November 9, 2015

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
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RE: ENSC 440W Design Specification for an Automated Cooking System

Dear Dr. Rawicz,

Enclosed is our Design Specification for the SmartChef system, which describes an automated cooking system. The goal of the SmartChef system is to prepare meals with fresh ingredients to facilitate lives of the physically disabled. Our ultimate goal is to enable those who are physically impaired to self-prepare meals using nutritious ingredients, providing them an additional degree of independence in their daily lifestyle.

This design specification describes in detail how we plan to build our product. It also discusses the testing methodology that will be used. This document will be later used as a guide for the design and development of our device.

The SmartChef team is comprised of four senior engineering students with a broad range of skills and specialties. If you have any questions or comments regarding our design specification or product, please contact me at cyh12@sfu.ca. Alternatively, you may contact me by phone at (778) 688-6157.

Sincerely,

Christine Huang
CEO
SmartChef

Enclosure: Design Specification for an Automated Cooking System

Design Specification for the

SmartChef Automated Cooking System

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Abstract

Physical impairment is a prevalent issue that affects individuals worldwide. Everyday tasks that are seemingly easy for the able-bodied population present unremitting obstacles for those who are physically disabled. While many home automation solutions already exist, we want to push these limits and further improve the quality of life for the disabled. We want to provide them with an additional degree of independence, regardless of their impairment.

In an aging population such as Canada, it is important to implement solutions for assisted living that eliminate the burden of home care services. Presently, a vast amount of home automation technologies exist. They encompass simple devices such as wireless remotes that control home appliances or lights, and can range to more complex solutions such as emergency assistance systems. Despite such a diverse scope of technologies, one area that is notably overlooked is kitchen automation in domestic environments. While a number of automated kitchen devices currently exist, they are costly, and are generally tailored towards industrial food applications. This is where the SmartChef seeks to fill the void.

The SmartChef is a home automated cooking system that prepares meals using fresh ingredients with the simple push of a button. Located anywhere at home, a physically impaired individual will have access to a remote that can activate the cooking system just by pushing a button. Correspondingly, the system will dispense the ingredients onto a heated element, stir and cook the ingredients, and serve the meal onto a plate. Using this automated cooking system, a daily task that may be difficult for the disabled has now been facilitated, thereby permitting a more independent lifestyle.

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Glossary

ACK	Acknowledged
CLS	Control line signal
GUI	Graphical user interface
MCU	Main control unit
NAK	Not acknowledged
POC	Proof of concept
RPM	Revolutions per minute

1. Introduction

The SmartChef is a home automated cooking system aimed to assist the physically disabled by helping them regain a more independent lifestyle. The main objective of the system is to prepare rudimentary meals with limited human interaction. The SmartChef system includes four distinct processes: dispensing ingredients, heating and mixing the ingredients, and finally serving the meal onto a plate. We strive to create an effective and safe product, such that it is appropriate for domestic use with little risk to the customer. Thus in addition to the aforementioned functions, our system includes safety mechanisms should the system fail during runtime. This document provides the design specification and test plans for the SmartChef system. Furthermore, it describes the functions and technical concept design of the SmartChef.

1.1 Scope

This document describes the design specifications for each major component of the SmartChef that must be met by the proof of concept (POC) device. The design details discussed in this document correspond to the functional requirements that are marked with “i” and “ii”. These requirements will serve as a basis to check on the project process. The list of test plans is also included in this document which will be used to test the POC device.

1.2 Intended Audience

The design specification document is intended to be used by the members of the SmartChef team throughout the design and testing stages. Additionally, engineering teams shall use this to determine the progress of the project throughout the development cycle. Finally, it shall be used by test engineers to demonstrate that the system works to the required functionality as mentioned in this document.

2. System Requirements

2.1 System Design

The SmartChef solution is a system that will automatically do the tedious and time-consuming work of cooking with the push of a button for physically impaired consumers. Figure 1 below displays the overall framework of the system to convey the general idea for both developers and for non-technical consumers. It presents the state of the art of our development process to locate, assemble and define each component of this electromechanical system proving its parallel running and conformance with the SmartChef functional specification. The top-level design overview of our model is shown in the figure below.

