

ENSC 305/440 Capstone Project

SmartChef Automated Cooking System

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Pasang Sherpa

Team Introduction

Christine Huang

- Hardware design: Automated pan motion

Wesley Kendall

- Hardware design: Solid dispenser
- Software design: Arduino programming

Amandeep Singh

- Hardware design: Stirring mechanism

Pasang Sherpa

- Hardware design: Liquid dispenser

Outline

- Background and motivation
- Target market
- System overview and features
- Project design
 - Heating element
 - Solid dispensing
 - Liquid dispensing
 - Stirring mechanism
 - Automated pan motion
 - Microcontroller
- Budget and scheduling
- Future plans

Background and Motivation

- The SmartChef is an automated cooking system with a diverse scope of functionality



The Cooking Problem

- The optimal robot chef must:
 - Clean, chop, and prepare any raw ingredient
 - Heat, broil, fry, sautee, blend, boil, bake, etc.
 - Serve on a plate and clean up afterwards
 - Do all this without burning or damaging anything

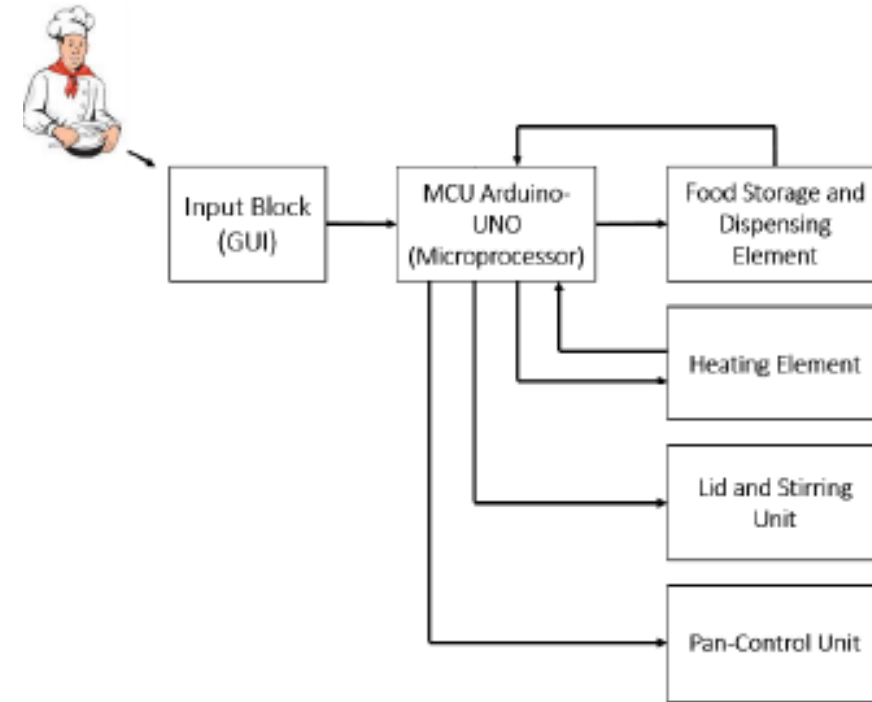
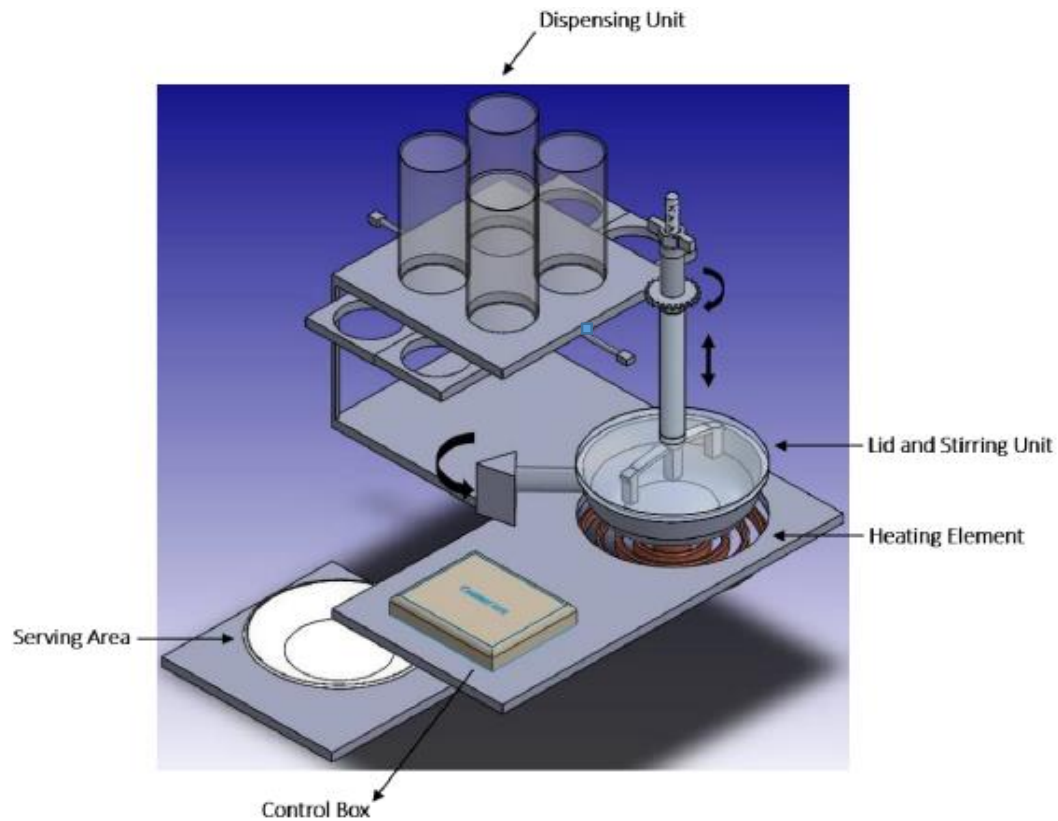


