance



Testable Requirements



01

Accessibility

- Supports up to 8 spices in a mix
- Simple and intuitive interface (Time requirement)
- Accurate dispensing, down to ± 0.1 teaspoon

02

Convenience

- Product is easy to move (Fits in 45cm x 45cm x 45cm)
- S.P.I.C.E. dispenses within time frame (at most 1 min)

03

Easy Maintenance

- Components can be disassembled
- Individual components can be washed
- Motors can be replaced with relative ease





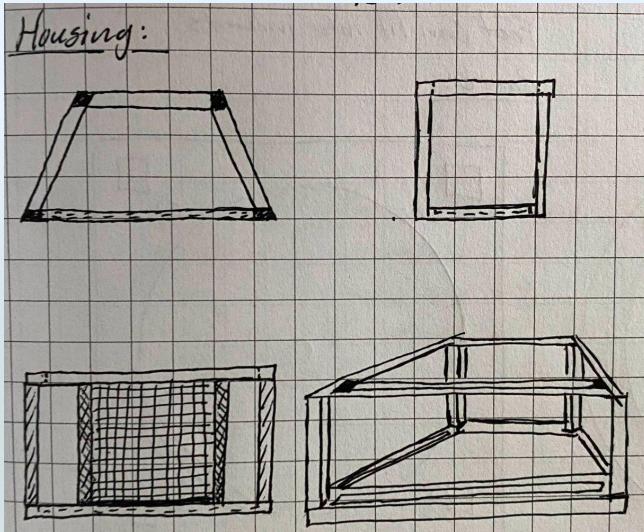
Design Alternatives & Changes

Updates to the proposed design

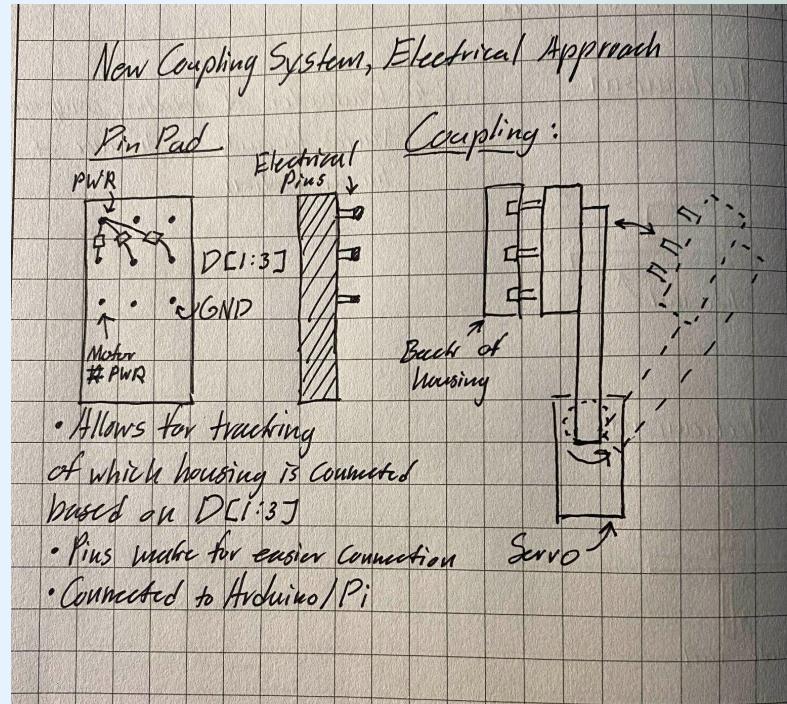
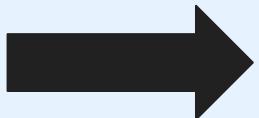
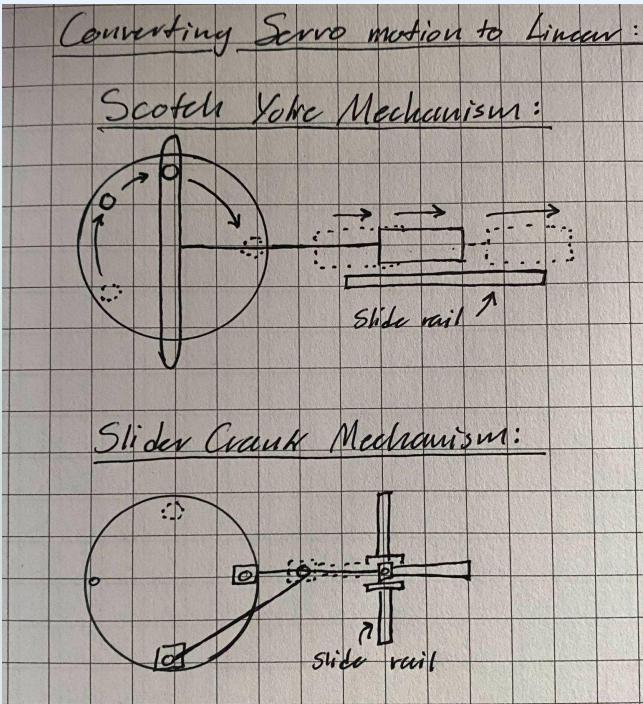
- Container change (Custom → Spice Bottle)
- Coupling system (Motor coupling → Pin coupling)
- Bearing gear (Split into four pieces for printability)
- Number of motors (Single Motor → Motor with each housing)
- Battery power for motor driver (5V → 9V power supply)
- Recipe database (Web Scraping → on-board memory)
- Updated budget (Added cost of 3D printing and more DC motors)



