S.P.I.C.E.

Final Design Showcase

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

Design Requirements

01 Accessibility

- Supports up to 8 spices
- 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

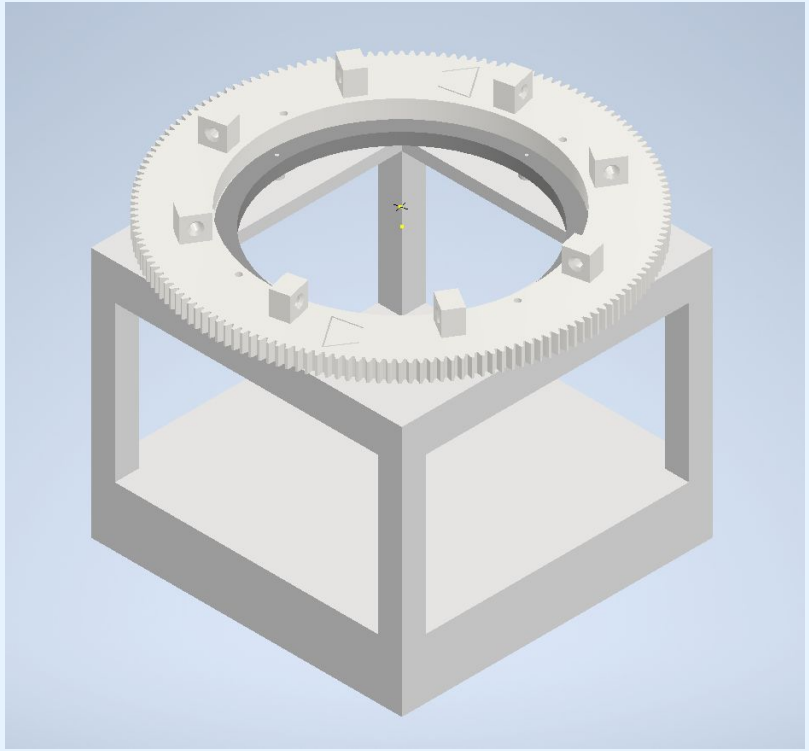
- Components can be disassembled
- Individual components can be washed
- Motors can be replaced with relative ease

