Prototype 1 - Group Summary

EGEN-310R Group 6

Alida Rehm
Faiz Alshehri
Matt Krueger
River Kelly
Treyton Pickering

Table of Contents

Problem Statement

The issue we identified is the inefficiency in maintaining food shelf-life and refrigerator storage. Refrigerators are often shared between multiple members of a residence. Being college students, each of us has learned to share space with other roommates and has realized a need for improvement in the kitchen. Typically, we find our refrigerators to be disorganized and lead to unnecessary waste. We believe that there exist alternate solutions to address this kitchen crisis. Many of the possible solutions allow each group member to apply their engineering discipline, which provides us with multiple avenues to explore.

Purpose

Each team member conducted tests to determine whether individual aspects of the design will be useful, feasible, and accomplish the objectives of the design. While these individual aspects have not been combined into a complete working unit, valuable information was gathered and will serve to provide more direction moving forward. The next steps are to refine each individual aspect, then determine the best ways to integrate all designs into a single unit.

Subsystem Functionality Experiment/Test/Model

Produce Decomposition - Alida Rehm

The goals of my tests and research for prototype number one were to determine if a sensor is a viable option for our design, how to best implement it (either in the fridge itself or in each tupperware), and determine a tupperware design.

Questions

Are there any usable sensors currently on the market?
If there are, what is the best way to place and utilize these sensors?
What might the new tupperware look like?

Test Results

To begin, I used a small spray bottle full of water to attempt to visually gauge the dispersion pattern of gases from a single source in a refrigerator. These tests were deemed inconclusive with regards to where a sensor should be placed inside of a refrigerator because there were so many items in the fridge that would produce a gas when decomposing that any sensor would be overloaded and the information that it would relay would be unhelpful to any user. Instead, a sensor inside of our newly designed tupperware would be far more useful since any user would know exactly which tupperware was triggering the alert.
This led to research on gas sensors that are currently available on the market. There are many types, but none of them would be a viable option for our group to use in a final design. For starters, an optical sensor would work since it would be able to recognize multiple gas absorptions, however they are all far too big and expensive to be used in an average tupperware. Electrochemical sensors also exist, but they have issues in being made of toxic materials --which violates the constraint of food safe--, unable to work at low temperatures, they require lots of maintenance and know-how to operate properly, and it would be challenging to get them down to an adequate size. Paper indicators also exist, but the only one out there that isn't toxic is to detect ammonia gas, which is only produced in small amounts, typically by anaerobic bacteria which are far less common in the oxygen filled tupperware. Another downside to paper indicators would be that the user would have to switch it out each time food started to go bad, which can quickly become a hassle.

Design Direction IPT 2

Moving forward, I will be scrapping the sensor idea since I do not have an entire research lab and funding at my disposal. Instead, I will focus more on how to design the tupperware to best interface with the software being designed to prevent food from being forgotten. This will possibly include buttons, bluetooth, and/or a timer display. All of these options and more will be explored to determine an ideal design.

First-In-First-Out Optimization and accessibility - Faiz Alshehri

The test will be about adding a rotating plate (Lazy Susan) and see how that can be helpful in making food more accessible and easier to organize

Questions

How to make food more accessible and easy to organize?

Test Results

The main point of building this prototype is to apply the concept of First in First out and maximize the accessibility and food management. Sometimes reaching for food in the fridge cannot be efficient since some items end up being far to reach or you need to move some items to grab things you want. So, I found out the best way to apply all of that is by introducing lazy Susan to the fridge. The way that lazy Susan rotates can make it easier and more organized. Also, one of the benefits of having lazy Susan is the ability to make the expiration dates on the item more noticeable that is facing out when rotating you can read them.
User Feedback: after building and installing the device in the fridge, I got my roommate to test it by himself and he gave me some feedback. What he liked is how the food has become more accessible, easy to be organized and saving him time and effort. Some data recorded shows that the time to check the expiration dates without having Lazy Susan was about 1 minute for 6 items and with Lazy Susan used the time decreased to 40 seconds. One of things that he wants me to upgrade is putting a divider on the lazy Susan so when you have more than one person using it, it will be organized to have a small section for everyone. See figures of the prototype.