The SmartChef Solution

- Reduce the amount of cooking processes to:
 - Dispensing
 - Heating and stirring
 - Serving on a plate
- A good variety of meals can be made



System Overview and Features



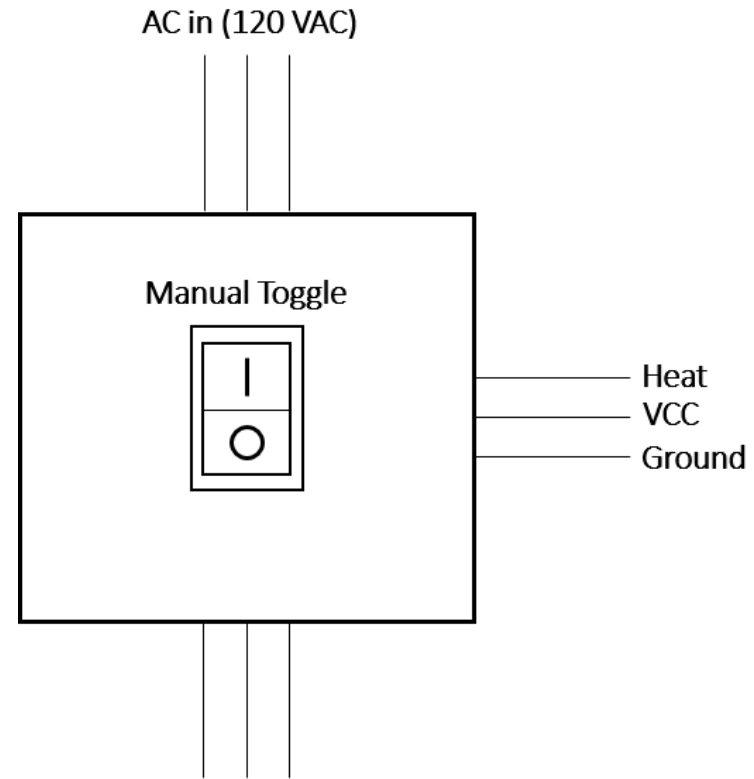
Target Market

Marketable audience

- Physically disabled
- Individuals with a busy lifestyle
- Restaurant applications