Design Alternatives & Changes

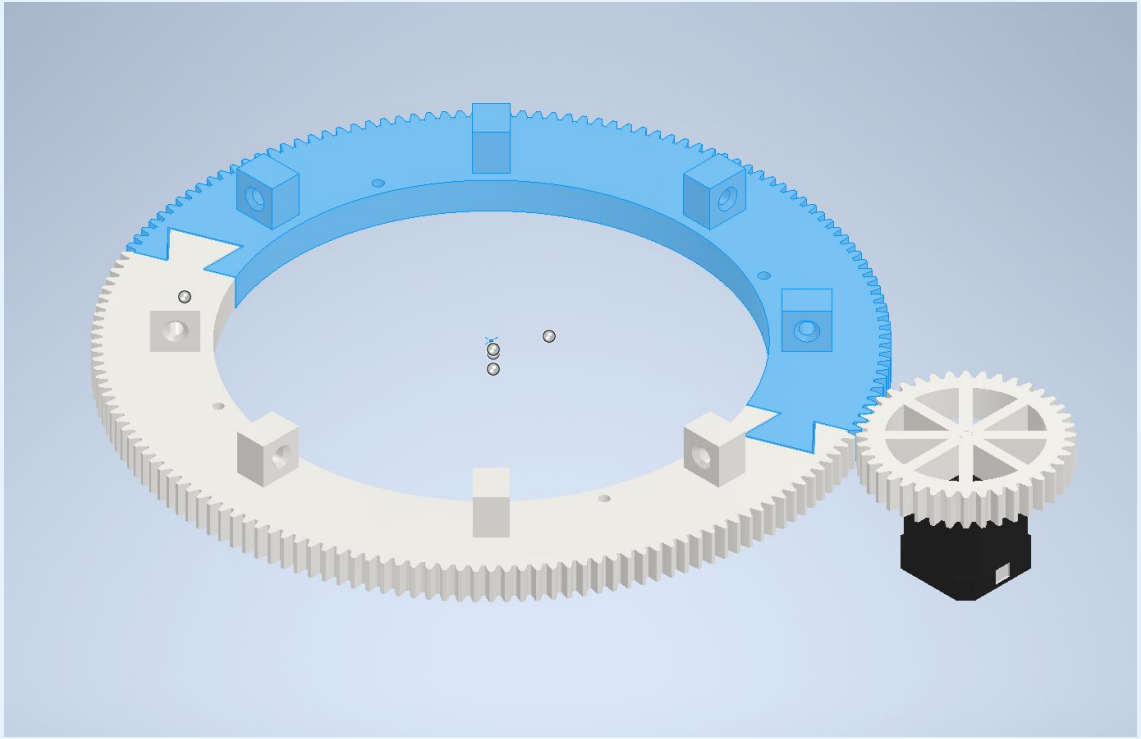
Design

- Container change (Custom → Spice Bottle)
- Bearing gear (Split into two pieces for printability)
- Number of motors (Single Motor → Motor with each housing)
- Battery power for motor driver (9V power supply → 12V power supply)
- Recipes (Web Scraping → on-board memory)
- Updated budget (Added cost of 3D printing and more DC motors)