Design Direction IPT 2

Some notes for the next prototype will be to have a divider on the lazy Susan and make them label to each person using it. Also, the materials that are going to be used for the final design should be sturdy and easy to clean. Other than that, the test was successful.

Maximize Storage Space - Matt Krueger

With this aspect of the design, the goal of the prototype was to look at the physical layout of the dividers. The idea was to find out what layout will maximize and separate space, and to determine how easy the design will be to live with. Images 1 and 2 show general layout ideas for 4-section and 3-section dividers. Image 3 shows a full-size mockup of one quadrant/section of the 4-section layout.

Questions

How can we maximize and separate storage space?
Will the design serve to hold a reasonable amount of refrigerated goods?

Test Results

To test the usability of the space, the prototype was filled with some common refrigerated items and shown to potential stakeholders. Due to time constraints, hands-on testing was not possible. The overall feedback was positive. All users determined the dimensions and overall shape were adequate to store common refrigerated items and liked how the sections were all equal size. The general consensus was that the unit would help reduce confusion with a shared fridge, and additional accessibility features would make organization easier.

The second goal was to keep wasted space at or below 20%. Using common refrigerated items and various sized food storage containers, a number of configurations were tested. Images 4 and 5 show a few of these configurations. While I did not have enough to fill the entire section, I was able to use measurements of rows and layers to extrapolate a metric for wasted space. This test only considered the open upper‑ area and not the lower drawer. See Wasted Space Table for detailed results.

Design Direction IPT 2

During the next iteration, better material and hardware will be considered. A fully functioning drawer will also be a goal, and it will explore ways to integrate aspects of the design being prototyped by other group members.

Technology Integration - River Kelly

The goal for my prototyping is to create a digital media mockup that demonstrates the user interface.

Questions

How can the integration of technology better assist the user in managing food inventory and prevent food waste?

Test Results

For my tests, I sent the demo to my roommate and two other friends. Each stated that they liked the idea and that they believed that it would be effective. Some of the feedback they provided was:

- The design was simple and easy to navigate
- The color scheme could use some work
- It would be difficult to complete each function on the fridge and recommended having a complimentary mobile phone app
- The Spotify functionality seems useless
- Some items were hard to see on the front page

Overall, the results seemed to be positive and provided direction for the next round of testing.

Design Direction IPT 2

After receiving feedback, I realized that my design was missing one major component; the ability to maintain multiple users and their individual needs. This will be the primary area of focus in phase 2 of prototyping. The other major aspect will be the mobile phone app. Additionally, trying a variety of different color designs.

Compact-ability V.S. Visibility - Treyton Pickering

The goal for my prototype is to design a fridge layout to maximize the visibility and availability so that it limits the amount of food waste.

Questions

How can the design of the fridge affect the availability and the visibility of the user to see into the back of the fridge.
Test Results: For my first of three rounds of testing for the prototype I decided to start the design process by drawing many possible fridge designs that would be the most efficient at providing vision to the entire fridge. This was good and was able to help me see in many ways the different views based on what material/design patterns you use in the fridge. Since our primary target consumer is college students who are living with multiple roommates. The design that I chose to go with is the picture located below. The reason for this design was to keep the fridge very open and easily accessible to reach anywhere throughout the fridge.

The design is based around having a lot of space throughout the fridge. Many fridges have small sliding drawers on the upper shelves but I think this just hinders your vision. Many times you put things in the drawer that block your vision to the back making you forget food. As a group we went with individual dividers where people can put food that they want for just themselves. That way there is area for your own individual stuff but still having large areas where you share common foods. The racks are see through so that there is nothing blocking your view from seeing into the back of the fridge. Many times I see class shelves that get food stuck on them and it makes it harder to see through, and the glass shelves are typically harder to clean off. As other teammates' ideas come in, I will then be able to see their designs. With that information I will be able to create my prototype fridge out of cardboard.

Design Direction IPT 2

I think I would first start off by looking at everybody's else's design and seeing how I could implement my design with there designs. Since Matt and I’s designs are similar, now we can look at each others designs and design a model to complete both of our goals.