Project Design: Heating Element



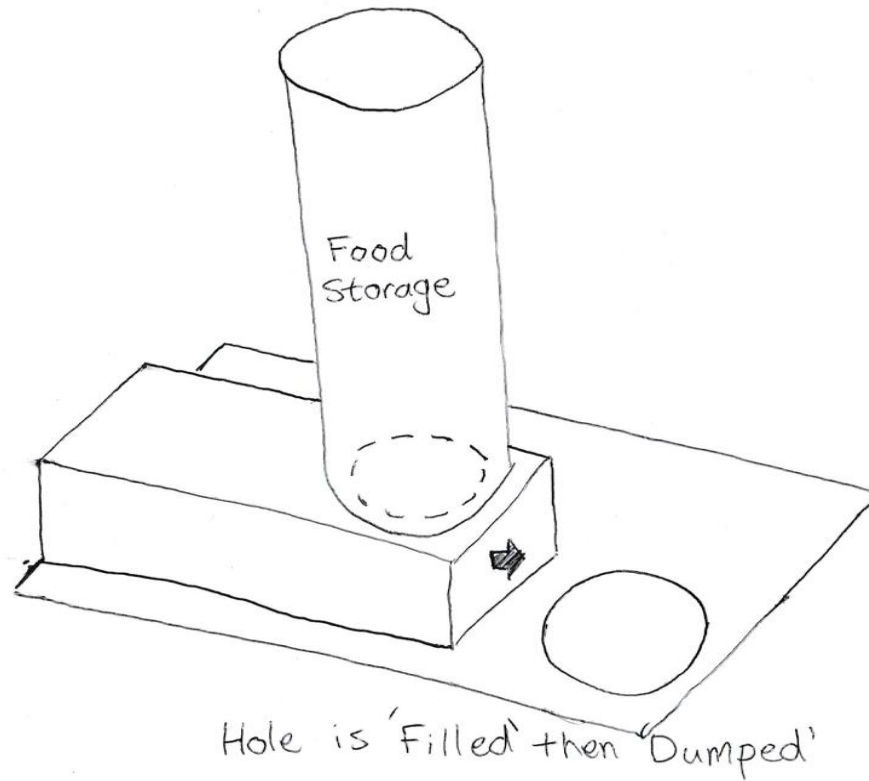
Dispensing: Examples of Common Ingredients

Ingredient	Quantization	Viscosity	Refrigeration
Eggs	1 egg	Slow fluid	Yes
Rice	½ cup	Solid	Yes
Beans	½ cup	Solid	Yes
Chopped Peppers	½ cup	Solid	Yes
Cooking Oil	1 tbsp	Liquid	No
Water	1 tbsp	Liquid	No
Flour	¼ cup	Powder	No
Chopped Whitefish	¼ cup	Solid/Liquid	Yes
Chopped Chicken	¼ cup	Solid/Liquid	Yes
Tofu	¼ cup	Solid/Liquid	Yes
Spices	1 tsp	Powder	No
Chopped Tomato	½ cup	Solid/Liquid	Yes

Project Design: Solid Dispensing Design

- Different foods require different dispensers
- We must take into account the quantity and material properties of the food being dispensed