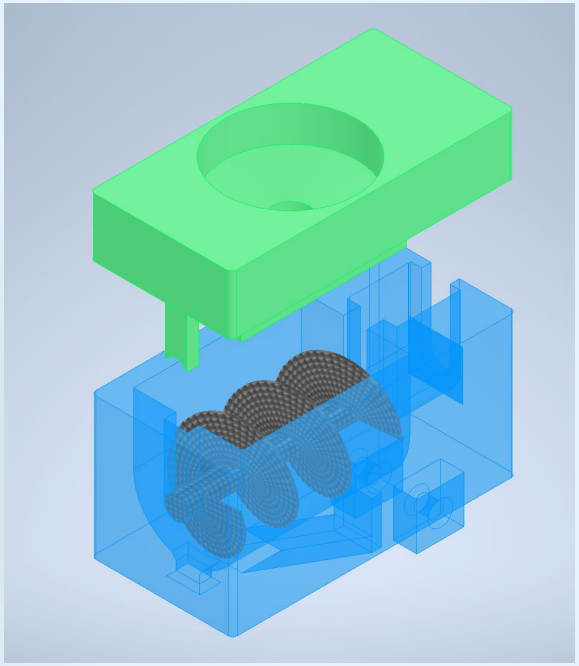
Base & Bearing Table

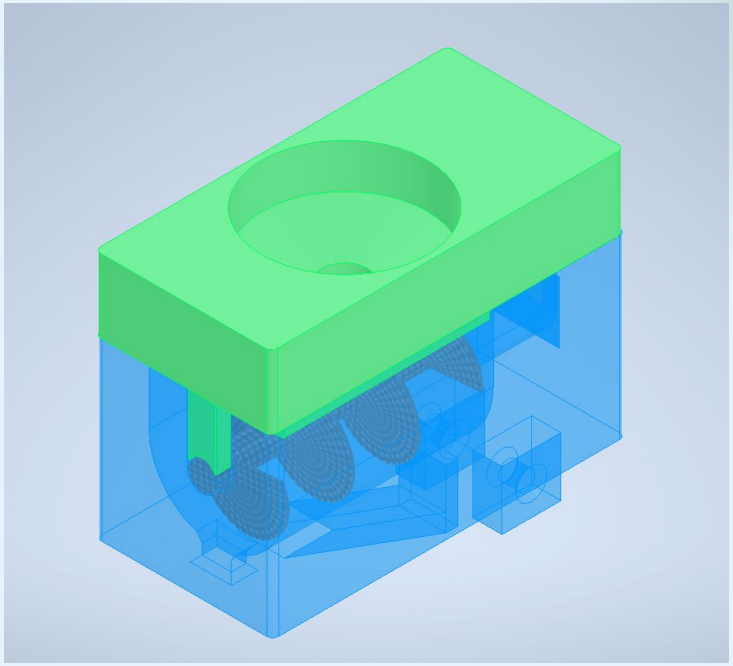


Bearing Gear

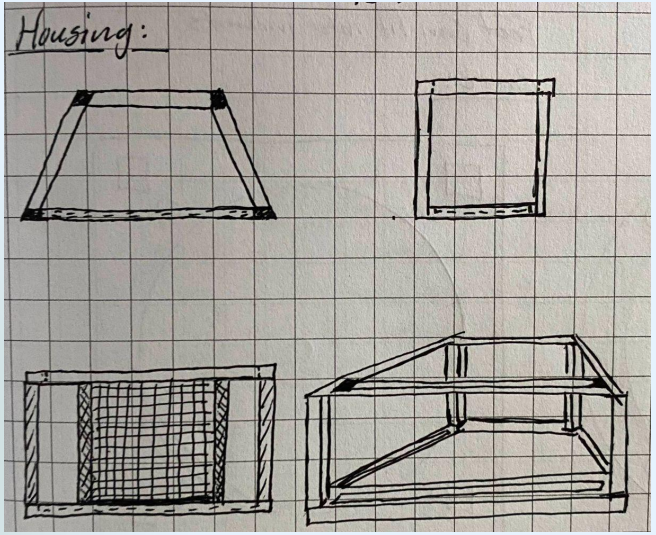


Number of Motors (Housing Design)



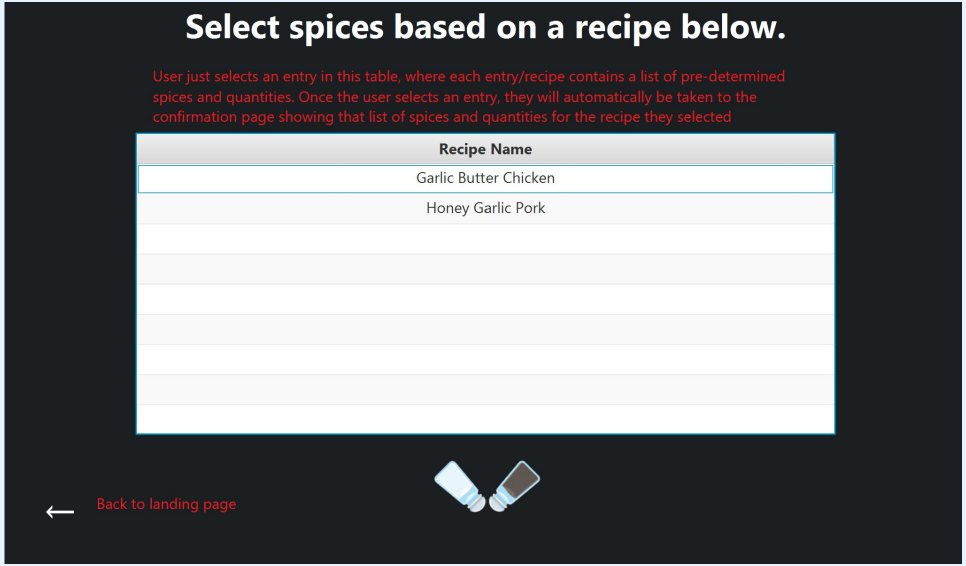


Container Change



Recipes

- Instead of an online search feature, S.P.I.C.E. uses a built-in class to store recipe data with their respective spices
  - No need for a keyboard to be implemented; user can just select from a list of recipes shown on the UI

