

February 11th, 2022

Ph.D. Mike Hegedus  
School of Engineering Science  
Simon Fraser University  
Burnaby BC, V5A 1S6

Re: ENSC 405W Requirements specification for Company 6

Dear Ph.D. Hegedus,

Please find the project requirements specification has been attached with this letter. This product is a convenience service station programmed to supply customized hot dogs to busy employees. Our mission is to help users save time and enjoy their own customized food.

The requirements specification document contains our designing background and outlines the requirements that constraint the product. The requirement list will cover requirements from the proof-of-concept stage to engineering prototype to final production vision. This document will provide high-level overview of general functional requirements, hardware and software design requirements as well as safety and sustainability requirements that the product will follow.

Company 6 is a team with six members: Linhan Pei, Mingqi Tian, Jerry Mazurek, Weilong Sun, Tsz Wing Choi and Chi Hong Yip.

Thank you so much for reviewing our project selection document. If you have any suggestions or questions, please contact our designated CCO, Jerry Mazurek, at [jmazurek@sfu.ca](mailto:jmazurek@sfu.ca).

Sincerely,

*Linhan Pei*

Linhan Pei,  
CEO  
Company 6

# Hot-dog Customized Machine Requirements Specification

## Company 6

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## **Abstract:**

The purpose of this product is to create a machine that can cook customized hot dogs for the customers. By adding customized features, this machine is able to enhance the user experience. Since we aim to satisfy every customer's needs, we will try to provide the combinations of the hot dogs as much as possible.

This product is made up of four parts: a storage that can freeze the pre-cooked sausages and buns; several heating modules to heat the sausages and buns, a set of dispensers to add the condiments onto the buns, and a food integration platform to bring the food to users.

This document outlines the functional requirements for this product. The various components' requirements, as well as safety and sustainability requirements, will be described in different sections. The purpose of this document is to provide readers with a detailed understanding of our product.

The requirements for this product include the following major components:

- General Requirements: including system and functional requirements
- Software Requirements: including general, performance, user interface, and privacy and security requirements
- Hardware Requirements: including components and storage requirements
- Safety and Sustainability Requirements: including general safety, electrical, food safety and sustainability requirements

Keywords: hot-dogs, customized, convenience, humanization

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# Glossary:

The following table includes the terms used in this paper.

Term	Definition
SFCR	Safe Food for Canadians Regulations
FSA	Food Safety Act
Arduino	Open-source electronic prototyping platform [1]

# 1. Introduction

This product provides a convenient service for the customer in order to make the customers enjoy their own preference for hot dogs conveniently.

## 1.1 Background

A survey [2] shows that over 70% of Canadian employees have only 30 minutes or less for lunch. Some employers prefer to keep their works on-site during lunchtime to avoid being late returning. Reducing the lunch hour to 30 minutes discourages people from leaving since it is hard to get much done during that time. On the other hand, lunch hour provides workers with a break from work-related stress and an opportunity to enhance peer networking. It is important for employees to use the lunchtime efficiently and refresh for the afternoon on a busy workday.

Our Company aims to develop an automatic hot dog machine as a solution to this conflict between employers and employees. This machine allows users to choose their favourite condiments and make hot dogs in a short time. It will help employees save their time for other activities while giving them one more option to stay in the office.

## 1.2 Requirement Classification

In the following requirements part, each requirement specification will be defined as the following labeling schema:

**[Req. S. SS. N - ProjectStage]**

- S = Section
- SS = Subsection
- N = Requirement number

Where the different project stages will be represented as the table below:

Encoding	The stage of development
A	Proof-of-concept
B	Engineering Prototype
C	Production Version

Table 1 - Representation of different stages

The proof-of-concept requirements outline the requirements that will be met by the end of ENSC 405W. The engineering prototype requirements outline the requirements that will be met by the prototype by the end of ENSC 440W. The production version requirements outline the requirements that will be met by the product once it is ready for production.

## 1.3 Stage Explanation

We will focus on finishing most hardware operations on stage A. And in the B developing stage, we aim to finish all of the functions we created for this product, which includes hardware and control panel. For the C developing stage, we wish we can do some improvements on the product in order to enhance the user experience.

## 2. General Requirements

This section will show the general requirements, which include the system and functional requirements. The details of other components' requirements will be explained in later sections.