Sold Dispensing: 'Fill and Dump' Diagram

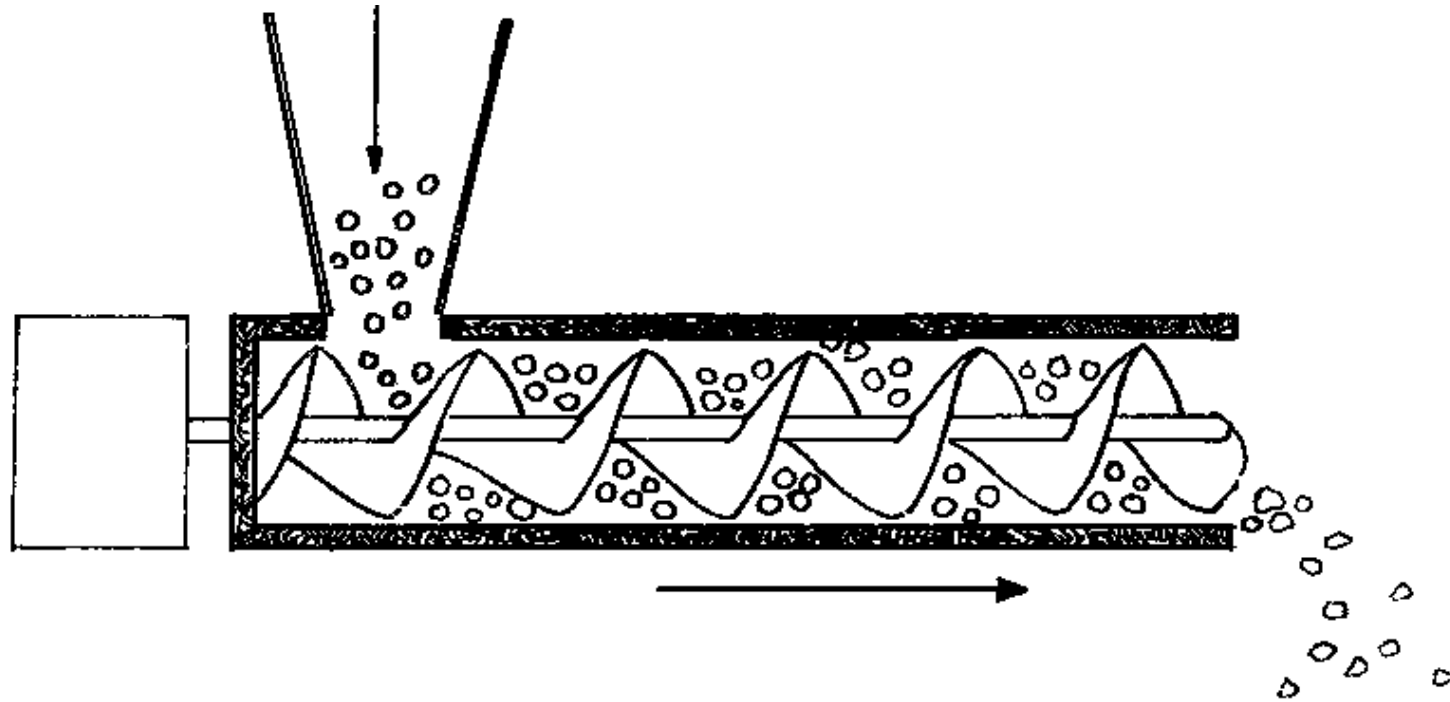


Solid Dispensing: 'Fill and Dump' Mechanism

- Delivers a discrete amount
- Allows food to be dispensed directly from storage
- 1 actuator required
- Requires cleaning

Solid Dispensing: Rejected Designs

- Auger Dispenser



Solid Dispensing: Issues

- Food jams where parts meet
- Not watertight
- Can be solved with better machining

Project Design: Liquid Dispensing

- First stage design ideas



Valves



Submersible Water Pump

- Valves didn't meet SmartChef's fail-safe functional specification
- Submersible pump – adds **high marginal cost** for the total system

Project Design: Liquid Dispensing

- Mini water pump design with lint shredder



CAD \$2 (Lint Shredder)



Design Concept

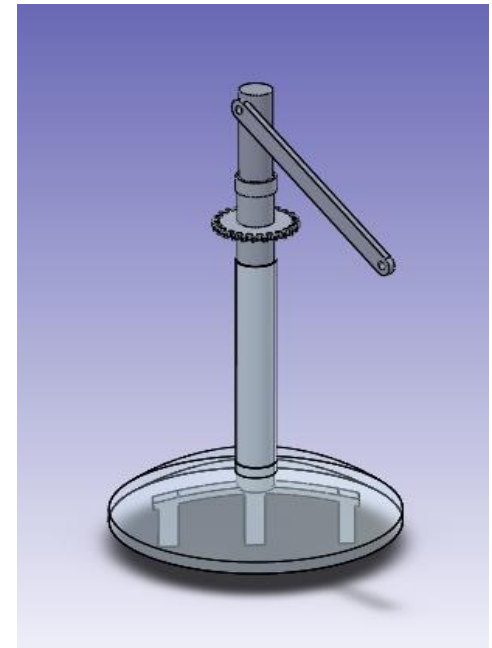
- 6V DC motor, relay, water capture and water outlet design
- Low cost and water force approximately equal to submersible pump

Project Design: Stirring Mechanism

- Closes the lid to prevent food from falling out
- Thoroughly mixes the ingredients
- Lifted up and down with the lid so that the cooking pan can be moved