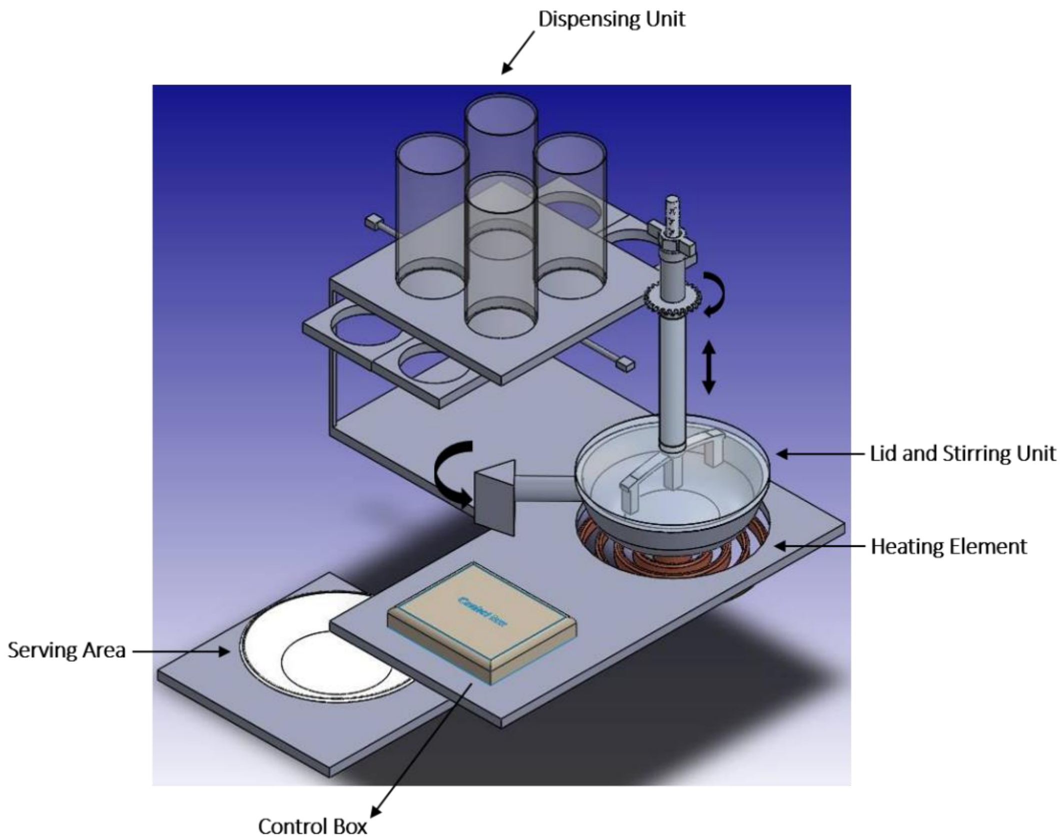

Figure 1: Top level system design overview

2.2 System Overview

Depicted in Figure 2, the system will be triggered with an input through a graphical user interface (GUI) that will initiate the process of sequential operation of servo motors that will drive the control system. Alternatively, the system also has a manual control using switches located in the control unit area for direct control on the specified unit, and also for safety reasons. Upon selecting the food item of choice by the user, the input will be passed to the Arduino processor that will run the mapped program stored in its memory. The precise control of the angular speed, direction and timing of the motors will be driven by a control line signal (CLS) handled by the program in the Arduino processor as a main control unit (MCU). This feature enables flexibility for any new SmartChef programmers to write their own recipe script to cook new items in the future.

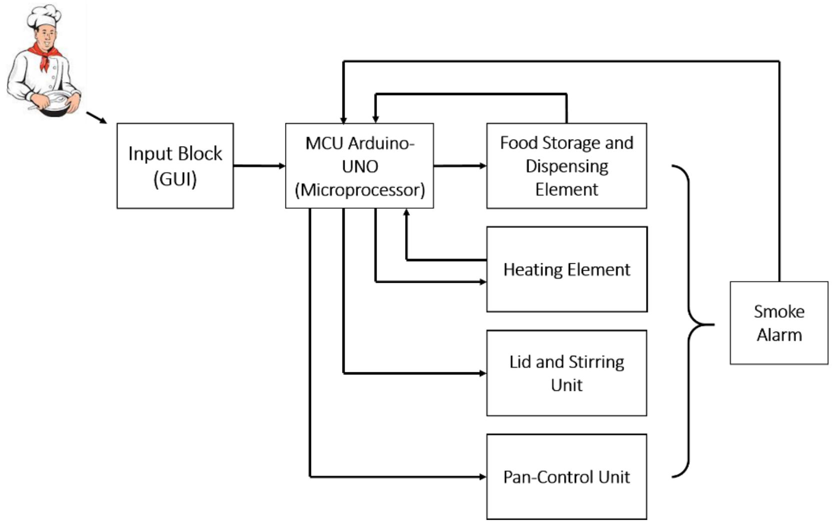

Figure 2: Block diagram of the overall system

The detailed design specification of each unit that builds our electromechanical system is discussed in their own subsections. The position of different elements in each unit is captured with a state machine approach where each unit will rely on the state of the other units. Initially, all the units are in its idle state where all the motors are in their OFF state. The acknowledgement of states of all the units in the MCU during the cooking process is crucial for an optimal performance and safety measures.

Seen in Figure 2, there are four subsystems that comprise the entirety of the SmartChef system: the dispensing unit, heating element, stirring unit, and finally the pan-control unit. These subsystems will be thoroughly described in the subsequent sections.