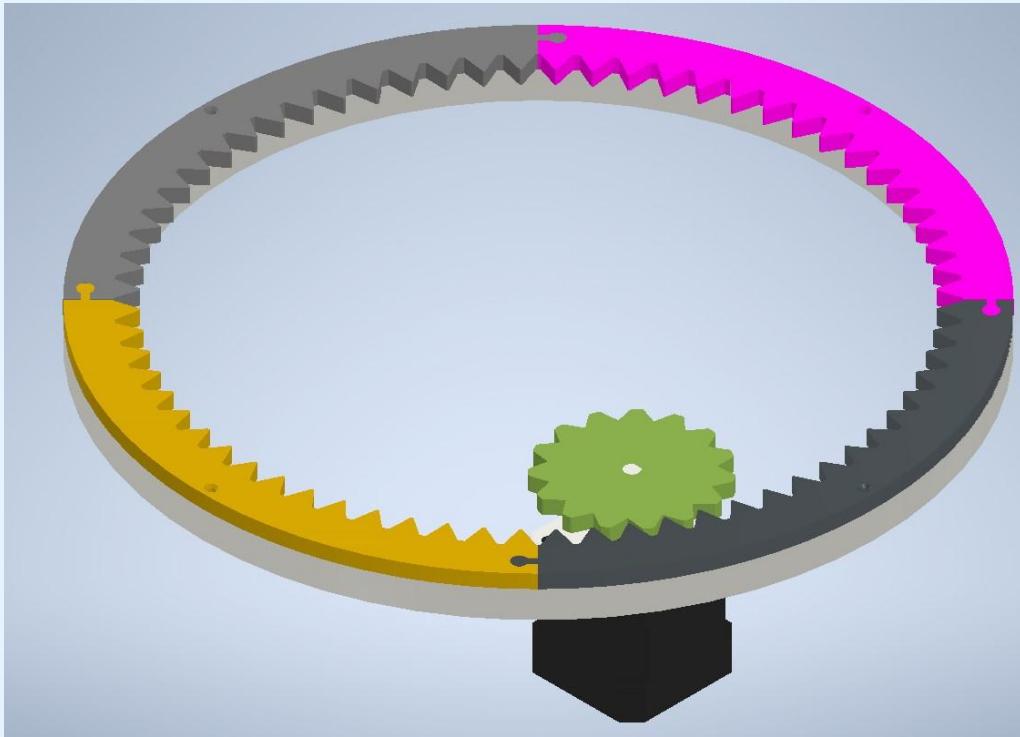
Container Change



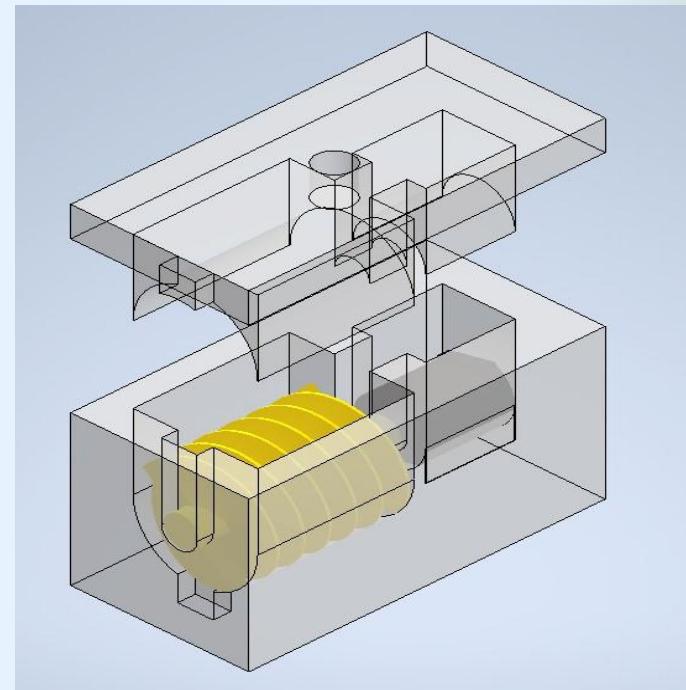
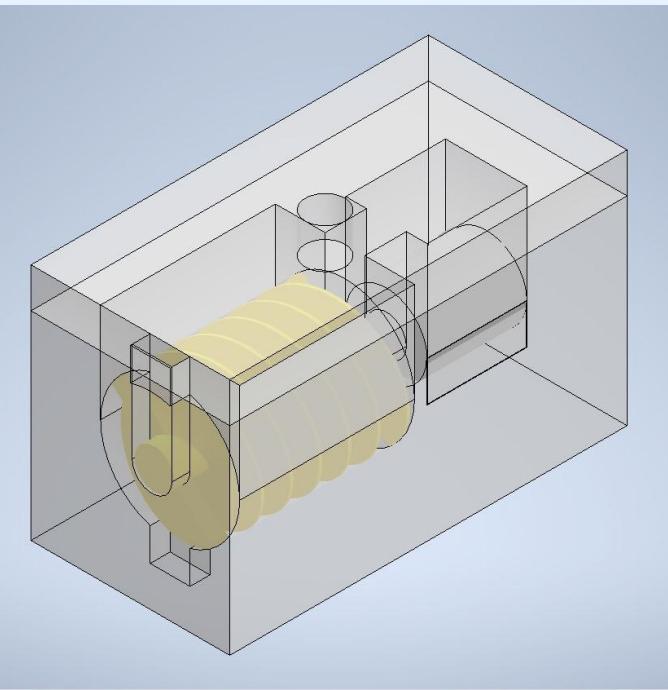
Coupling System



Bearing Gear

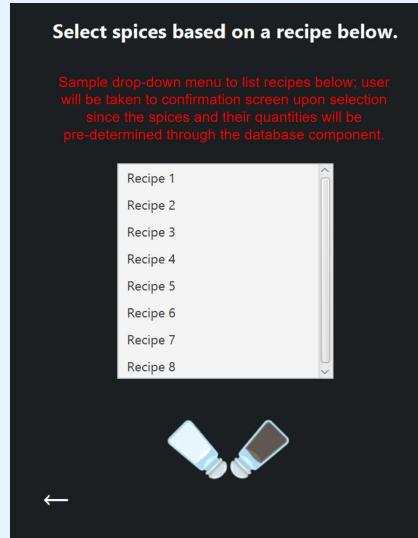


Number of Motors



Recipe Database

- Instead of an online search feature, S.P.I.C.E. will use a database uploaded to the Raspberry Pi for the recipes
 - No need for a keyboard to be implemented; user can just select from a list of recipes stored in the local database