Stirring Mechanism: Design

- Moves up and down smoothly
- Closes the lid when lowered onto the pan
- Uses a ball bearing in the middle to spin the bottom part while keeping the upper part fixed

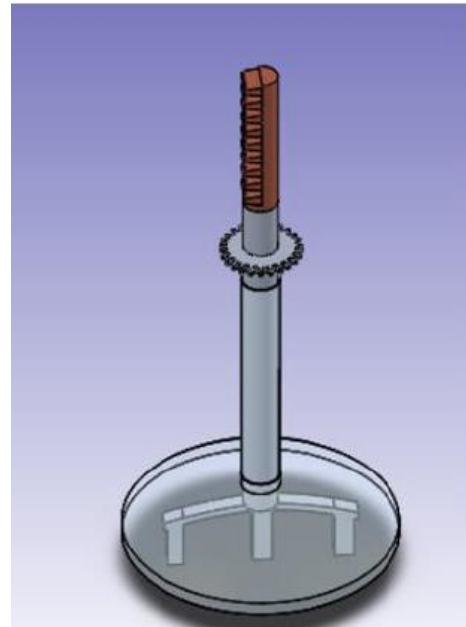


Stirring Mechanism: Issues

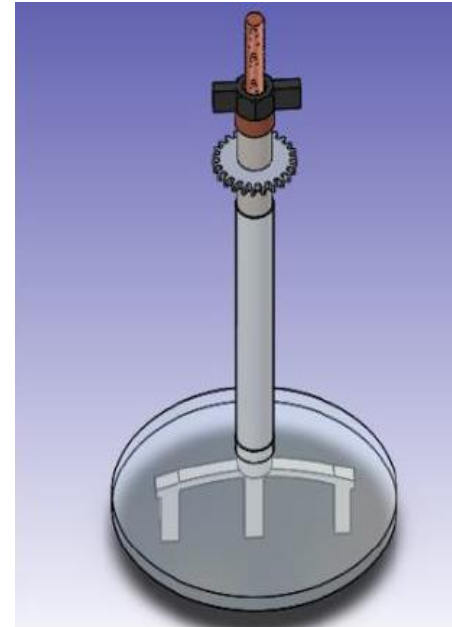
- Pins were not mixing the food properly
- Turning the power off causes the stirring mechanism to occasionally fall due to its weight

Stirring Mechanism: Rejected Designs

- The first design was not able to hold the weight of the mechanism
- The second design takes too long to lift up and down