3. Food Storage and Dispensing Unit Requirements

3.1 Solid Ingredients Dispensing

The final structural design of our solid ingredients dispensing unit is done as shown in Figure 3. The entire design of this unit was done with the constraints and methods mentioned in the SmartChef functional specification. As specified in the aforementioned document, the total power consumption by this unit is less than 15 watts during its dispensing cycle. This is achieved by limiting the total weight of the moving components and their distance from the motor's shaft contributing towards the net load torque to not exceed the motor's stall torque of 9.60 kg·cm operating at 6.0 V. The range of the angular movement of the positioning shaft is constrained to 35 degrees. The delivery of the ingredients is conducted in a controlled fashion. Control parameters involved in controlling the amount of food delivery are: a *counter for motor's positional cycle*, and the *volume of the in-between block*.

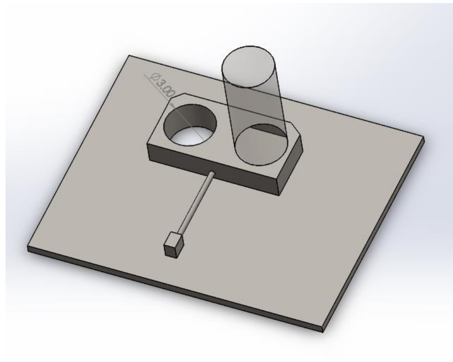

Figure 3: Solid ingredients dispensing unit

The operation of the dispensing unit is the following:

1. Upon receiving the input CLS from the MCU, the servo motor will initiate a clockwise rotation of the block and align the hole of the block with the container. This step will accumulate ingredients in the block by it's cyndrical volume.
2. At this point, the main program in the MCU checks for the state of the pan's position
3. If the state of the pan's position is in delivery mode (i.e. aligned with the hole in the plywood) then it sends an ACK to the dispensing state of the dispenser unit. A NAK is sent by the pan element if the state of the pan is in heating mode or in serving mode.
4. The dispenser motor then rotates the block counter-clockwise aligning the hole in the block with the plywood's hole and dispenses the ingredients contained in the block. At this step, a counter of the motor's positional cycle is incremented, thus keeping track of the total dispensing cycle to record the total amount of ingredrients dispensed.

3.2 Liquid Dispenser

The liquid dispensing device is designed in a cost-effective and efficient manner to deliver a controlled amount of liquid in a fail-safe constraint for our SmartChef consumer's safety. The key engineering behind this design involves the development of a mini fluid pump powered by an inexpensive 6V DC motor. The design implementation is purely based on the DC motor that can generate up to 8100 RPM which rotates the propeller that is inserted into the liquid container. The high RPM of the blades will in turn build enough water pressure to pump up the liquid out of the container into the pan through the pipe. The overall structure of the liquid dispenser is depicted in Figure 4.

Figure 4: Liquid ingredients dispensing unit

Notably, the key feature about this design is that the dispensing of the liquid will stop if the motor fails during its operation, proving its reliability over a simple valve opener and closer. The speed of the DC motor is controlled with a potentiometer circuit embedded in the MCU as depicted in Figure 5.

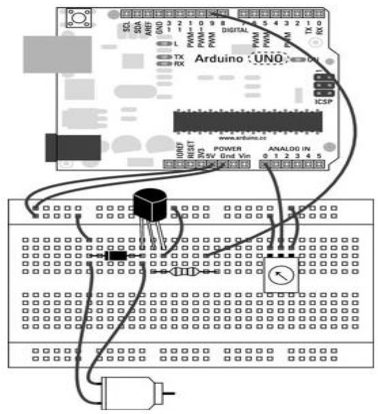

Figure 5: Potentiometer circuit implementation for DC motor

When the DC motor is switched off, it will still have some inertia that can generate an electromotive force with back voltage of opposite polarity. In result, this is capable of damaging the transistor placed in the potentiometer circuit where the transistor current from the source to the drain is flowing in the opposite direction. To compensate for this, a diode is placed in parallel so that the resulting current passes through the diode to the ground. A test implementation has been performed to ensure the stability of the transistor in use for this circuit with the measure of the backfired opposite polarity voltage and the current through the diode.

Figure 6 displays the decrease in the torque of the motor as it starts speeding up and climbing to the optimal torque in demand from the water's opposing force.

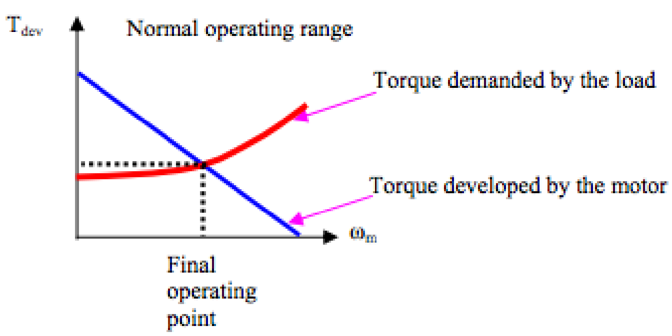

Figure 6: Torque-speed characteristic [5]

4. Stirring Unit Requirements

The main purpose of the stirring mechanism is to thoroughly mix the ingredients in the pan while it's over the heating element to ensure they don't stick to the cooking utensil. The stirring unit will be covered with a lid to protect food from falling out of the pan. Furthermore, the stirring mechanism will be lifted up and down with the lid so that the cooking pan can be removed from the heating element should the addition of ingredients be required.