### 2.1 System Requirements

The system requirements are used to rule the whole machine, which are about the composition of the machine, main tasks of the machine, and other details of the machine. The following table shows the general requirements for the system.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 2.1.1 - A]	Machine must be majorly made up of Micro-Controller Board [3], Electric Griddle [4], Sausage Roller Grill [5], Fume Extraction Fan [6], Cooling Controller [7], Temperature Sensor [8], Pump Sauce Dispenser [9].
[Req 2.1.2 - A]	Users must be able to set the order of the hot dog on the machine.
[Req 2.1.3 - A]	Machine must make the entire hot dog automatically given a user request.
[Req 2.1.4 - B]	Machine must provide hot dogs for a customer in a parallel working scheme. (i.e. sausage baking and buns heating at the same time)
[Req 2.1.5 - B]	Machine must be less than 15 kg.
[Req 2.1.6 - B]	The cost of the machine must be less than \$400 [3] - [9].
[Req 2.1.7 - C]	Machine should have storage for napkins and plates.
[Req 2.1.8 - C]	Machine must have a user manual to support users.

Table 2 - General System Requirements



## 2.2 Functional Requirements

The functional requirements are used to define the sub-parts of the system, which include the procedures of making hot dogs improvement within the development stages. The following table shows the general requirements for the system's functionality.

Requirement ID	Requirement Description
[Req 2.2.1 - A]	Machine must include a sausage roller grill for sausages.
[Req 2.2.2 - A]	Machine must include an electric griddle for buns.
[Req 2.2.3 - B]	Storage must be divided into three parts, which are bread, sausage and sauce.
[Req 2.2.4 - B]	Machine must be able to move buns from storage to the location of the electric griddle.
[Req 2.2.5 - B]	Machine must be able to move buns from the location of the electric griddle onto a dining plate.
[Req 2.2.6 - B]	Machine must be able to move sausages from storage to the location of the sausage roller grill.
[Req 2.2.7 - B]	Machine must be able to move sausages from the location of the sausage roller grill into buns.
[Req 2.2.8 - B]	Machine must be able to serve a completed hot dog to the user.
[Req 2.2.9 - B]	Machine must be able to help to add sauce to hot dogs if the user wants liquid condiments. (i.e. ketchup and mustard)
[Req 2.2.10 - C]	Machine must be able to help to add condiments to hot dogs if the user wants solid and liquid condiments. (i.e. ketchup, mustard and onions)
[Req 2.2.11 - C]	Machine must be able to provide the chance to decide the volume of condiments the user wants.
[Req 2.2.12 - C]	Machine must be able to provide the napkins and plates to the users.

Table 3 - General Functional Requirements

## 3. Software Requirements

This section will provide the software requirements for the product in general functions, performance, user interface design and privacy and security. The software will utilize a microcontroller board to program the machine control panel. The potential choice of the microcontroller board is the Arduino board. To meet the best performance, the control panel will be programmed by C++.

### 3.1 General Requirements

This subsection will specify the general functional requirements of the control panel for the project. Some functional requirements have been specified in the previous General section.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 3.1.1 - B]	Control panel must alert the user once the order is completed
[Req 3.1.2 - B]	Control panel must be able to track the order to the microcontroller board.
[Req 3.1.3 - C]	Control panel must be able to notify users to clean the machine after a period of working time. (i.e. 30 days)
[Req 3.1.4 - C]	Control panel must notify the user if there is an unsuitable food storage temperature.
[Req 3.1.5 - C]	Control panel must notify the user when the stock of food (buns, sausages) is low.
[Req 3.1.6 - C]	Control panel must be able to notify users to refill condiments when they are about to run out.

Table 4 - General Software Requirements

## 3.2 Performance Requirements

This subsection will specify the performance software requirements in regards to start-up time and memory usage.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 3.2.1 - B]	Control panel must be loaded within 3 seconds.
[Req 3.2.2 - B]	Control panel must be less than 30 MB in size.
[Req 3.2.3 - B]	Control panel must be compatible with the microcontroller board.
[Req 3.2.4 - C]	Control panel must not crash while in use.
[Req 3.2.5 - C]	Control panel must not exceed 50 MB of RAM while operating.

Table 5 - Performance Software Requirements

## 3.3 User Interface Requirements

This subsection will specify the user interface designing requirements, where customers should have a cognitive ease interface. Most activities of the machine must be visible here.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 3.3.1 - B]	User Interface must have simple and clear icons for navigating users.