Updated Budget

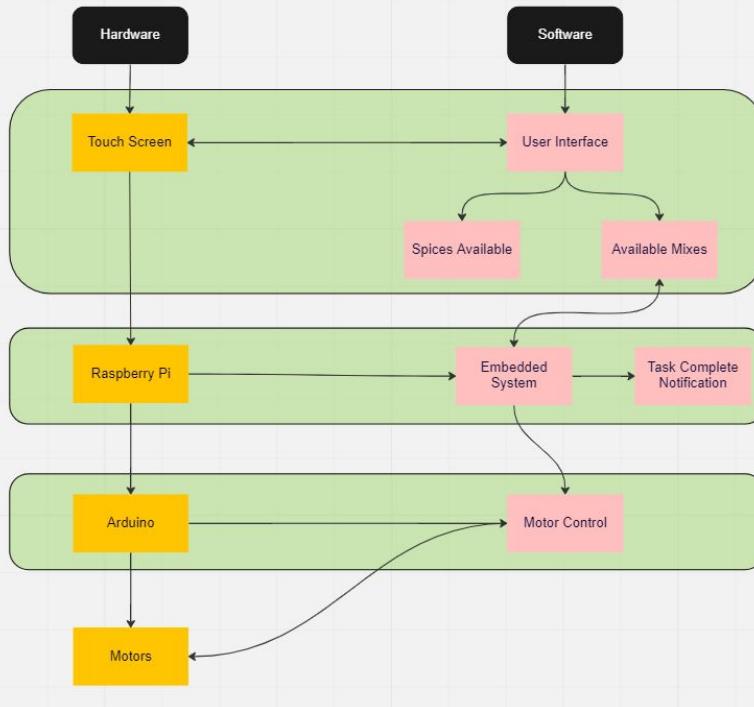
| Item | Quantity | Cost Per Item | Total Cost |
|-------------------------------|----------|---------------|------------|
| Raspberry Pi Touch Screen | 1 | \$63.99 | \$63.99 |
| Brown PLA 1.75mm (1kg) | 2 | \$19.99 | \$39.98 |
| High Torque DC Motor | 0 | \$30.72 | \$0.00 |
| HDMI to Micro HDMI Adapter | 0 | \$8.99 | \$0.00 |
| 4 Pack L298N Motor Controller | 1 | \$11.59 | \$11.59 |
| Bearing Table | 1 | \$15.99 | \$15.99 |
| 20 kg Servo Motor | 1 | \$12.99 | \$12.99 |
| 3D Printing Services (\$/g) | 2500 | \$0.03 | \$75.00 |
| Total | \$219.54 | | |





System Specifications

System Description



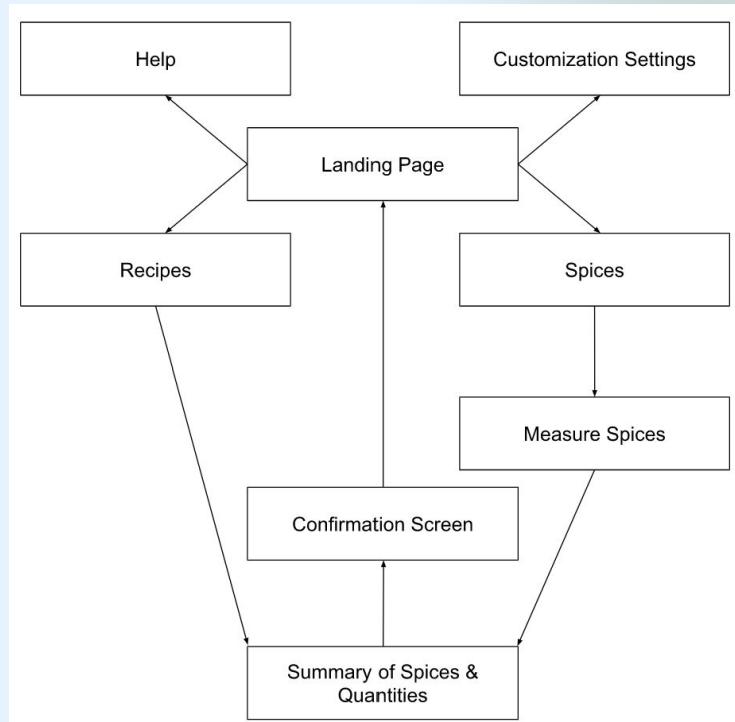
Hardware

- Touch Screen
 - Main point of contact for users; displays UI
- Raspberry Pi
 - Process human interactions and send data to the arduino
- Arduino
 - Controller for servos and motors throughout the device; receives instructions from Raspberry Pi on which motors to activate depending on user input from UI
- Motors
 - Distribution motor for each housing component