4.1 Physical and Mechanical Design

The stirring unit consists of two different motions: rotational and vertical. Each motion serves its own purpose. The vertical movement will move the entire stirring unit up and down, allowing the pan to move freely if needed. The rotational motion will rotate the inner arm of the unit in a circular motion to stir the food while cooking.

The stirring mechanism will be suspended in air. This will be done by a mechanism labeled as "vertical movement" in Figure 7. To achieve a vertical motion, the system will use different components including ball bearings, nuts and screws.

The top part of the screw is directly attached to the motor, while the motor is in a fixed position at the top of the stirring unit. The nut will be connected to the one side of the ball bearing while the other side is attached to the rod that is responsible for rotational movement. By changing the direction of the motor (either clockwise or counter clockwise), the entire stirring unit will move up or down.

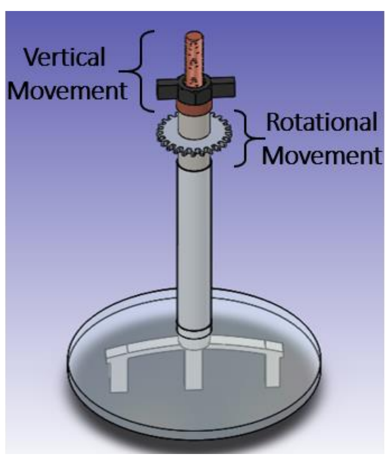

Figure 7: Stirring mechanism

When the entire stirring unit moves up or down, it will also move the rotational unit simultaneously. Rotational movement will be achieved by using a combination of different components, including circular gears, rods, ball bearings, and stirring teeth. These components are labeled as "rotational movement" in Figure 7. The top part of the rod will be connected to the ball bearing, and the bottom portion will be connected to the stirring teeth. The gear will be welded onto the rod near the upper portion. Thus when the motor is connected to the gear, it will spin the entire stirring unit, up to the ball bearing.

Finally, the stirring unit will include a lid and a hollow pipe. The lid and pipe will only move up and down, however they will not rotate. The user will only be able to see the stirring unit up to the end of the hollow pipe. The rest of the unit will be hidden by a static frame used to support all the subsystems. This design feature will ensure safety by eliminating the risk of users accidentally touching the unit while in use.

4.2 Other Designs

A few other designs were considered for the stirring unit, however they were not used due to issues that were encountered. For example, a previous design is shown in Figure 8, where the vertical mechanism was changed. It was unable to hold the weight of the stirring unit since the entire weight was placed on the motor. The revised design will be able to hold the weight of the entire mechanism as it is held by a nut and bolt, which are fixed to the static frame of the SmartChef system.

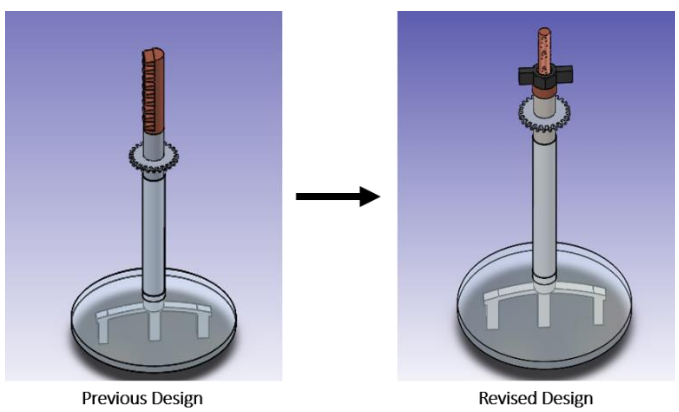

Figure 8: Revised stirring mechanism

5. Pan-Control Requirements

The system will include automated pan motion that serves two purposes: to move the pan between the heating and dispensing areas, and to serve the meal onto a dish. A general schematic of the pan-automation is shown in Figure 9.