Prototype 2

After each team member conducted their first prototype test on a chosen aspect, we have a better idea of how this design will come together and incorporate all the features to meet the design objectives. User feedback confirmed the design accomplishes the goals of the refrigerator interior, and the FIFO features help with usability and accessibility. Moving forward, the primary goals for the next prototype will be to determine how best to integrate each aspect and make them work together seamlessly as one complete unit.

- Illuminates some specific area of progress and outlines high level plans for the final prototype.
- Lessons Learned are being considered.

Product Management

As of now, the budget is in great shape. Because this first round of prototyping was primarily for proof of concept, all materials were found around the house and no money has been spent.

The biggest challenge we can see is to keep track of the main goal and not get sidetracked by small details. The small details are often the most fun part of the design, but if too much energy is spent in those areas, it may prevent us from combining individual solutions into a seamless single solution.

Address any risks that can be identified relative to the project schedule at this point.
Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation.Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation.Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation.

Images/Diagrams

Image 1

Image 2

Image 3

Image 4

Image 5

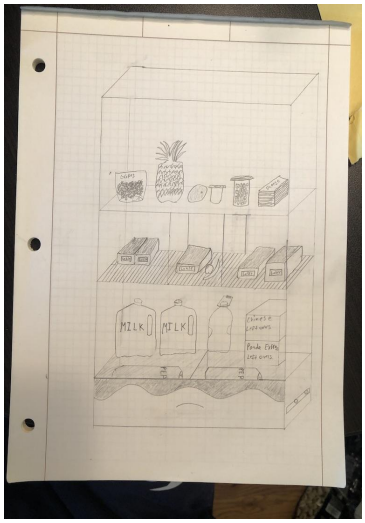
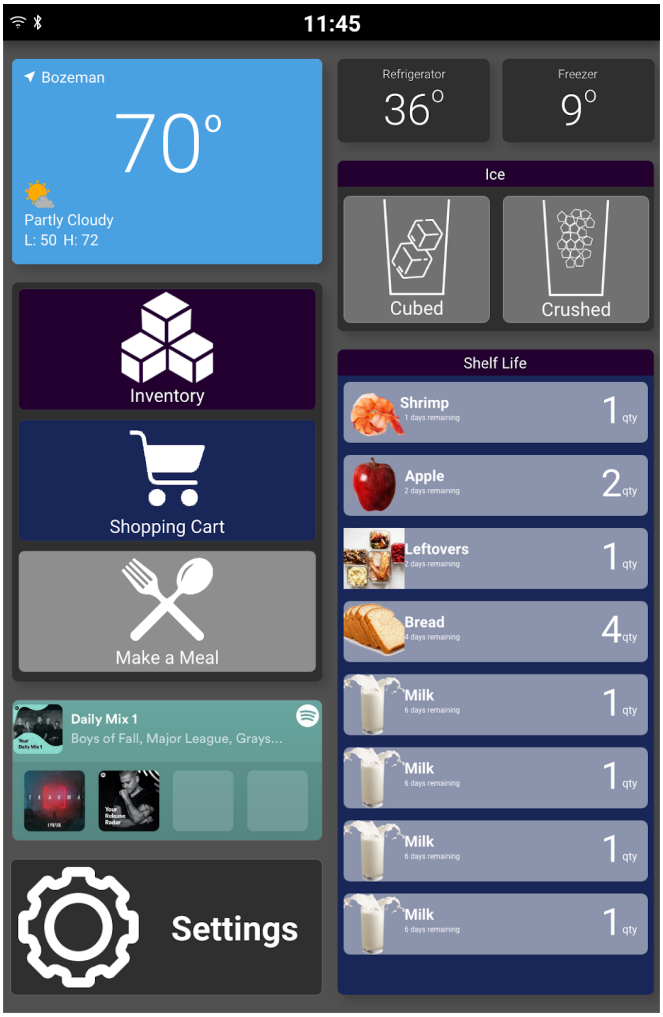


Image 6

(First-In-First-Out Optimization and accessibility)



Wasted Space Table

Full Section Volume (not including drawer)**: 4928 in^3**		
Type of configuration	**Estimated Wasted Volume (in^3)**	**Estimated Wasted Space**
All square/rectangular containers	542	11%
All circular containers	1282	26%
Mix of square/circular containers	1175	24%
Mix of containers, bottles, loose food (what you'd expect to find in a typical fridge)	1528	31%