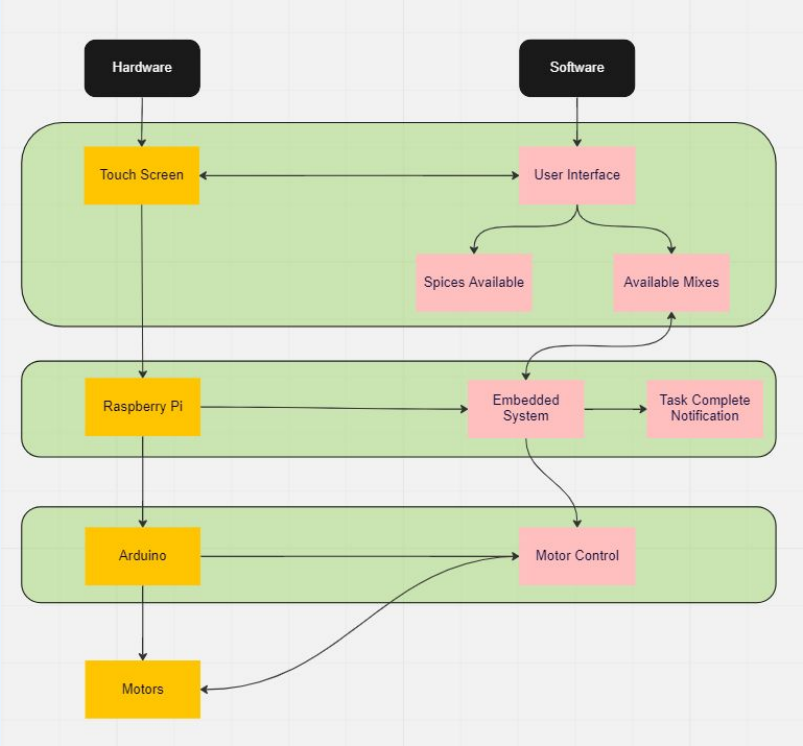


Final Budget

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
4 Pack L298N Motor Controller	1	$11.59	$11.59
Bearing Table	1	$20.82	$20.82
20 kg Servo Motor	1	$12.99	$12.99
6 Pack DC Motor	1	$8.99	$8.99
Stepper Motor	1	$12.99	$12.99
3D Printing Services ($/g)	982	$0.03	$29.47
Total	$200.82		