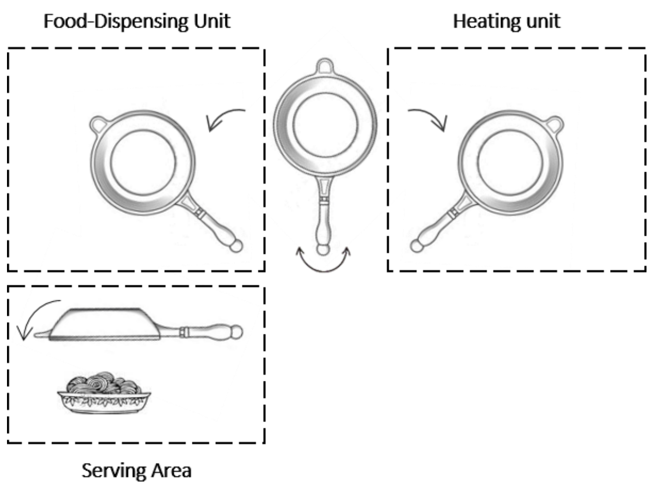

Figure 9: General schematic of pan-automation

The pan will move between the heating and dispensing units to ensure the utmost in safety. In cases where ingredients fall outside the pan during dispensing, they will not fall onto the heating element. This design feature is particularly important if oil is to be dispensed as it is a flammable liquid. Finally, once the meal is finished cooking, the pan will be rotated to serve the meal onto a dish for the user. The design mechanisms of the pan-automation will be described in the following subsections.

5.1 High-Torque Servo Motors

The pan will be controlled by two high-torque servo motors. The servo motors will be placed in an arrangement demonstrated in Figure 10. One motor will be responsible for controlling the motion between the heating and dispensing units (labeled “servo motor 1”), while the other motor will be responsible for rotating the pan to serve the meal onto a dish (“servo motor 2”).

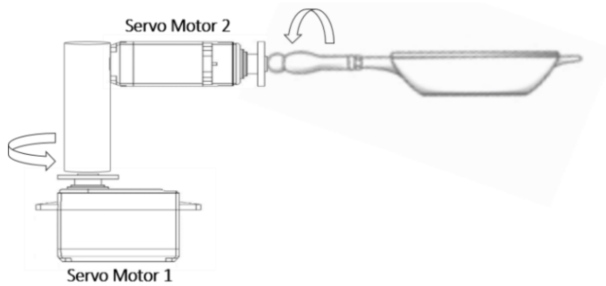

Figure 10: Servo motor arrangement [4]

The design of this automated mechanism relies on the specifications and dimensions of the servo motors, which can be found in Table 1.

Table 1: High-torque servo motor specifications [3]

General Specifications	
Speed @ 6V	0.14 sec/60°
Stall torque @ 6V	17 kg·cm
Speed @ 4.8V	0.16 sec/60°
Stall torque @ 4.8V	15.5 kg·cm
Lead length	11 in
Dimensions	
Size	40.7x20.5x39.5 mm

The design of the pan automation will aim to minimize the load on both motors to keep the stall torque well under the maximum specification listed in table 1. Furthermore, the servo motor dimensions will be taken into consideration when designing the physical and mechanical aspects of the pan automation (discussed in section 5.2).

5.2 Physical and Mechanical Design

A pan with a maximum diameter of 8 inches will be used, in which it will be resting on a surface while moving between the heating and dispensing units. The purpose of these design features is to ensure that the load is minimized on the servo motors.

Two wooden supports will be constructed to hold the servo motors in place, shown in Figure 11. They are dimensioned to suit the size of the motors (given in Table 1). “Wooden support 2” will rest over “wooden support 1” to ensure that “servo motor 1” rotates steadily about its axis. Furthermore, as previously mentioned, the pan will be resting on a surface at all times, thus minimizing the load placed on “servo motor 2”.

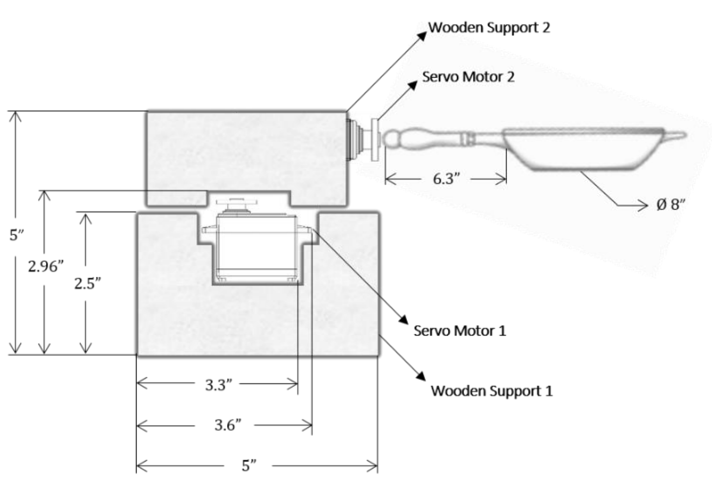

Figure 11: Dimensioning of wooden supports

The weight of the load placed on “servo motor 1” includes the weight of “wooden support 2”, “servo motor 2”, and the pan. The weight of the load placed on “servo motor 2” includes the weight of the pan. The approximate weights of each component are listed in Table 2.

