HotBox

Divide and Conquer

Spring 2021

Group 14

Chaitanya Vemuri - Computer Engineering
Haafiz Shafau - Computer Engineering
Austin Tillotson - Computer Engineering
Ahmed Kazzoun- Computer Engineering

Table of Contents

Project Description and Motivation

For this project we wanted to focus on the main problem with takeout food places which is receiving your food cold. As a customer that pays for the food, we should at least be entitled to warm food. Especially with the times we are in now, contactless food pick up is almost sought after in a lot of stores and restaurants. And it's not always a guarantee that you'll receive your food on time and it'll be hot and ready to consume. However, with the (name of device here), a smart electric food heater and warmer that sends out notifications to the customer picking up the order when the food is in the box and keeping warm ready to be picked up. With this project, not only will the food be warm and ready when you pick it up, it hopes to reduce a majority of the traffic and congestion in the restaurant/store itself by letting the customer know when it is ready to be picked up. Main goal of our project is to heat and warm the food to an appropriate temperature for the food to taste good. So the box will sense when food enters the box, and will be able to warm most supported materials and hold temperature for a reasonable amount of time. It also sends a notification out to the customer's devices app when the food is present in the box and heating.

Goals and Objectives

The ultimate goal of Senior Design is to create and implement a project idea into a functioning physical prototype that can be demoed and presented. The Senior Design lectures help guide us on our path to this destination and the bootcamp gave us a strong starting point, having us form a foundation to build off of. There are many smaller goals and objectives that will lead us to the end goal. Senior Design is an opportunity to display all that has been learned over each of our college careers; to show that we have acquired all the necessary skills and overall knowledge needed to become successful engineers in the workplace. As such, one goal for this semester is to display these abilities and to strengthen them. Senior Design will present many challenges that we have never encountered before. And with every challenge is an opportunity to grow. Being that we are taking Senior Design II over the summer semester, and thus having less time to build the physical project, it will be important to have well thought out and thorough documentation to make this process as painless as possible. Success is paramount for these two semesters and that cannot be achieved alone. While individual contribution will be of the utmost importance, working as a team will be the only way to succeed. Our objective must consist of strong teamwork and communication or every goal along the way will be all the more difficult to achieve.

For the documentation, we strive as a group to not procrastinate and be diligent in making new progress each week. Each time we meet, we will set specific goals that must be completed prior to the next meeting. Meetings must be effective and efficient, a time to discuss what must be done, what challenges will come, and how to deal with them. A plan must always be in place with a shared goal attached. Problems that arise should be discussed and dealt with in a reasonable manner, to ensure a positive working environment is always present. These are our group objectives.

As for the project itself, we aim to create something that is not only useful but something that would improve our resumes. We all hope to find a career and make a living with the last four or so years of hard work. This project is the final step of this journey and the potentially the last thing we will have to place on our resumes from college.

Functionalities

Keeping food warm: the main functionality of the HotBox would be to keep takeout food warm whilst waiting for a delivery driver to come pick it up. This would involve a hot plate for the restaurant to place the food on top of and a circuit to notify the customer while the food is being heated. The box will also be insulated and sealed to keep temperatures from varying. The box will be reasonably sized to fit most reasonable meals.

Web/App Notifications: Another functionality of the device would be to notify the driver when the food is being heated. This would ensure the food will still be warm when it gets to the customer, assuming a normal travel distance, and notifies the restaurant that the (insert name here) is empty and can be used for another order. The web app will have a GUI showing which boxes are empty and send the order number to an empty box for the employee to put the food in. This would help the driver in finding which HotBox holds the food that they are delivering.

Weight/Temperature: The circuit should also be able to detect the weight of the food being placed and the temperature of the plate by itself so it is limited to a certain degree to avoid burning the food or letting it get cold.