<b>[Req 3.3.2 - B]</b>	User Interface must provide tips for instructing users.
<b>[Req 3.3.3 - B]</b>	User Interface must have physical highlight buttons for guides users' attention.
<b>[Req 3.3.4 - B]</b>	User Interface must display related responses when users press buttons. (i.e. keypad tone or page change animation)
<b>[Req 3.3.5 - B]</b>	User interface must be able to allow users to customize food.
<b>[Req 3.3.6 - B]</b>	User Interface must have text annotation for every icon, button and picture.
<b>[Req 3.3.7 - C]</b>	User Interface must calculate and show the Calories of the selected ingredients.
<b>[Req 3.3.8 - C]</b>	User Interface must provide the option to cancel the order.
<b>[Req 3.3.9 - C]</b>	User Interface must show the information of order status.
<b>[Req 3.3.10 - C]</b>	User Interface must display the current temperature of food and condiments storage areas.
<b>[Req 3.3.11 - C]</b>	User interface must be humanized to customers. (i.e. display welcome and goodbye messages)

Table 6 - User Interface Software Requirements

### 3.4 Privacy and Security Requirements

The following table includes the privacy and security software requirements for the product.

<b>Requirement ID</b>	<b>Requirement Description</b>
<b>[Req 3.4.1 - B]</b>	Control panel must not gather any user private information.

Table 7 - Privacy and Security Software Requirements

## 4. Hardware Requirements

This section provides the hardware requirements, which can be separated into components requirements and storage requirements. The required components include chilled storage, heating elements and tactile user interface, as well as necessary electrical hardware for supplying power from a typical Canadian household outlet.

## 4.1 Components Requirements

The hardware component is one of the most fundamental sections of our project. Before we can assemble our machine, we need to check for the quality of all components, and to make sure they are not damaged and also fit the requirements stated in the table below.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 4.1.1 - B]	Machine must have the button for power ON/OFF.
[Req 4.1.2 - B]	Machine must have at least 1 LED indicator for power status (ON/OFF).
[Req 4.1.3 - B]	Machine must be able to connect to the household power supply (110V).
[Req 4.1.4 - B]	Machine must have a screen to display the control panel.
[Req 4.1.5 - B]	The numpad consists of 13 keys; number keys from 0 to 9, enter key, return key and reset key.
[Req 4.1.6 - B]	A num pad must be able to be set under the control panel to select the quantity of sausages, buns, condiments and hot dogs.
[Req 4.1.7 - C]	Machine must have a heating indicator light, where ON is for preheating or when the temperature drops below the desired temperature and OFF when the desired temperature is reached. [10]
[Req 4.1.8 - C]	All components must be able to operate between 40°F [11] and 325°F [12].
[Req 4.1.9 - C]	Machine must be able to operate continuously for at least 3 hours per day.
[Req 4.1.10 - C]	All components must not interfere with each other's operations.
[Req 4.1.11 - C]	A fume extraction fan must be around the heating module.
[Req 4.1.12 - C]	Pump must be able to eject over a maximum of 30 mL of condiments.
[Req 4.1.13 - C]	Hot dog roller and assembler must be able to reach and withstand at least 325°F [12].
[Req 4.1.14 - C]	Hot dog roller must be able to continuously roll.

Table 8 - Components Hardware Requirements

## 4.2 Storage Requirements

Storage of the food, such as buns and sausages, needs to be considered as it is not desirable to have to restock the machine every time after producing one hot dog. Ingredients must also be stored at a low enough temperature to minimize bacteria growth. The following table includes the storage requirements for the product.

<b>Requirement ID</b>	<b>Requirement Description</b>
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[Req 4.2.1 - B]	Machine must store up to 20 hot dog buns and sausages.
[Req 4.2.2 - B]	Storage area must separate the storage areas of hot dog buns, sausages, and condiments.
[Req 4.2.3 - C]	Storage area must be built with food-grade metals (stainless steel and aluminum). [13]
[Req 4.2.4 - C]	The storage area must pass the FSA (Food Safety Act) [14].

Table 9 - Storage Requirements

## 5. Safety and Sustainability Requirements

This section will discuss the safety requirements, which include general, electrical, food safety and sustainability. Safety labels should be included in the final version of the product as it contains heating elements and machinery that could result in injury if misused. Concerning the environmental impact of the product, biodegradable and recyclable materials should be used wherever possible.