Table 2: Weight of pan-automation components [4]

Component	Weight
Wooden support 2	0.5 kg
Servo motor	0.063 kg
Pan (including 1 serving size of ingredients)	1.0 kg

Using the values listed in Table 2 and the dimensions specified in Figure 11, the torque of each motor can be calculated. Assuming that the load is placed at 90°, the torque of “servo motor 1” is calculated as the following:

$$(0.5\text{kg} + 0.063\text{kg} + 1.0\text{kg}) * 5.18\text{cm} = \mathbf{8.10\ kg \cdot cm}$$

The torque of “servo motor 2” is calculated as:

$$1.0\text{kg} * 16\text{cm} = \mathbf{16.0\ kg \cdot cm}$$

Both values of the calculated torques fall under the maximum specification of the motor’s stall torque.

Finally, since the material used to support the motors is wood, the pan-automated subsystem will be well isolated from the heat source to avoid any risk of fire.

5.3 Electronic Design

The motors will be controlled with an Arduino using an external power supply with 6 V, as per the specifications given in Table 1. A simple schematic is shown in Figure 12.

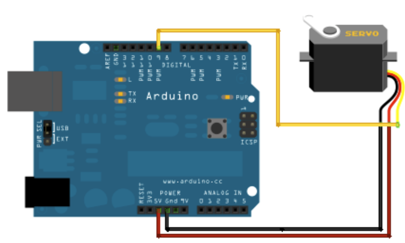

Figure 12: Servo motor connected to the Arduino [2]

The ideal model of the SmartChef is an entirely automated cooking system with one simple push of a button. However, in case of errors during runtime, we will include manual control of the system using separate buttons. The circuitry of this manual feature is shown in the schematic in Figure 13.

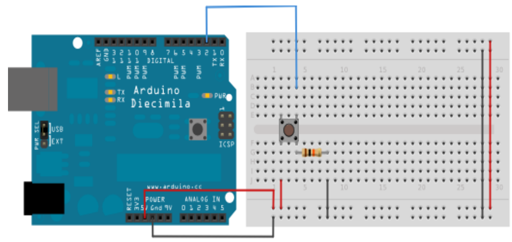

Figure 13: Arduino pushbutton schematic [3]

The button is supplied with 5V and is grounded from the Arduino board. The button is then connected to a digital pin for control, while the other leg is connected to a “pull-down” resistor [1]. When the pushbutton switch is closed, the microcontroller input is at a logical high value. When the switch is open, the resistor pulls the input voltage down to ground.

There will be two buttons for the manual control, one labeled “right” to move the pan to the heating element, and the other labeled “left” to move the pan under the dispensing unit. Should the user continue to press “left”, the pan will continue moving to the left and serve the meal onto a dish.

6. Heating Element Requirements

The heating element is required to heat food to a proper cooking temperature. To achieve this with the minimum amount of design effort, we will use a standard electric coil range element. The coil is secured to a metal bracket and connected to fire-retardant treated plywood. Plywood is chosen for its workability in the prototyping stage, and would be replaced with standard appliance sheet metal in the finished product. The coil receives AC power which is gated by a mechanical switch and a 5V relay. Both the relay and mechanical switch are rated for 5A+ at 240V AC. All of the high voltage elements will be enclosed in a certified electrical box which is grounded. The electrical inputs and outputs of the subsystem are outlined in Figure 14. The current design for the POC device isolates the high power electronics from the DC microcontroller subsystem, with the 5V connections required for the relay bridging between the two. Our microcontroller will be able to toggle the power to the relay in a controlled fashion, to achieve a bang-bang style temperature control. The level of heat can be abstracted to a duty cycle which can be lowered or raised by the embedded system. A range of temperatures can be achieved through this mechanism, which will allow the platform to control heat as a part of the overall cooking sequence.

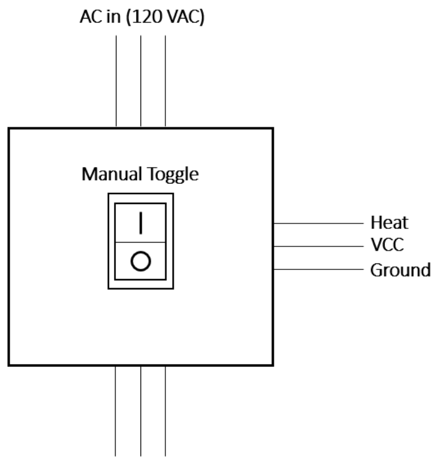

Figure 14: Heating element electrical inputs and outputs

A summary of the functional specifications that the design satisfies is included in Table 3.