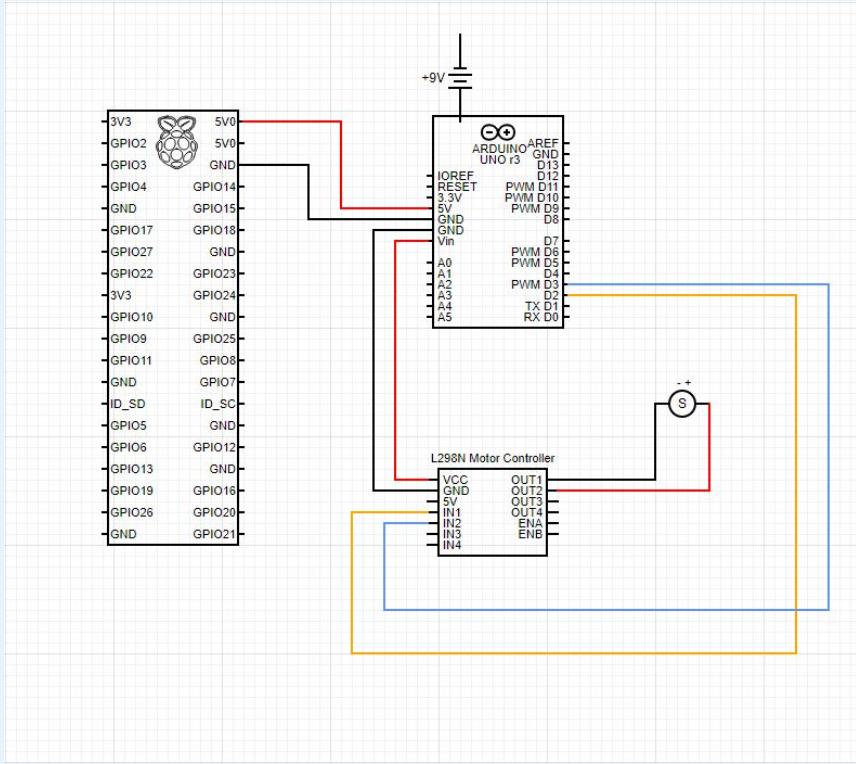


Software

- User Interface
 - User can choose between two different options for dispensing
 - Spices
 - User can manually measure quantities of spices in tsp with the use of a slider
 - Recipes
 - Database to store recipes and their spices



Circuit Diagram

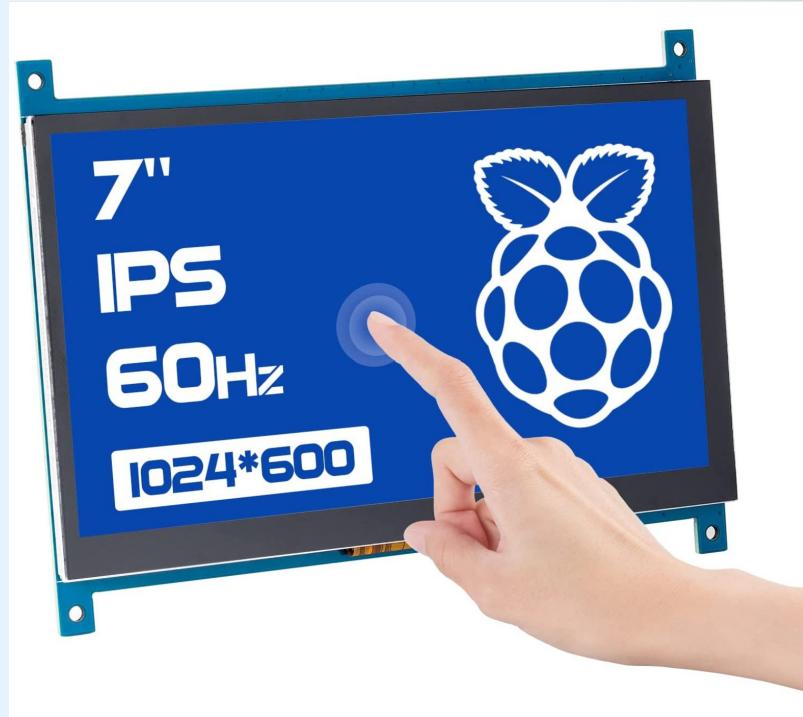




User Interface

Interface

- Resolution: 1024x600
- Size: 7 inches
- Operating Voltage: 5V



UI Design

- Landing Page
 - Spices
 - Measurements
 - Recipes
 - Use recipe database to store recipes and their spices
 - Mappings
 - Assign spices to containers



Landing Page

Welcome to S.P.I.C.E.