### 5.1 General Safety Requirements

Safety is the most important thing that needs to be considered while the machine is operating. The maintenance of the machine is also important when the machine is not in use, since some components may be damaged by the environment. If those factors are being ignored, dangerous accidents may happen during the operating machine. The following table includes the general safety requirements for the product, including warning labels, and general and electrical safety concerns.

Requirement ID	Requirement Description
[Req 5.1.1 - A]	Machine must include warning labels near hot surfaces.
[Req 5.1.2 - B]	A cooling module should be installed to adjust the temperature inside the machine during operation and prevent component overheating
[Req 5.1.3 - B]	Machine should not overheat on the buns or sausages.
[Req 5.1.4 - B]	Machine's heating elements must be inaccessible to the user during operation.
[Req 5.1.5 - B]	Machine and its components must not contaminate foods during operation.
[Req 5.1.6 - C]	Product must not have any exposed wiring or electronics.
[Req 5.1.7 - C]	Machine should include a warning about never placing it near flammable objects.
[Req 5.1.8 - C]	Machine should include a warning about putting one's hand inside the machine.

<b>[Req 5.1.9 - C]</b>	In the case of an electrical component overheating, the machine should safely power off.
<b>[Req 5.1.10 - C]</b>	Machine must not have any sharp edges.
<b>[Req 5.1.11 - C]</b>	Machine should be placed in the dry area to prevent machine or component damage from moisture. [15]
<b>[Req 5.1.12 - C]</b>	Before cleaning the machine, the machine should be turned OFF and waited for cooling down after operation. [15]
<b>[Req 5.1.13 - C]</b>	Machine must not be operated in dangerous environments, such as near toxic, explosives or chemicals. [15]

Table 10 - General Safety Requirements

## 5.2 Electrical Requirements

Before the machine operation, electrical requirement is also an aspect which needs to be aware of, since if the electrical requirements of the machine are not fitted, then the machine can be damaged during the machine operation, and some potential hazards, such as electric shock. The following table includes the electrical safety requirements for the product. The product should be safe for use with a typical 110V power outlet.

<b>Requirement ID</b>	<b>Requirement Description</b>
<b>[Req 5.2.1 - A]</b>	The circuit inside the machine must not be built by short circuit or incomplete circuit.
<b>[Req 5.2.2 - B]</b>	Machine must be grounded properly to prevent electrical shock or machine damage. [15]
<b>[Req 5.2.3 - B]</b>	Machine specification values should be close to the standard stated in the product's instruction manual.
<b>[Req 5.2.4 - B]</b>	A fuse must be installed to protect from short circuits during the machine operation. [15]
<b>[Req 5.2.5 - C]</b>	Machine must not draw more than 1200 Watts while in use. (average power consumption of a toaster)

Table 11 - Electrical Safety Requirements

## 5.3 Food Safety Requirements

For any organization like restaurant or retailer selling their foods, only the foods that are in good quality can be sold to the customers. To keep the foods in good quality, food safety is always required. The following table includes the food safety requirements for the product. Hot dogs produced by the machine should be safe for human consumption.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 5.3.1 - A]	Machine must have a module that can keep the food resource fresh.
[Req 5.3.2 - A]	All the ingredients must pass Safe Food for Canadians Regulations (SFCR) [16]
[Req 5.3.3 - B]	Refrigeration module must keep ingredients below 40°F [11].
[Req 5.3.4 - B]	The produced food must pass Safe Food for Canadians Regulations (SFCR) [16]
[Req 5.3.5 - C]	A thermometer should be installed to monitor the temperature.
[Req 5.3.6 - C]	Machine must include an alarm for when the temperature rises above safe levels.
[Req 5.3.7 - C]	Machine should send a signal before the foods are being overcooked.

Table 12 - Food Safety Requirements

## 5.4 Sustainability Requirements

We hope the machine can be used for longer time. We also hope that the machine is environmental-friendly while operating the machine. The following table includes the sustainability requirements for the product. To minimize environmental impact, safe and sustainable materials should be used wherever possible.