Table 3: Heating element satisfied functional specifications

Requirement	Description	Solution/Justification
[R50-ii]	The heating element will controllably reach a cooking temperature range up to 300°C	-Duty cycle control of relay from microcontroller -Heating coil element from standard electric range
[R51-ii]	The heating unit can be manually switched off	-AC-rated rocker switch connected to enclosure
[R52-ii]	The heating area enclosure will be constructed from a non-flammable, low heat-conductance material	-Fire-retardant treated plywood

7. Microprocessor and Circuit Board

The main processor is responsible for orchestrating the various mechanisms, and ensuring that the system behaves in a friendly way. The embedded system allows for both manual and automatic control of the cooking tools through the use of configurable pushbuttons. While the prototype circuit board has enough processor overhead to expand to a Wi-Fi and TCP/IP compliant system, we are only simulating this type of system by having a pushbutton to kick off the automatic capabilities. This 5V microcontroller is appropriate for driving DC motors and relays, and the Arduino platform allows us to easily program the board and provides access to libraries required to control the servomotors. The system runs off of an external power supply, which provides enough current overhead to meet the current demands of the relays and servo motors. The relays and motors need three leads for control: power, control, and ground. We have made these conveniently detachable from the circuit board so that each system can be removed and tested independently.

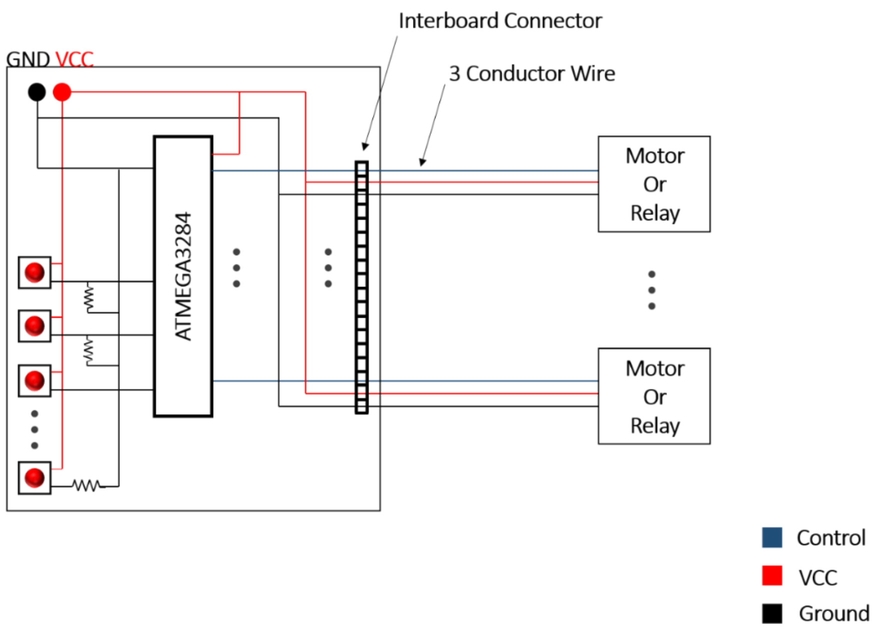

Figure 15: Schematic of microprocessor and circuit board

The functional specifications that the design satisfies are included in Table 4.

Table 4: Microprocessor satisfied functional specifications

Requirement	Description	Solution/Justification
[R53-i]	The processor must have sufficient memory to store recipe programs written by SmartChef engineers	-Built-in Arduino Flash meets this requirement
[R54-i]	The processor must be powered in a voltage range of 5-12V.	-Power supply meets this requirement
[R56-i]	The processor should be able to provide the rotational data of the motors in order to analyze the transient response of the motors for performance analysis	-Servomotors include feedback control mechanism
[R57-i]	The processor board should be enclosed in a waterproof box to avoid contact with food items during the process of cooking	-Food items located sufficiently out of range of processor, no enclosure for prototype system
[R58-ii]	The processor must support the use of 8-bit PWM signal or a digital I/O as the CLS to control the servo motors	-Supported by Arduino servo library
[R59-ii]	Powering up the servo motors with the processor board should be avoided	-Independent power supply is used
[R60-ii]	The processor must be able to handle multiple motors at the same time	-Supported by Arduino servo library

8. System Test Plan

The SmartChef system will undergo a series of tests, as per the following subsections.

8.1 Food Storage and Dispensing Testing

The testing of the dispensing element is part of the justification process to make it compliant with the requirements as specified in the functional specification. The design implementation is within the constraints of the functional specification and thereof tested to prove its optimal functionality in different general, physical, electrical and safety requirements. The following is the dispensing unit test package unfolded into individual test cases, which are to be PASSED to have it fully certified for operation.

1. Food containers of food grade category that are non-toxic and non-reactive.
2. Circuits enclosed in a non-conductive box.
3. One cycle of the motor's positional period delivers 14 $inch^3$ of ingredients.
4. 5V powered servo-motors that do not exceed 1.5A of current during its duty cycle.
5. Solid and liquid dispensers are in non-dispensing state when the motors are off.
6. Test food containers to be below room temperature (21˚C) during operation.
7. Test the opposite polarity voltage induced across the diode when the DC motor is turned off.
8. Circuit breaker element shuts the entire system down with the dispensing unit in its non-dispensing state.
9. Counter is updated after each dispensing cycle in the MCU as a feedback control.
10. Power level testing of the dispensing cycle is less than 15 watts.