Choose an option below to proceed.

Spices Select spices of your choice.

Recipes Select spices based off a recipe.

Mappings Assign spices to containers.





Spice, Recipe, Mapping Pages

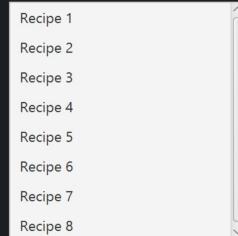
Choose a spice below to dispense.

(User can select spice from drop-down below; spice names to change later based on spices in the system)



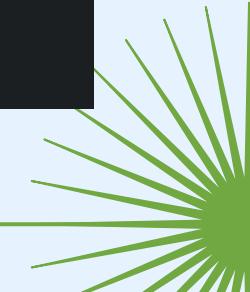
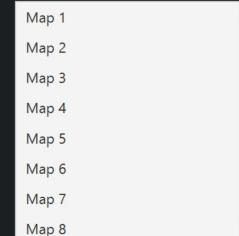
Select spices based on a recipe below.

Sample drop-down menu to list recipes below; user will be taken to confirmation screen upon selection since the spices and their quantities will be pre-determined through the database component.



Assign mappings to each of the spices.

Sample drop-down menu shown below; may create another page to display a list of spices to assign each mapping to.



Measurement Page

Measure the quantity of the spice below.



Quantity: 25 tsp

Use slider to measure quantity of spice the user selected; UI to later display the selected spice name at the top of the screen. Sample quantity displayed above to demonstrate slider functionality.



← →



Confirmation Page

Do you want to dispense the following spices?

Sample format (based on user-selected spices or recipe containing pre-selected spices):

- (Spice name) - (User-selected quantity)
- (Spice name) - (User-selected quantity)
- (Spice name) - (User-selected quantity)
- ...

CONFIRM



←





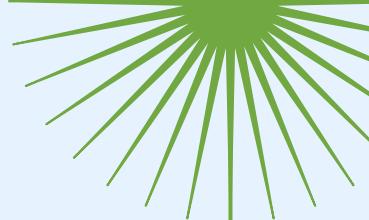
Design Validation

Validation Procedures

- Test UI for accessibility and usability
 - Record average time it would take to input data into the system
 - Test buttons and each page throughout development
- Durability
 - Test the system in its intended environment (kitchen)
 - Expected to operate under 65–75°F
 - Observe behavior of components in relation to temperature
- Accuracy
 - Would require hardware to be synchronized with UI
 - Take various measurements of spices via user input and compare measurements generated by S.P.I.C.E. with manual measurements
- Final round of testing with the fully integrated system
 - Test any possible edge cases



Vision for Demonstration



01

Spice Dispensing (Mixes)

02

Moving with spices
attached (Seal Test)