Requirements Specifications

#	Requirements	Specifications
1.1	The packaging must be insulated to keep food warm.	Box size should be large enough to accommodate different fast foods. Size around 10" x 8" x 5"
1.2	The plate that is in the interior of the box should be able to detect the weight of the food placed on it and accurately set the temperature of the plate to avoid burning the food or letting it get cold.	The amount of heat food needs varies for different foods. For example, heating 2 burritos requires more heat to keep warm in comparison to 1 burger from McDonalds. So it's important for the box to distinguish between the two in order to not burn food.
1.3	The microcontroller will also have to be able to connect to a web app in order to send notifications to the customer.	The web app must be able to send notifications to the client so they know when their food is being placed on the plate to be kept warm and when the delivery driver picks up their food. Using Android Push notifications or SMS to send messages to the customer.
1.4	The LCD on the box should flash the order number in order to signal to the driver to which box to pick up.	The order number would be pulled from the restaurant and flash. The software team would have to create the connection from the order and the box.
1.5	There should be a connection between a web app and the boxes themselves in order to tell which one is empty or ready to be picked up.	A web app would have to be developed in order to connect to multiple boxes to send the order number to the box and reply saying that it is empty.

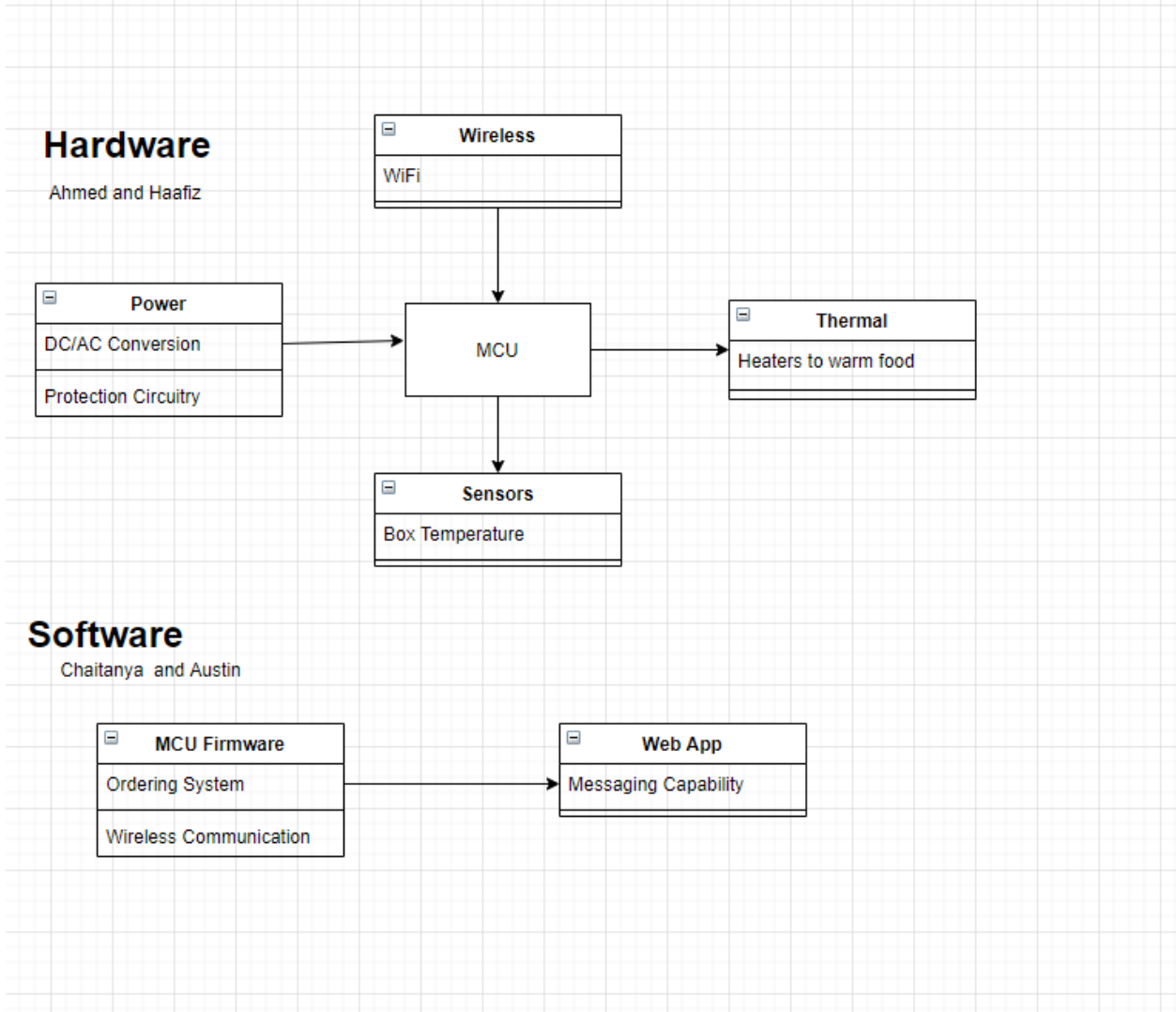*Table 1. Requirement Specifications*

Project Block Diagram

Figure 1. Project Block Diagram

Budget and Finance

For a single box

Item	Quantity	Estimated Cost
Food storage box	1	~$15-30
Heating pad	1	~$12-13
Some type of sensor to sense the food	1	~$5-10
Insulated Aluminum liner	1	~$7-15
Microcontroller(Arduino)	1	~$15-20
LCD Display	1	~$5-10