<b>Requirement ID</b>	<b>Requirement Description</b>
[Req 5.4.1 - C]	All components of the machine should be recyclable.
[Req 5.4.2 - C]	No pollutants should be produced during operation of the machine.
[Req 5.4.3 - C]	Machine must go into sleep mode after being idle for a long time. (i.e. 30 mins)
[Req 5.4.4 - C]	The machine must not be built using materials that are dangerous to humans, such as toxic or explosives.
[Req 5.4.5 - C]	The materials used should be in good quality to maintain a longer lifespan of the machine.

Table 13 - Sustainability Requirements

## 6. Conclusion

In this document, several requirements were outlined for the automatic hot dog machine. Requirements for the user interface as well as the hot dog assembly were listed. Alongside functional and system requirements for both hardware and software components, several safety and sustainability factors were considered, including Canadian food safety standards.

With these in mind, the product is a safe and efficient alternative to traditional food preparation methods for small appliance users in the home and office.

The challenge of Company 6 can be specified as thinking about the method to transfer the sausages, buns, and the entire hot dogs from one module to another module inside the machine efficiently to improve the space efficiency. The preferred method is to design the mechanical arm to finish the instructions distributed by the Micro-Controller Board. In the progress of the product, Company 6 will keep focusing on solving current challenges, researching for building better product performance and expanding the target market.



# 7. Appendix

## 7.1 PoC Appendix

For the proof of concept deliverable that will be presented during the poster presentation, we will present the following functionalities:

- A heating unit with rollers
- An automatic pump condiments dispenser that can dispense ketchup or mustard when an object is near to the dispenser.

### 7.1.1 Heating Unit

We will develop a system that consists of a pair of rollers, a heating indicator light, a motor and a temperature controller. The surface of the rollers will be heated up to approximately 300°F, and the heating indicator will illuminate during the process. The motor will roll the rods to heat food evenly. The temperature controller will monitor the actual temperature of the rods and help to remain the temperature at the setpoint.

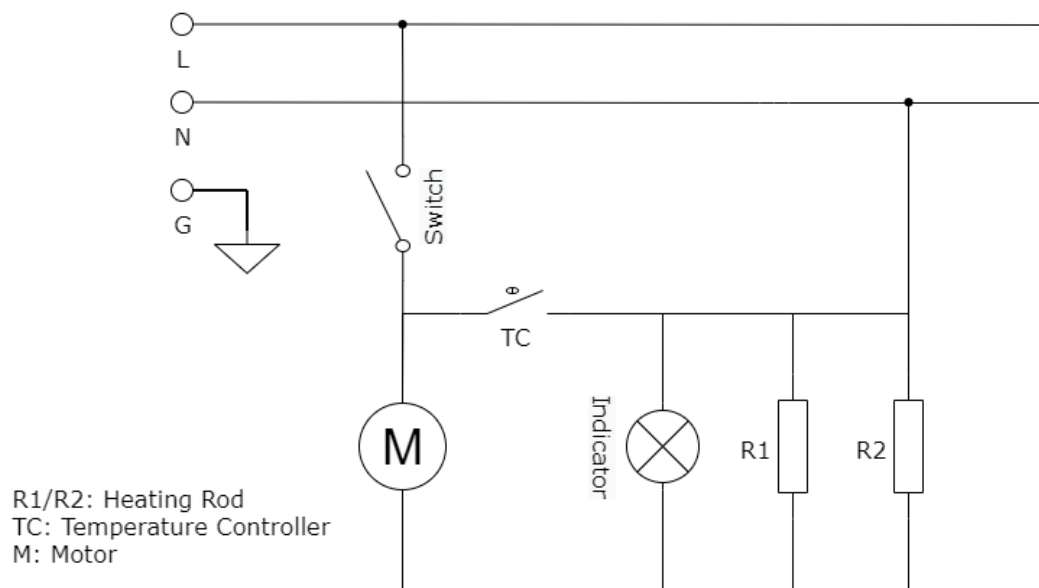


Figure 1 - Schematic Diagram of Heating Unit

### 7.1.2 Pump Condiment Dispenser

At this stage, we will focus on the thick sauce such as ketchup and mustard, and develop an automatic pump condiment dispenser. An ultrasonic sensor or a proximity sensor will be applied to detect if any object is placed close to the dispenser. A valve will be used to control the flow of the condiments through the pump. When an object is close to the sensor, it triggers the microcontroller to make the pump dispense condiments.



Figure 2 - Block Diagram of Pump Condiment Dispenser

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