03

Cleaning Demo





Team Structure & Management

Updated Task Outline

| WORK BREAKDOWN STRUCTURE | TASK TITLE | TASK OWNER | AMOUNT OF WORK IN HOURS | | | SPRINT | START DATE | DUE DATE | DURATION | PCT OF TASK COMPLETE |
|--------------------------|---------------------------------------|---------------|-------------------------|-----------|-----------|--------|------------|-----------|----------|----------------------|
| | | | ESTIMATE | COMPLETED | REMAINING | | | | | |
| 1 | Proposal | | 67 | 67 | 0 | | | | | 100% |
| 1.1 | Project Proposal | ALL | 18 | 18 | 0 | 0 | 2/13/2023 | 2/15/2023 | 3 | 100% |
| 1.1.1 | Presentation | ALL | 8 | 8 | 0 | 0 | 2/13/2023 | 2/15/2023 | 3 | 100% |
| 1.2 | General Design of Parts | ALL | 10 | 10 | 0 | 1 | 2/16/2023 | 2/22/2023 | 7 | 100% |
| 1.3 | Gather Parts | Carlos | 3 | 3 | 0 | 1 | 2/16/2023 | 2/22/2023 | 7 | 100% |
| 1.4 | Draft Design of Mechanical Components | Caleb, Carlos | 12 | 12 | 0 | 1 | 2/16/2023 | 2/22/2023 | 7 | 100% |
| 1.5 | Draft Design of UI | JP | 8 | 8 | 0 | 1 | 2/16/2023 | 2/24/2023 | 9 | 100% |
| 1.6 | Draft Design of Microcontroller | Kile, Caleb | 8 | 8 | 0 | 1 | 2/16/2023 | 2/24/2023 | 9 | 100% |
| 2 | Design | | 46 | 34 | 12 | | | | | 74% |
| 2.1 | Finalize Motor Mechanism | Caleb, Carlos | 12 | 6 | 6 | 2 | 2/22/2023 | 3/1/2023 | 8 | 50% |
| 2.2 | Finalize Sliding Shaft | Caleb, Carlos | 12 | 6 | 6 | 2 | 2/22/2023 | 3/1/2023 | 8 | 50% |
| 2.3 | Begin working on UI | JP, Carlos | 22 | 22 | 0 | 2 | 2/26/2023 | 3/8/2023 | 11 | 100% |
| 2.4 | Begin work on Arduino | Kile, Caleb | 22 | 22 | 0 | 2 | 2/26/2023 | 3/8/2023 | 11 | 100% |
| 3 | Fabrication | | 220.8 | 3 | 217.8 | | | | | 1% |
| 3.1 | Fabricate Rotating Base | Caleb, Carlos | 13.8 | 0 | 13.8 | 3 | 3/1/2023 | 4/3/2023 | 34 | 0% |
| 3.1.2 | Fabricate Housings (Motor Bases) | I | 116 | 0 | 116 | 3 | 3/5/2023 | 4/3/2023 | 30 | 0% |
| 3.1.3 | Fabricate Corkscrew Dispensers | I | 18 | 0 | 18 | 3 | 3/19/2023 | 4/3/2023 | 16 | 0% |
| 3.2.1 | Design Pin Connection | I | 6 | 3 | 3 | 3 | 3/22/2023 | 4/3/2023 | 13 | 50% |
| 3.2.2 | Fabricate Pin Connection | I | 14 | 0 | 14 | 3 | 3/22/2023 | 4/5/2023 | 15 | 0% |
| 3.1.4 | Attach Motors | V | 8 | 0 | 8 | 3 | 4/5/2023 | 4/7/2023 | 3 | 0% |
| 3.3.1 | Finalize UI | JP | 3 | 0 | 3 | 3 | 3/8/2023 | 3/24/2023 | 17 | 0% |
| 3.3.2 | Integrate Touch Screen | JP, Kile | 12 | 0 | 12 | 3 | 3/24/2023 | 3/29/2023 | 6 | 0% |
| 3.4 | Finalize Arduino Functionality | Kile | 30 | 0 | 30 | 3 | 3/8/2023 | 3/29/2023 | 22 | 0% |
| 4 | Validation | | 127 | 0 | 127 | | | | | 0% |
| 4.1 | First Round Validation | All | 16 | 0 | 16 | 4 | 4/10/2023 | 4/12/2023 | 3 | 0% |
| 4.2 | Fix Mechanical Issues | Caleb, Carlos | 20 | 0 | 20 | 4 | 4/12/2023 | 4/17/2023 | 6 | 0% |
| 4.3 | Add Spice Mix functionality | JP, Kile | 16 | 0 | 16 | 4 | 4/10/2023 | 4/17/2023 | 8 | 0% |
| 4.4 | Second Round Validation | All | 15 | 0 | 15 | 4 | 4/17/2023 | 4/21/2023 | 5 | 0% |
| 4.5 | Final Fixes | All | 30 | 0 | 30 | 4 | 4/21/2023 | 4/28/2023 | 8 | 0% |
| 4.6 | Final Round Validation/Updates | All | 30 | 0 | 30 | 4 | 4/21/2023 | 4/28/2023 | 8 | 0% |



Updated Schedule (Gantt Chart)



Roles

| Role | Member(s) |
|--|--|
| Project Manager | Carlos Zapata III |
| Mechanical Design | |
| <ul style="list-style-type: none">• Component Modeling• Material Acquisition• Hardware Placement | <ul style="list-style-type: none">• Caleb Herrera, Carlos Zapata III• Carlos Zapata III• Caleb Herrera |
| Software Design | |
| <ul style="list-style-type: none">• UI Designer• Microcontroller Specialist• Hardware Networking | <ul style="list-style-type: none">• JP Bartsch• Kile Zimmermann• JP Bartsch, Kile Zimmermann |
| Validation Lead | JP Bartsch |



Thanks

Do you have any questions?

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