Table 2. Budget and Finance

Table 2 shows the project budget and finances. The food storage box will be used to contain the food and the heat generated inside. The heating pad will maintain a temperature to keep the food inside warm but not cook the food further.

House of Quality

Marketing Requirements			Engineering Requirements					
			Dimensions	Production Cost	Power Consumption	Web app Communication	Temperature Regulation	Security
			(-)	(-)	(-)	(+)	(+)	(+)
Size	(-)		↑↑	↑↑	↑		↑↑	
Ease of Use	(+)		↓			↑↑	↑	↑
Reliable	(+)				↑	↑↑	↑↑	↑↑
Easy to Maintain	(+)		↑			↑		↑
Quality	(+)			↑↑	↑	↑	↑↑	↑
Temperature	(+)		↓		↑		↑↑	
Targets for Engineering Requirements			15"/13"/12"	<$150	100 watts	WIFI	140F - 250F	QR Code

Correlations	
Strong Positive	↑↑
Positive	↑
Strong Negative	↓↓
Negative	↓
No Correlation	

Figure 2. House of Quality

Initial Project Milestones

Task	Start Date	End Date	Status
Senior Design I			
Form Group	1/10	1/14	Completed
Senior Design Bootcamp	1/21	1/21	Completed
Project Discussion and Decision	1/21	1/24	Completed
Initial Project Document - Divide and Conquer	1/24	1/29	Completed
Final Divide and Conquer Document	1/31	2/12	Completed
Start Final Document	2/15	-	In Progress
40 Pages Completed Goal	-	3/8	In Progress
60 Page Documentation Draft	3/28	4/2	In Progress
100 Page Documentation Report	4/11	4/16	In Progress
Final Revisions and Proof Readings	4/18	4/27	In Progress
Final Document	-	4/27	In Progress
Acquire Project Parts	4/28	-	Not Started
Senior Design II			
Assemble Prototype	5/2	-	Not Started
Test Prototype	-	-	Not Started
Assemble Final Prototype	-	-	Not Started
Prepare Demo	-	-	Not Started
Final Prototype Demo	-	-	Not Started
Prepare Presentation	-	-	Not Started
Practice Presentation	-	-	Not Started
Final Presentation	-	-	Not Started

Table 3. Initial Project Milestones

References

[HOTLOGIC Food Warming Tote, Lunch Bag 120V, Black - Food Warmer and Heater – Lunch Box for Office, Travel, Potlucks, and Home Kitchen](#)