System Specifications

System Description

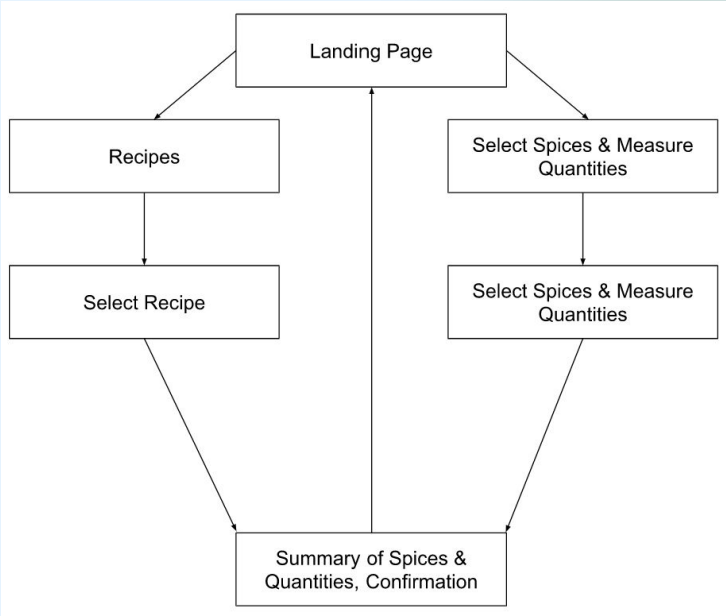


Hardware

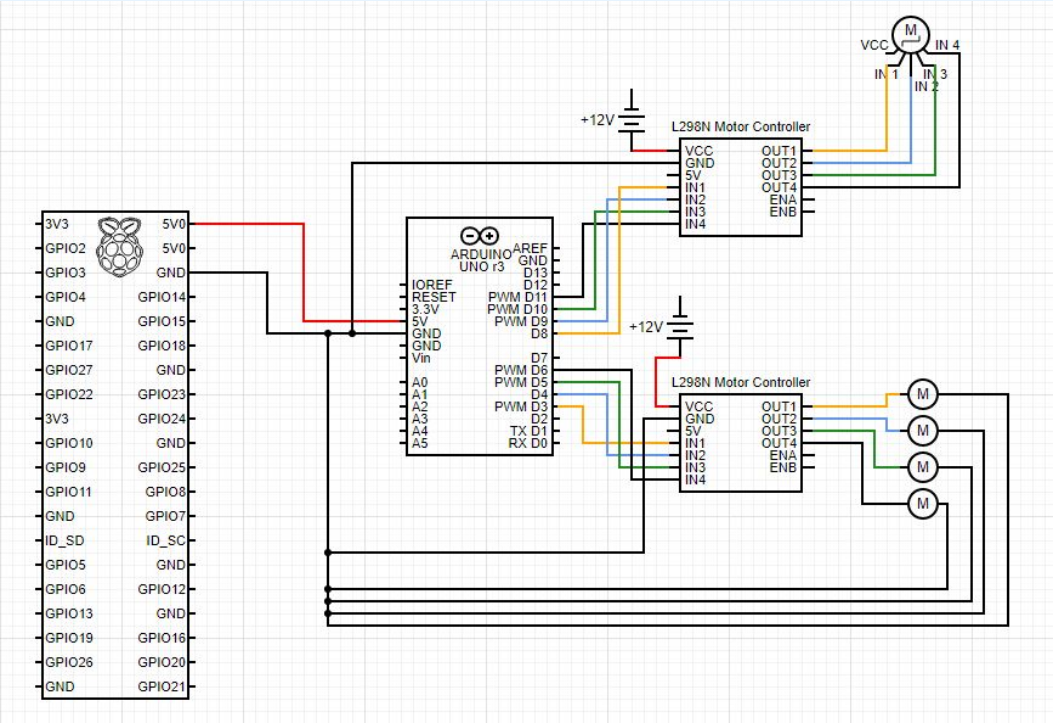
- Touch Screen
  - Main point of contact for users; displays UI
- Raspberry Pi
  - Process human interactions and send data to the arduino
- Arduino
  - Controller for servos and motors throughout the device; receives instructions from Raspberry Pi on which motors to activate depending on user input 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
    - Use a class to store recipes and their spices



Circuit Diagram



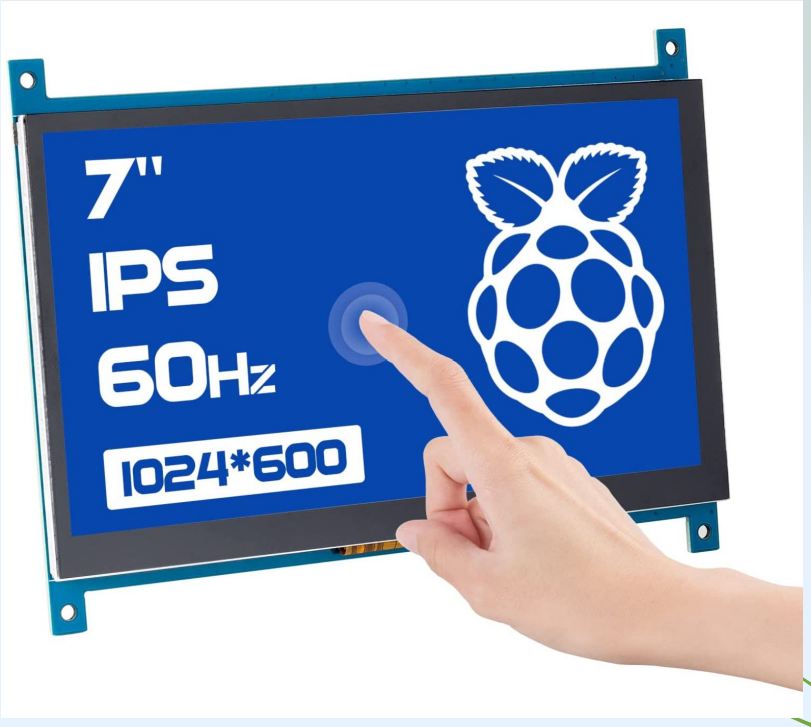
Two Motor Drivers:

- Stepper Motor
- Housing Motors

User Interface

Interface

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



UI Design

- Landing Page
  - Spices
    - Measurements
  - Recipes
    - Use recipes class to store recipes and their spices
  - Mappings
    - View spices and their assigned housings
      - Each housing represented with an integer value

Landing Page

Mapping Page

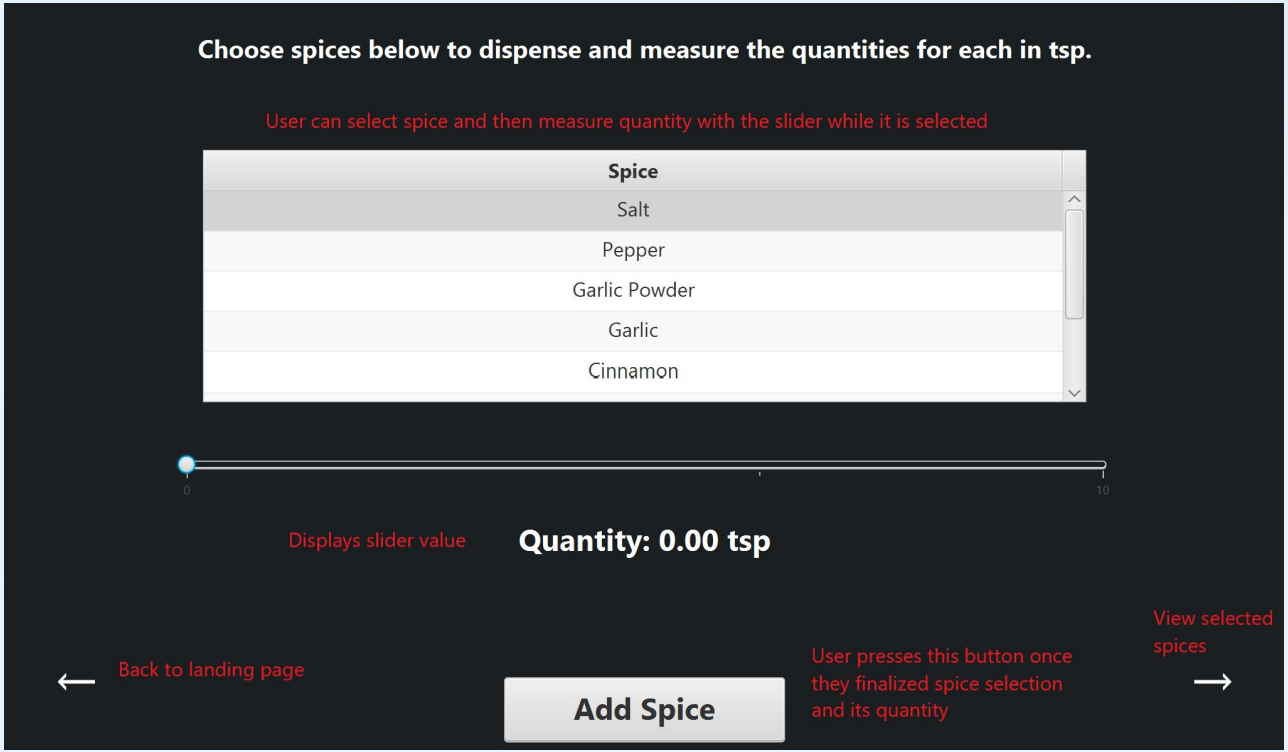
Mappings Table for Spices

Housing assignment for spices

Spice	Mapping
Salt	1
Pepper	2
Garlic Powder	3
Garlic	4
Cinnamon	5
Paprika	6
Curry Powder	7
Turmeric	8

← Go back to landing page

Spice Page


Choose spices below to dispense and measure the quantities for each in tsp.
User can select spice and then measure quantity with the slider while it is selected
Spice
Salt
Pepper
Garlic Powder
Garlic
Cinnamon
0
10
Displays slider value
Quantity: 0.00 tsp
Back to landing page
Add Spice
User presses this button once they finalized spice selection and its quantity
View selected spices

Recipe Page

Select spices based on a recipe below.