8.2 Stirring Unit Testing

To verify that the stirring mechanism is working according to its functional specifications, it will undergo a series of tests. The tests to be performed are as follows:

1. The electrical components will be completely isolated from any metallic parts of the stirring unit.
2. The stirring unit will not touch any flammable materials while in use.
3. All moving parts must be covered so that stirring mechanism should be safe for the user to touch when the system is on/off.
4. The lid must be lowered on top of the pan before the rotational mechanism has started, and must be stopped before lifting the lid.
5. The system should be able to fully shut down once the circuit breaker is on.
6. When the mechanism is fully lifted, it should have at least a 20mm clearance from the top of the pan.

8.3 Pan-Control Testing

The automated pan motion will be tested according to its functional specifications, as per the following:

1. The cooking pan moves between the heating and food-dispensing units when using the appropriate pushbuttons ("left" moves the pan to the dispensing area, "right" moves it over the heating element).
2. Upon pressing the "left" pushbutton twice, the pan will serve the final meal onto a dish
3. The pan is able to contain the ingredients while maintaining a torque under the motor's stall-torque (listed in Table 1).
4. The pan lays completely flat to its resting surface to ensure a flawless motion between the heating and dispensing areas.
5. The pan remains within the static frame of the SmartChef system (to minimize the risk of burn related injuries).
6. All motors stop immediately and return to their original positions if malfunction occurs.

8.4 Heating Element Testing

The heating element is to be tested while mounted on the overall system assembly. We will test the following configurations:

1. Manual switch OFF, relay ON: The heating element will not heat
2. Manual switch ON, relay OFF: The heating element will not heat
3. Manual switch ON, relay ON: The heating element heats to maximal temperature
4. Manual switch ON, relay at 50% duty: The heating element produces less heat than in previous test

9. Conclusion

This document has presented the SmartChef system design specifications. This document serves as a guide to the development and testing stages of our system. Details regarding the four subunits (dispensing, stirring, pan control, and heating) are included, as well as the reasoning for the specified design features. The main focus is on the aforementioned systems which will be controlled by a single microcontroller, non-obstructive modularization of the cooking process, and proper frame constructing. Each module will be individually testable and independent, with safety addressed through fail-safe mechanisms, and hazard consideration. With the specifications in place, we will be able to construct a prototype by December 2015.

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[2] Arduino - Sweep. Retrieved November 7, 2015, from *https://www.arduino.cc/en/Tutorial/Sweep*

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[4] Servo Motor Specification Sheet (1501MG). Retrieved November 6, 2015, from *https://www.pololu.com/file/download/HD-1501MG.pdf?file_id=0J729*

[5] Understanding DC Motors. Retrieved November 8, 2015, from *http://lancet.mit.edu/motors/motors3.html*

Appendix: General Algorithm for System Subunits

A. Entire automation of system

If Pushbutton == HIGH

1. Turn on heating element
2. If the pan is in an arbitrary position
    a. Move the pan over the heating element

   Else (the pan is already over the heating element)

    b. Keep the pan at the same position
3. Dispense oil and wait for it to be heated
4. Place the pan under the dispensing area
5. Dispense ingredients
6. Move the pan over to the heating element and wait for ingredients to cook
7. If more ingredients need to be added
    a. Move the pan back under the dispensing area
    b. Dispense ingredients
    c. Move the pan back to the heating element

   Else (no further ingredients need to be added)

    d. Keep the pan over the heating element
8. Rotate the pan to serve the final meal onto a dish

Else (Pushbutton == LOW)

9. Remain inactivated

If any other pushbutton during runtime == HIGH

10. Do nothing

B. Manual control of each subsystem

Dispensing Unit

If (Pushbutton == HIGH) && Pan is under the dispensing area

1. Dispense ingredients

Else if (Pushbutton == HIGH) && Pan is NOT under the dispensing area

2. Do nothing

Else (Pushbutton == Low)

3. Remain inactivated

If any other pushbutton during dispensing == HIGH

4. Do nothing

Stirring Unit

If (Pushbutton == HIGH) && Pan is over the heating element

1. Stir ingredients

Else if (Pushbutton == HIGH) && Pan is NOT over the heating element

2. Do nothing

Else (Pushbutton == Low)

3. Remain inactivated

If any other pushbutton during dispensing == HIGH

4. Do nothing

Pan Control

If Pushbutton1 == HIGH

1. Move the pan over the heating element

If Pushbutton2 == HIGH

2. Move the pan under the dispensing area
3. Increment a counter

If (Pushbutton 2) == HIGH && (Counter == 2)

4. Rotate the pan to serve the meal

If Pushbutton1 & Pushbutton2 == HIGH

5. Do nothing

If any other pushbutton during the pan automation == HIGH

6. Do nothing