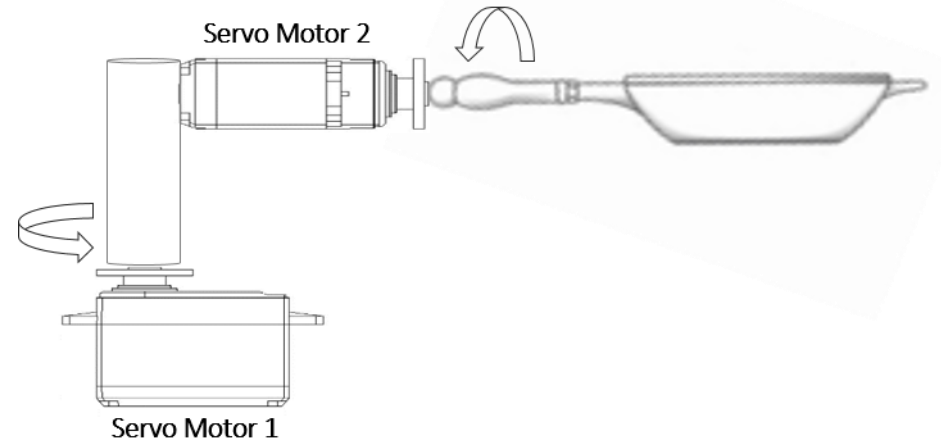
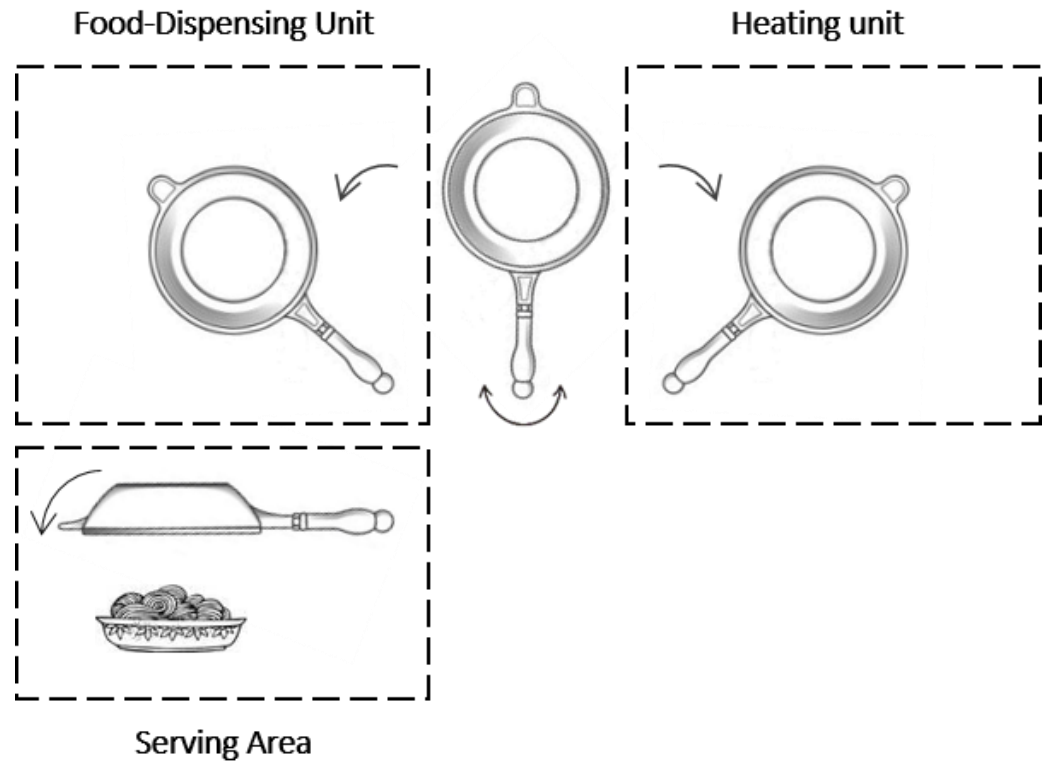


First Design



Second Design

Project Design: Automated Pan Motion



Project Design: Microcontroller

```
noodleCook | Arduino 1.6.5
File Edit Sketch Tools Help
noodleCook
void heatOn() {
  heat_state = heat_stateON;
  digitalWrite(heat_pin, heat_state);
  delay(500);
}
void heatOff() {
  heat_state = heat_stateOFF;
  digitalWrite(heat_pin, heat_state);
  delay(500);
}

void waterOn() {
  digitalWrite(water_pin, 0);
  delay(500);
}
void waterOff() {
  digitalWrite(water_pin, 1);
  delay(500);
}
}

Done compiling.
Sketch uses 8708 bytes (11%) of program storage space. Maximum is 32,256 bytes.

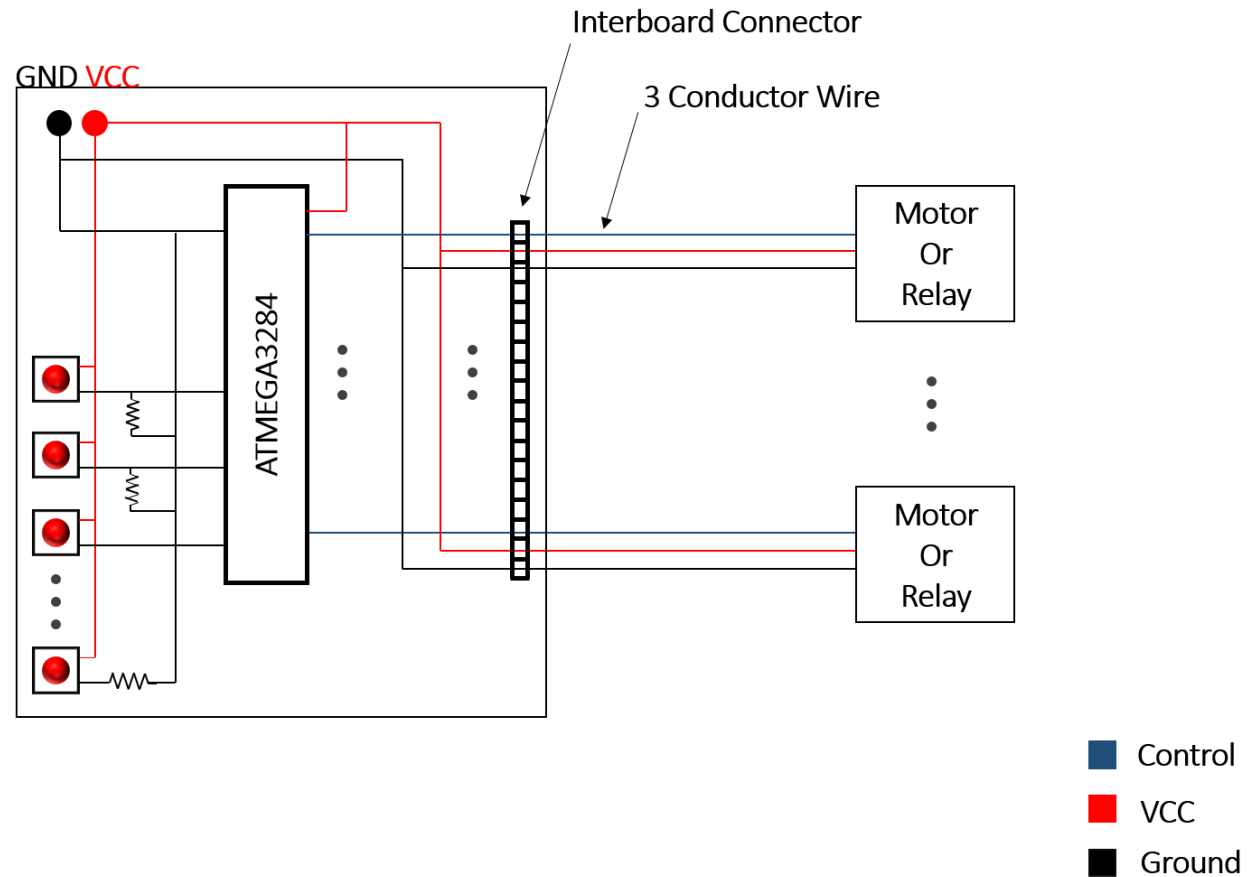
Global variables use 80 bytes (3%) of dynamic memory, leaving 1,968 bytes for local variables. Maximum is 2,048 bytes.
207 Arduino/Genuino Uno on COM5
```

```
noodleCook | Arduino 1.6.5
File Edit Sketch Tools Help
noodleCook
void movePan(int new_pos) {
  if (new_pos == SERVE_AREA)
  {
    moveServo(span_move, pan_angle, PAN_SERVE_ANGLE);
    pan_angle = PAN_SERVE_ANGLE;
    moveServo(span_serve, PAN_FLAT_ANGLE, PAN_TILT_ANGLE);
    delay(3000);
    moveServo(span_serve, PAN_TILT_ANGLE, PAN_FLAT_ANGLE);
  }
  if (new_pos == DISPENSE_AREA)
  {
    moveServo(span_move, pan_angle, PAN_DISPENSE_ANGLE);
    pan_angle = PAN_DISPENSE_ANGLE;
  }
  if (new_pos == HEAT_AREA)
  {
    moveServo(span_move, pan_angle, PAN_HEAT_ANGLE);