User just selects an entry in this table, where each entry/recipe contains a list of pre-determined spices and quantities. Once the user selects an entry, they will automatically be taken to the confirmation page showing that list of spices and quantities for the recipe they selected

Recipe Name
Garlic Butter Chicken
Honey Garlic Pork

← Back to landing page

Confirmation Page

Do you want to dispense the following spices?

If the user clicks on "Yes", the UI will send the mappings to the Arduino to process as signals to determine which motors will spin with a sequence of directions. User is also taken back to landing page

Spice	Quantity
Salt	1.71
Pepper	3.07
Garlic Powder	4.01

Back to recipes page or spices page

←

Yes

No

Clears the table of its data

Demo Video

https://www.youtube.com/watch?v=JAQy7jq56z0

Environmental Analysis

- The team used PLA for 3D printing various components for the device.
  - Housings
  - Lids
  - Spirals
  - Gears
- The finished product does not have any impact on the environment, as it is a household product and should not contribute to existing environmental issues such as pollution.

Environmental and Health/Safety Concerns

- Exposed Circuitry
  - All hardware is placed on top of the wooden frame without a cover
    - Potentially make a dome to cover up components
- Food Contact with Materials
  - PLA is deemed safe for food contact
  - Potential hazard of putting microplastics in food
- Requires a Stronger Power Source
  - 9V battery → not enough power for the entire system
  - Adjustable Power Supply
    - 12V & 2A → enough to power entire system reliably
  - Ideally, use a wall outlet

Social, Political, Ethical Concerns

Socially - This product is designed to be affordable and easily accessible to all people with a focus on the elderly.

Politically - This product doesn't currently have internet capabilities, but later iterations might. Models with access to the internet would also need to be secured similarly to other IOT devices to protect users data.

Ethically - Production emissions, plastic waste, and recyclability will need to be taken into consideration if this product became commercially available.

Economic Analysis

01 Economical Viability

02 Sustainability

03 Manufacturability

Economical Viability

- S.P.I.C.E. will be highly marketable to the community
- Similar products contain features that other products don't have
    - S.P.I.C.E. took inspiration from those products and integrated those features to become one working prototype
- Simplifies the difficult cooking process for elderly people living alone and those who are motor disabled
- Moderate cost since the product relies heavily on hardware and no resources are needed for the software besides the touchscreen

Sustainability

- Many parts are available from multiple vendors.
  - Makes it easier to replace parts if anything happens to them.
- Repairs on the device should be fairly straightforward if designed properly.
- The Raspberry Pi and Arduino are the only valuable components that will be hard to replace in the event that one or both of them break.

Manufacturability

- Tolerances are incredibly important to this design
  - Could lead to spices mixing unintentionally
- Friction between spirals and spices was an issue that we encountered; had to dispense spices without large amounts of spices inside housings

Test Results

- UI successfully displays on touchscreen with correct proportions and button responses
- Motors spin when housing is empty and when small amounts of spice have been loaded
- Stepper motor and individual DC motors correctly respond to serial communications
- Minimum of 12V required for stepper motor to rotate the main gear
- Adjustments had to be made to one of the housing lids; part of the motor shaft was most likely being blocked by it

Thanks

Do you have any questions?

CREDITS: This presentation template was created by **Slidesgo**, including icons by **Flaticon** and infographics & images by **Freepik**

Sources

1. J. Ausubel, “Older people are more likely to live alone in the U.S. than elsewhere in the world,” *Pew Research Center*, 24-Sep-2020. [Online]. Available: https://www.pewresearch.org/fact-tank/2020/03/10/older-people-are-more-likely-to-live-alone-in-the-u-s-than-elsewhere-in-the-world/. [Accessed: 13-Feb-2023].
2. C. Martinez, “Disability statistics in the US: Looking beyond figures,” Inclusive City Maker, 21-Nov-2022. [Online]. Available: