Mechanical Engineering
Carnegie Mellon University

SEAL & SERVE - Custom Drink Maker

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PROBLEM STATEMENT

The existing market for prepackaged drinks doesn't allow users to customize the flavor profile, sweetness or the strength (if alcoholic) of the drink. This **lack of customization** restricts consumers to the available options, leading to a compromise on personal preferences. Cocktail making can also be **time consuming** and requires skill. Conventional cocktail machines do not produce **portable drinks**, which are suitable for outdoor settings and to prevent drink tampering.

CUSTOMER NEEDS

Customer Needs were identified from a survey (~ 50 responses) which drove the high-level system requirements:

50% drink pre-packaged drinks weekly ⟶ *High Demand*

86% value compact sized appliances ⟶ *Size (10 x 15 x 20 in)*

36% struggle with cleaning products ⟶ *Modular Parts*

80% make a drink under 5 min ⟶ *Speed of subsystems*

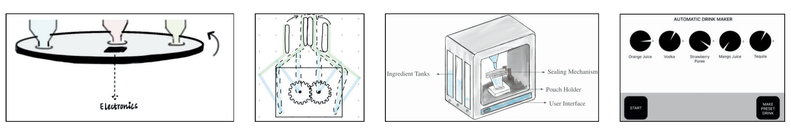
There is a **high market** demand for a product like Seal and Serve, provided the customer needs are met.

CONCEPT GENERATION

The product was broken down into **5 main sub-functions** with multiple concepts generated for each. The 10 most feasible concepts were evaluated in a Pugh matrix against weighted criteria. Some other options considered were:

- Rotating drink carousel
- Using drink bottles as storage
- Using solely gravity to pour drinks.

Shown below are some sketches of initial brainstorming:



a)

Full System Design	STORING	MOVING	MEASURING	SEALING	UI
#1	Wooden Barrels	Moving Glass Under	Force Sensor	Parallel Jaw Grip	Touchscreen
#2	Drink Bottles	Moving Glass Under	Timer	1 Plate Moving: Screw	Touchscreen
#3	Upside Down Bottles	Turntable	Optical Sensor	1 Plate Moving: Gear	Knobs/Sliders
#4	Proprietary tanks	Moving Glass Under	Timer	1 Plate Moving: Scotch-Yoke	Knobs/Sliders
#5	Upside Down Bottles	Turntable	Force Sensor	1 Plate Moving: Piston	Touchscreen
#6	Proprietary tanks	Pumps	Force Sensor	Parallel Jaw Grip	Touchscreen
#7	Wooden Barrels	Pumps	Timer	1 Plate Moving: Piston	Bluetooth/WiFi
#8	Upside Down Bottles	Gravity	Optical Sensor	Parallel Jaw Grip	Touchscreen
#9	Proprietary tanks	Pumps	Optical Sensor	1 Plate Moving: Gear	Bluetooth/WiFi
#10	Drink Bottles	Pumps	Force Sensor	1 Plate Moving: Screw	Bluetooth/WiFi

b)

		Full System Design #									
Criteria	Ref	1	2	3	4	5	6	7	8	9	10
Feasibility	0	1	-1	-1	0	-1	1	-1	0	1	0
Efficiency	0	0	0	-1	-1	1	1	1	0	0	1
Accuracy	0	-1	0	0	-1	0	-1	1	0	-1	0
Maintenance	0	1	0	1	1	1	1	1	1	-1	1
Safety	0	1	0	1	0	0	-1	1	0	0	1
Aesthetics	0	0	1	-1	0	1	1	0	1	1	0
Space Efficiency	0	-1	1	-1	1	0	1	0	-1	1	1
TOTAL	0	2	1	-2	0	2	3	4	1	1	4

Table 1: Concept Combination Table (a) and Pugh Matrix (b)

CONCEPT OVERVIEW

Key Features (Fig. 1):

- Touch Screen User Interface (1)
- Heat Sealing Mechanism (2)
- 3D-printed pouch holder (3)
- Removable drink tanks (4)

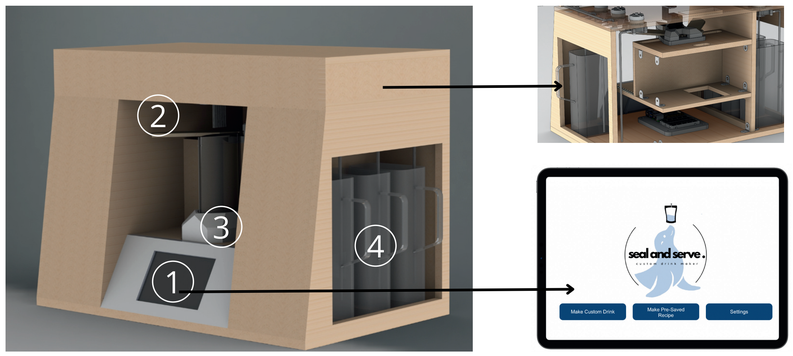
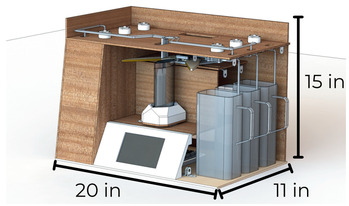


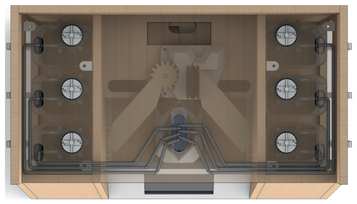
Fig.1 - Full System Render

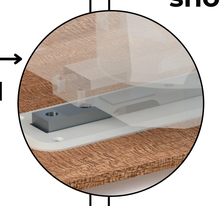
CONCEPT DESCRIPTION

The enclosure houses all wiring, subsystems & removable drink tanks.

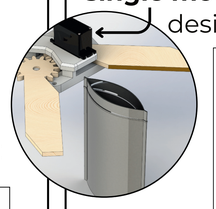


Peristaltic pumps dispense ingredients which are measured using a **Load Cell**





The heat sealing mechanism uses two gears controlled by a **single motor**. Various iterations of the mechanism were designed, including a linkage setup and cantilever gears.



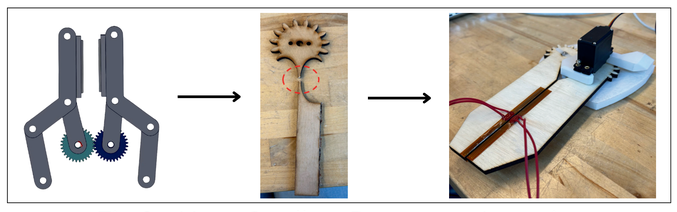
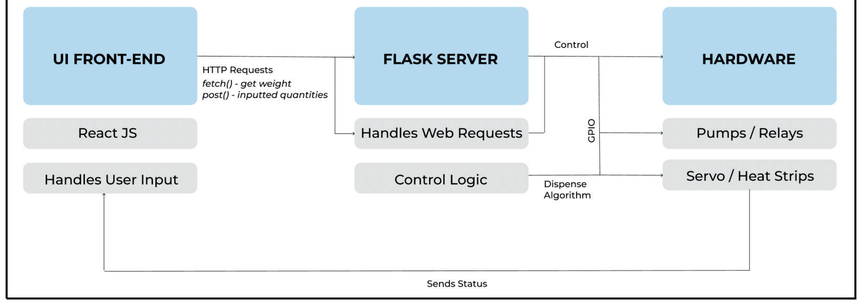


Fig.2 - Heat Sealing Prototype Iterations

System Control: Code Architecture



ANALYSIS

HEAT SEALING

Time to heat up: 20 seconds
Time to seal: 5 seconds
Optimal wattage: 12W

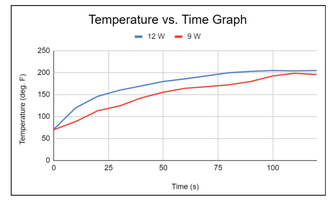


Fig.3 - T vs t for different power

PUMPS

Avg. volume flow rate: *2.3 ml/s*
Although pumps provide a steady flow rate, timing alone is not sufficient, a **weight sensor is needed** to measure each dispensed liquid.

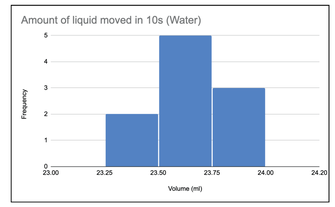


Fig.4 - Pump Flow Histogram

TESTING

Based on quantitative and qualitative tests,

- The product can make a full drink in **less than 3 min**.
- Users prefer inputting ingredient measurements in **shots** rather than percentages or volumes.

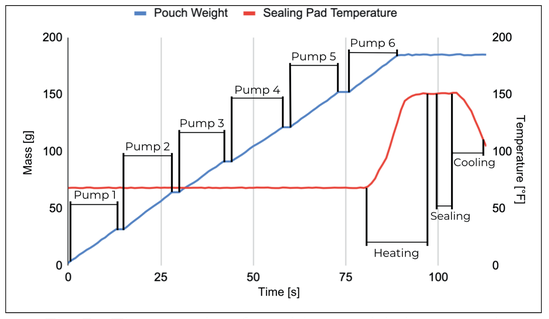


Fig.5 - Time cycle of making a drink on testing

Full System Prototype

CONCLUSION

Seal & Serve is a **user-centric** product that can prepare a large range of customizable drinks. It can **successfully seal** plastic pouches to dispense a tamper-free and portable beverage unlike any other cocktail maker in the market in **under 3 minutes**!

Some future considerations could include:

- Change the main material of the frame from plywood
- Adapt the product to fit both pouches and glasses
- Improve the liquid movement system to handle carbonated ingredients
- Develop reusable pouches to reduce one-use waste