    pan_angle = PAN_HEAT_ANGLE;
  }
}

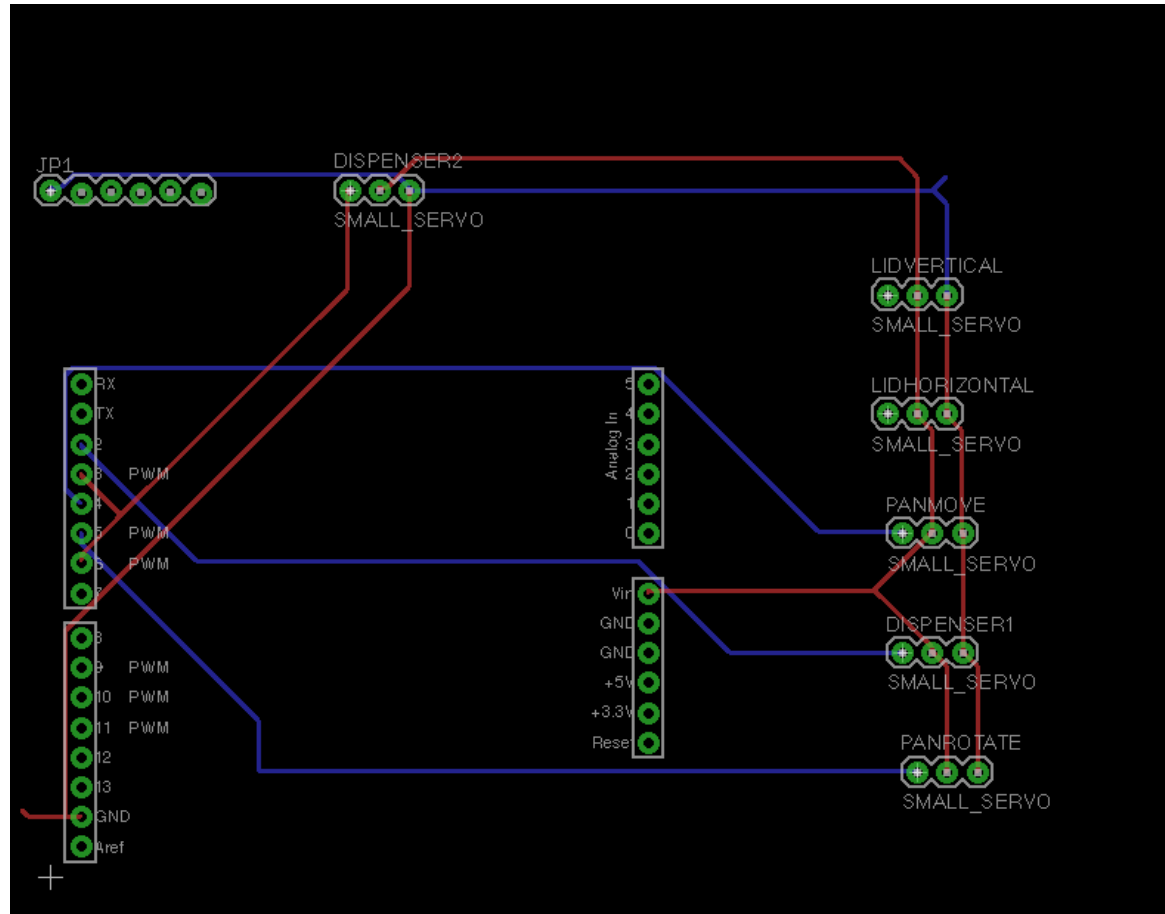
Done compiling.
Sketch uses 8708 bytes (11%) of program storage space. Maximum is 32,256 bytes.

Global variables use 80 bytes (3%) of dynamic memory, leaving 1,968 bytes for local variables. Maximum is 2,048 bytes.
136 Arduino/Genuino Uno on COM5
```

Project Design: Microprocessor Board



Project Design: PCB Layout



Budget

- Total Expected budget
 - \$900
- Final Product Cost
 - \$389.16
- Funding Sources
 - ESSEF: \$250
 - Scrapped kitchen appliances

Future Plans: Improvements to Make

- Redesign chassis and mechanical parts using plastic
- Reduce size of subsystems
- Use linear actuators instead of rotation
- Consolidate electronics to single PCB

Future Plans: Not Yet Attempted

- Refrigeration
- Temperature feedback
- Dispensers for liquid containing solids (ex. tomatoes)
- Interchangeable stirring devices, skillets, pots
- Adjustable temperature ranges
- Recipe interpretation (ie: an adjustable list of commands that can be parsed to cook food)

Summary

- The prototype meets many of the project goals
- The SmartChef is aimed to improve the lifestyle of the physically disabled
 - Marketability can be extended to other demographics
- Further work can be done to improve the features of the system

Acknowledgements

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Questions?