

Tab 1

# FridgeMate

## The Perfect Fridge Companion

INFO-I300 Group 2

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### Table of Contents:

1. Full Project Overview
2. Context & Problem Framing
3. Design Process
  - Early Sketches
  - Primary Research: Interviews
  - Secondary Research
4. Design Development
5. User Testing
6. Final Design
7. Limitation & Future Directions

## Project Overview:

Food waste in shared households is rarely caused by a lack of storage space. Instead, it stems from disorganization that causes poor visibility, inflexible layouts, and forgotten food.

Our target audience is college students living in shared apartments of three to four roommates. In these environments, groceries are purchased at different times, leftovers accumulate unpredictably, and items are often placed wherever space is available. High cognitive load, busy schedules, and shared ownership make consistent organization difficult. At the same time, this group has a low tolerance for complex or high-maintenance technology.

Through interviews with college-aged individuals living in shared apartments, we identified consistent patterns:

- Fresh produce and leftovers are often pushed to the back and forgotten
- Drawers hide food rather than highlight it
- Large items (milk cartons, egg cartons, sauces) disrupt organization
- Inconsistent routines increase spoilage
- Users prefer mechanical flexibility over complex smart features

As one insight summarized:

**“Food that is visible gets eaten. Food that is hidden gets wasted.”**

Secondary research reinforced this finding. Studies show that spoiled food is commonly found at the back of refrigerators, and that individuals under cognitive load rely on convenience over systematic organization. Visibility and clear structure directly influence consumption and waste patterns.

To address this, we developed **FridgeMate**, a refrigerator system centered around:

- Adjustable, movable compartments
- Modular zones for flexible categorization
- Rotating elements to prevent hidden food
- A lightweight companion app with internal sensors

The app does not replace physical organization. Instead, it provides minimal, ambient support by:

- Mirroring the fridge layout in a digital twin
- Monitoring zone conditions such as temperature and humidity
- Allowing optional zone labeling for shared coordination
- Providing gentle reminders (or nudges) for items nearing expiration

This fridge is ‘smart’ by combining physical modularity with minimal digital support, FridgeMate aims to reduce food waste, improve shared organization, and better align refrigerator design with real household behavior.

# Context and Problem Framing

The refrigerator is one of the most used appliances in a house, and yet its internal organization does not correspond to real-life habits. Living spaces are shared environments, and food is always being added, relocated, and forgotten. Although refrigerators are spacious, they do not always accommodate the needs of multiple users, different habits, and varied food practices. Without flexible structure, the system gradually becomes disordered.

Our focus is on **college students and young adults** living in **shared apartments** of three to four people. In these environments, groceries are purchased at different times, leftovers accumulate, and items are placed wherever there is available space. Over time, this leads to crowded shelves, hidden food at the back, squished fruits, and confusion over what needs to be eaten first.

Many problems arise from limited visibility and inflexible layouts. Drawers hide items instead of highlighting them. Large containers are hard to organize. Food that is meant to be eaten soon gets pushed behind newer purchases. Despite having enough storage capacity, the system itself does not adapt to the household's changing needs.

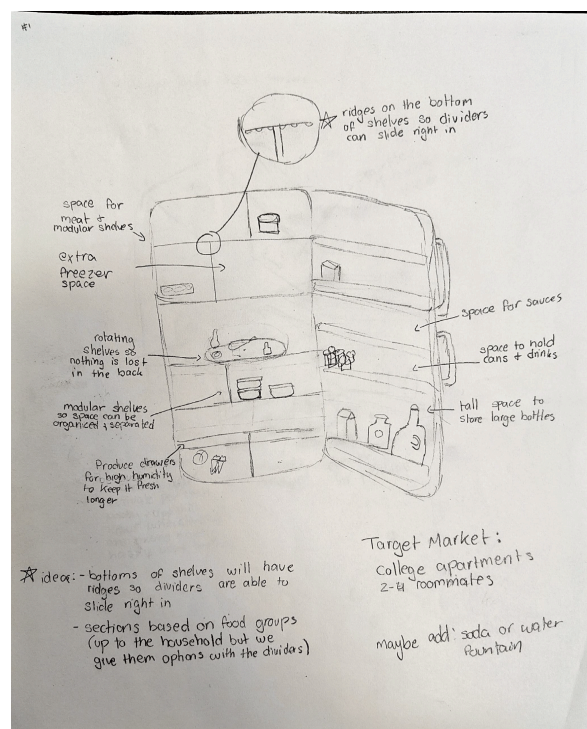
Recognizing these patterns in shared living situations led us to question whether the problem was truly about space, or about how that space is designed and organized. Despite having enough storage capacity, the system itself does not adapt to the household's changing needs. This realization became the starting point for our design exploration.

From this foundation, we began developing and testing potential solutions through an iterative design process.

## Design Process

### Initial Ideation

Before conducting interviews or formal research, we began by reflecting on our own experiences with refrigerators in shared living spaces. As college students living with roommates, we repeatedly encountered small but frustrating issues: leftovers getting pushed to the back and forgotten, less space for items, and large items like milk cartons disrupting shelf balance. Even when the fridge was not full, it often felt disorganized.



Through this discussion, we recognized that the core problem was not a lack of storage capacity, but a lack of adaptability. Fixed shelves forced us to work around the fridge's structure rather than letting the structure adjust to our needs. Over time, items were placed wherever space was available, leading to hidden food and inefficient use of space.

These shared experiences helped us clarify that the problem was rooted in organization, visibility, and flexibility, not simply size.

**Design Decision: From this initial thinking, we determined three initial design decisions. Emphasis on reconfigurable storage rather than simply increasing overall storage, emphasis on visibility to prevent forgotten foods, and modular components such as adjustable dividers or movable sections as a starting point.**

## Interview Process

### **Demographic**

We interviewed four college students living in shared apartments with two to four roommates. All participants regularly used a shared refrigerator and stored groceries, leftovers, produce, dairy, and condiments.

### **Questions Asked**

Our interviews focused on understanding habits, problems, and preferences.

- What do you typically store in your fridge?
- How many people do you live with?
- What annoys you most about your current fridge?
- What foods are hardest to store properly?
- What runs out the fastest?
- Do you have issues sharing fridge space?
- Would you trade storage space for other features?
- Would you use smart features like screens or apps?
- Do compartment labels help or feel restrictive?

### **Cristina (College Student - Lives with 2 people):**

Stores fruits, veggies, dairy, eggs. No issues sharing the fridge. They are quite lenient in their house, but they designated shelves in the beginning. Would appreciate a designated fruit section/ produce. Likes the shelves in the fridge and how they clearly separates things that run out of fruits the fastest. Doesn't like the empty side shelves that are oddly sized. I am annoyed that the shelves get dirty. Finds fresh produce to be hard to store. She would trade storage space for other mechanical features, but wouldn't use screens and apps.

**Anvi (College Student - Lives with 3 other people):**

We store our fruits and veggies in the drawers, and usually do not have an issue with space there. However, with most dairy products, we tend to buy too much of each and do not have enough space on the sides for the extra milk or space in the fridge for the big egg cartons. I really like the main shelves because they clearly separate everything and help us run through fruits the fastest without much hassle. While there is space, fresh produce either gets squished or forgotten, as we use it once and don't use it again. Finds that having some storage space with better mechanical features like adjustable dividers would be beneficial.

**Kennedy (College Student - Living with 3 other people):**

Stores condiments, meat, fruit, vegetables. Would like an alcohol section. Water dispenser is the best thing about current fridge. Runs out of fruits and drinks the fastest. roommates forget to throw things away so a lot of it goes bad. No never had anything lost, stolen, or mixed up. Not necessarily because they go bad but any sauces because they take up a lot of space. would trade some of the fridge storage for more freezer storage. Compartment labels feel annoying. No, would not use smart features on a fridge. Not that she can think of, fridge works like she wants it too.

**Viraj (College Student - Lives with 4 other people):**

Mostly stores meal-prep containers, leftovers, dairy, sauces, and some produce. Leftovers gets pushed back and forgotten. Feels that the fridge technically has enough space, but it's poorly organized for items that are meant to be eaten later rather than immediately. Likes clear shelves but wishes there was a better way to visually distinguish "eat soon" food from long-term items. Finds drawers inconvenient because he forgets what's inside them. Would prefer physical features (like dividers, shallow trays, or visibility-based layouts) over digital reminders or smart features.

**Key Findings**

- The problem was not conflict between roommates, but lack of intuitive organization.
- Fresh produce and leftovers were frequently forgotten, especially when pushed to the back.
- Drawers often hid food rather than protecting it.
- Large items such as milk cartons, egg cartons, and sauce bottles disrupted spatial balance.
- Participants preferred mechanical flexibility (adjustable dividers, zones) over complex smart technology.
- Fixed compartments and rigid labels felt limiting.

**Design Decision: While our interviews showed strong preference for mechanical solutions, the project required us to critically define what "smart" means in this context. We therefore explored a minimal digital companion that reinforces, rather than replaces, physical organization. The interview process gave us clarity of purpose which allowed us to decide to: create a system of flexible, movable compartments to increase not only flexibility, but also visibility; include features such as rotating parts to minimize waste of food in**

**the back of the fridge; break away from traditional labeling and instead create a system of flexible zones; and use technology as a lightweight addition, rather than a central part of the system. This stage of the process took our flexible storage system and made it a system designed to combat hidden food, shared use, and actual user behavior.**

## Secondary Research

Since our demographic is shared homes, we decided to take an approach for better space management and organization.

Our secondary research showed that many people make decisions on the fly and decide what to get when they are already at the store. People will rely more on memory, rather than having a system. This increases the likelihood of food that ends up being forgotten in the back of the fridge(Berge, 2013).

Visibility is one of the main drivers in food waste and expiry. Food Waste Index findings estimated that consumers were spending roughly \$1800 per year on food that was being thrown away. Another thing that was mentioned was that regular fridge checks, clear organization, and increased visibility reduced overbuying and increased food spoilage(Turner, 2021).

More observations showed that there is a clear correlation between food spoilage and food being in the back of the fridge hidden behind newer items, and that food that isn't visible can sit for weeks or even months on end. Most of the items that were found with this issue were dairy and produce because people were also unsure about freshness or expiration dates, which led to people throwing them away early. In shared households, these issues also increased(Ozanne, 2022).

Research on student apartments showed that leftovers sat because people didn't know whose food it was and how long it had been in the fridge, which led to confusion on whether the food was good for consumption. This also led to food being thrown away early or just left there to go bad(Turner, 2022). Our secondary research tied into what we gathered from our interviews, which confirmed our idea and enhanced our ability to iterate on what we had already come up with for a viable solution.

To combat that exact visibility problem. Javaria Akbar added a 'Lazy Susan' hack on a TastingTable article in 2025. She claims "you can purchase turntables that have a rectangular space-saving design these days, such as this Nostalgic 360° Rotating Lazy Susan available on Amazon that pulls out and revolves, eliminating this issue. Having said that, it's still worth using a classic lazy susan if you can't get your hands on a rectangular one because it allows you to see every item in your fridge and make use of them before they expire (because what's the point of filling up the extra space when it leads to more food waste anyway?) Moreover, fridges work more effectively

when they aren't overstocked and the cold air inside can circulate more freely around containers and jars.”

As per organization. We looked into how fridges are already divided. Produce drawers, or crisper drawers, are designed to extend the shelf life of fruits and vegetables by creating a controlled, high-humidity microclimate that prevents wilting and moisture loss. According to Sam Stone of Bon Appetit in 2023, drawers act as enclosed, separate spaces that stop cold, dry refrigerator air from drying out produce. High-humidity settings (closed vents) keep leafy greens and thin-skinned produce (lettuce, cucumbers) from losing moisture. Low-humidity settings (open vents) allow ethylene gas, which speeds up ripening, to escape, preventing fruits (apples, pears) from rotting too quickly.

**Design Decision: Our research gave us key information and metrics to further explore and iterate on our product. We gathered a lot of information that aligned with our current ideas and decided to implement more solutions based on those key findings. Our improved fridge layout and modularity decreases the possibility of food spoilage, increases organization, and also increases storage. This paired with our app acting as a digital twin also helps reinforce organization by giving the consumer access to reminders, ownership, and better tracking of where their food is, its environment, and how long it's been there.**

## Design Development

Our sketch encompasses a lot of intentional organization elements.

- Modular Shelves

Due to a large number of our interviewees complaining about the lack of clear storage sections per resident, we developed a system that has optional organization dividers. They are optional so the layout doesn't dictate and limit usage. Instead it is flexible and supports individual households. The dividers are accompanied by sensors that will eventually mirror the layout of the fridge in our user's apps.

- Rotating Disk (Lazy Susan)

According to a lot of our secondary research, visibility was a key factor that led to food waste. Therefore, we made the intentional decision to sacrifice corner space in order to add a feature that allows for better visibility. This is also optional and removable in the situation that tons of space is required.

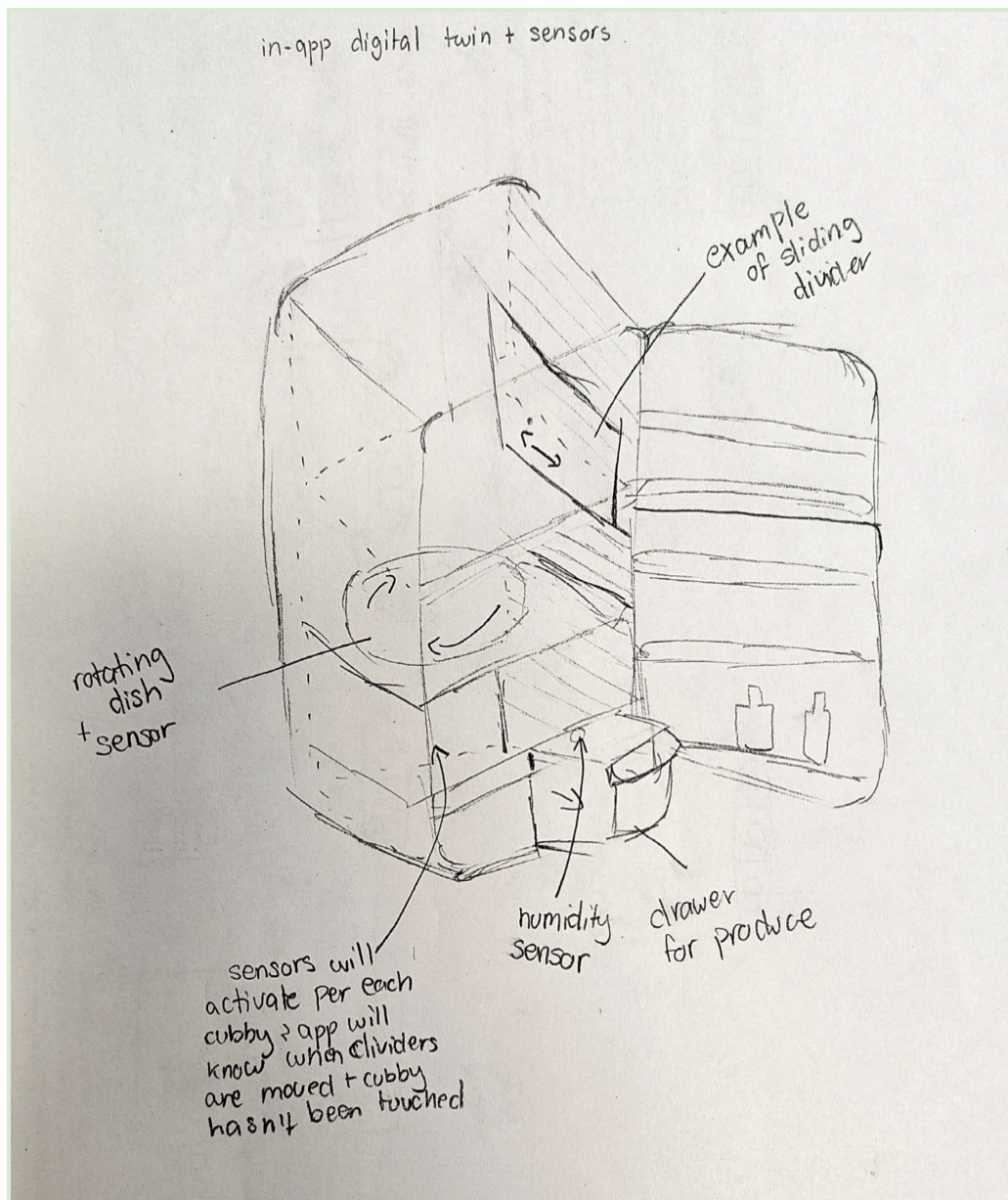
- Produce Drawer

Our demographic emphasized the need for visible and easy access to fruits and vegetables. According to our secondary research, produce and crisper drawers exist to separate ethylene-producing items from those sensitive to it. Since we want to prevent food waste,

this form of built in organization with humidity sensors will help prevent rotting. Humidity controls are available on the app.

- Other

A common theme of fridge designs is the need for storage space. Some bulkier items tend to ruin the flow. Therefore, we added large amounts of space in the side door to accommodate alcoholic beverages and other tall containers. Same with the freezer section.



## Class Activity Board


\* Group 2 \*

Consumer Demographic: College Apartments/Single-family apartments  
-helps with categorization  
-easy storage/easy access

Features:

- rotating shelf
- modular shelves
- customization
- larger storage space
- high humidity section

Rough Sketch



What we gathered from interviews:

- ⊙ People do not want to use apps
- ⊙ storage > smart feature
- ⊙ Fruits & veggie storage
- ⊙ waste is caused because  
People forget about food
- ⊙ large items are hard to store

## Feedback Notes

### Notes:

#### Group 7

- Certain things taller than others
- Spacing number of shelves and space needed (find equilibrium)
- Butter section on door
  - Use unused space
- Cross contamination mitigation
- Plastic flaps on the front

#### Group 8

- Wants a system to give an idea on what to make
- Wine storage is IMPORTANT
- Have some features on the outside
- Ice machine and ice dispenser
- Maybe add condiments dispenser

**Design Decision:** Our classmates gave us many ideas. We chose to keep in mind that some objects are taller than others so we decided to make sure space can be created when needed. Elements in the front of the fridge such as ice machines and ice dispensers would take up some internal space to hold

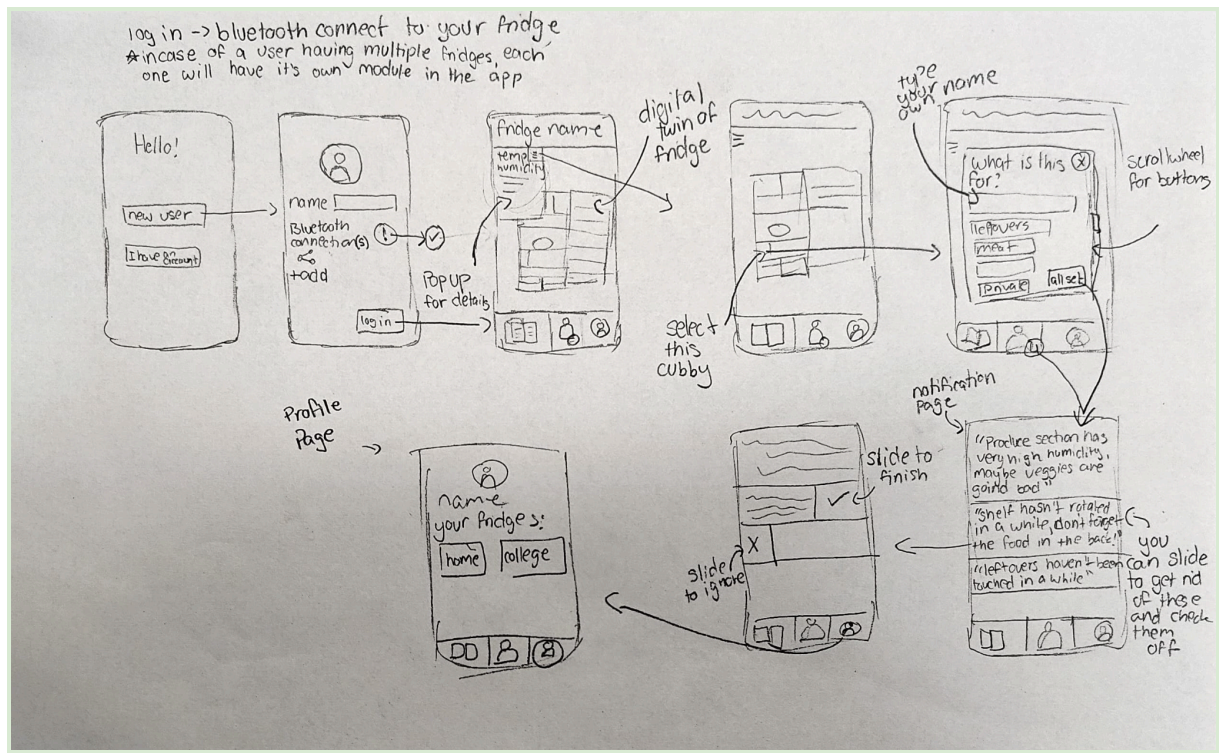
the ice. Along with accounting for our specific client demographics, we did not add elements to the front for economical purposes.

## Physical Design

To truly test our design during the user testing portion, we made a physical cardboard prototype of our fridge. It contains the drawer elements, removable dividers, functional rotating lazy susan, clear distinction between freezer and fridge space, extra dividers(not shown in the photo) and is relatively to scale.



# App Development



To combat the issues of **wasted food and forgotten produce**, we have decided to build an app to help users with organizing how much food is in the fridge and when things are about to go bad. **FridgeMate** is designed to improve visibility of what is in the fridge and what needs attention, helps manage fresh produce and leftovers, which are especially prone to waste, and uses sensors and a connected app rather than heavy, screen-centric “smart” features. FridgeMate helps users keep track of what’s inside, who it belongs to, and when it needs attention, reducing confusion and additionally preventing food waste.

The core concept is a **Bluetooth-connected fridge** companion app paired with small **sensor modules** placed in different fridge zones. After a simple pairing process, users see a visual preview of their actual fridge layout in the app. They can:

- label compartments
- view live temperature readings for different zones
- receive notifications when produce is likely to go bad
- get reminders (nudges) to rotate items on shelves or discs so that food at the back is brought forward.

When the user first opens the app, they are guided through a quick setup process. They enter their fridge’s layout, such as the shelves, drawers, and compartments, and connect their devices to Bluetooth to activate the sensors in key zones like the produce drawer, door shelf, or leftovers area. The app then creates an **editable digital twin of the fridge**, where users can name each zone, assign ownership, and define its purpose. Each sensor tracks movement, temperature (and optionally

humidity), giving users live and historical data. The app alerts them when zones fall outside ideal conditions, like a dairy shelf that's too warm.

To reduce waste, users can log when they add items. The app uses this data, combined with real fridge conditions, to send helpful reminders. Finally, the app supports better organization through a "reminding" feature. Users can tag shelves that tend to hide food or use rotating discs, prompting reminders to reorganize regularly. Overall, the app fosters shared responsibility, visibility, and minimal waste.

## User Testing and Evaluation

We used both our physical prototype along with our sketched app prototypes to conduct our user testing. Since a major portion of our design includes optional modular elements in the fridge, we wanted to make sure that the app usage and design properly blends into the day-to-day interactive usage with the fridge.

### User Testing Questions

- Create a cubby for your personal food and label that zone in the app.
- Make a shared snacks section using the dividers.
- The app shows: "Produce zone needs checking." What would you do?
- The app shows: "Back rotating shelf hasn't been checked recently." What would you do?
- Mark the correct zone as "checked" in the app.
- Change one zone from "snacks" to "meal prep" in the app.

### Questions Post Interview:

- What felt easiest?
- What felt annoying?
- Would you use divider zones at home?
- Would you use the app labeling?
- Were the reminders helpful or unnecessary?
- Did anything feel confusing?

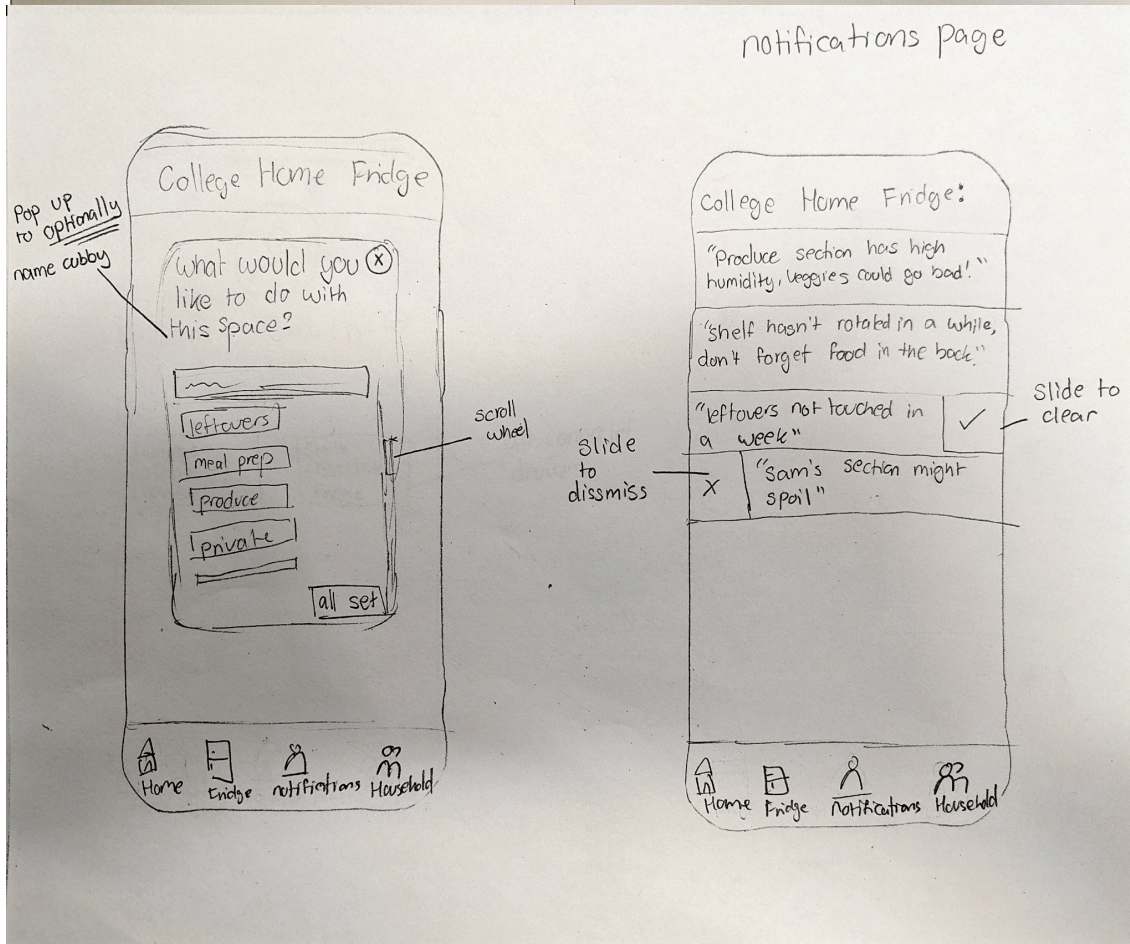
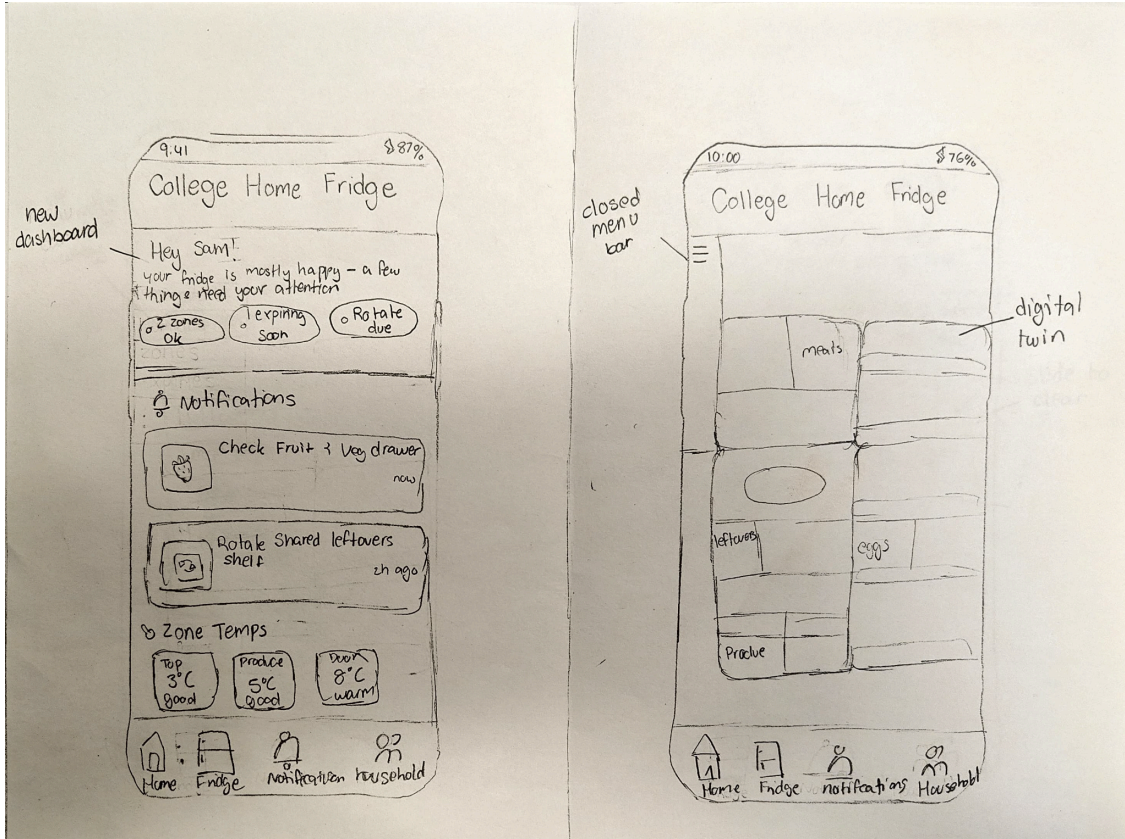
### Notes taken during user testing

#### **Billy (College Student - Lives with 2 other people):**

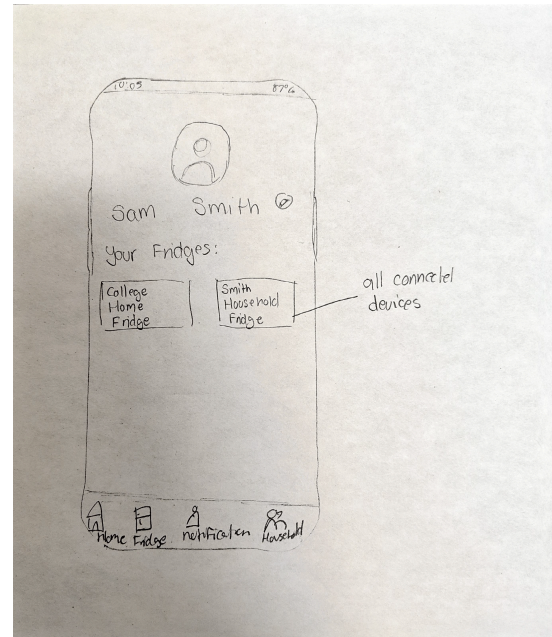
Enjoyed the lazy susan element because he often forgets things a lot. Dividers felt intuitive. He meal preps for the gym often so he said he would make a cubby for that. The app felt easy to follow. The main menu could be changed to account for all the different zones. Liked the notification section a lot. Would feel annoyed by constant notifications so would like the option to choose what to get notified for. Also suggested a main dashboard so you don't have to click around.

#### **Sally (College Student - Lives with 2 other people):**

Liked that the physical prototype was easy to use. Was also able to make a cubby and name it. Said she would likely remove dividers and certain sections so she enjoys that things are optional. Likes to keep her eggs separate so she made a cubby for those. Clarified that the app only nudges if things actually need to be checked. Would like the dashboard feature but doesn't need it. Felt confusing to understand zones. Understood after explanation.



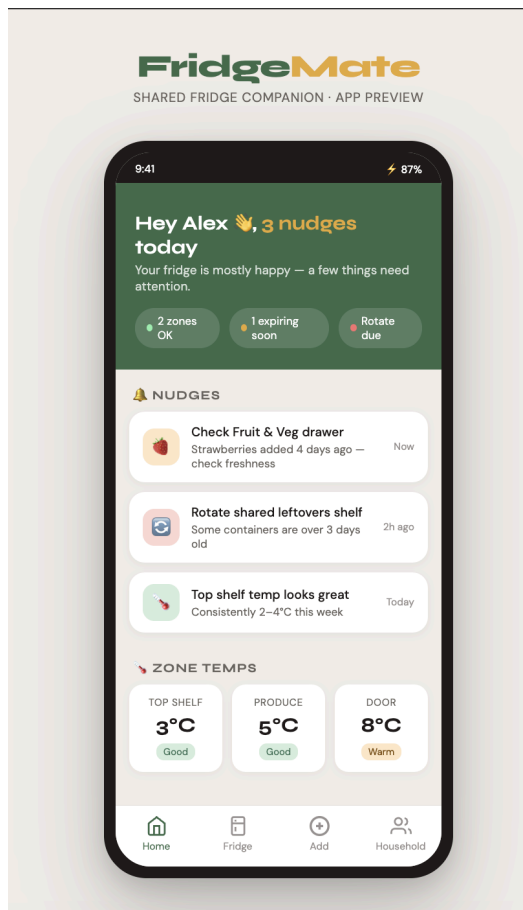
**Design Decision:** Our iteration and refinement after the user tests mainly consists in the app design. Though most things felt intuitive, we will change up the menu portion so specific zones can be clicked on and edited (temperature/humidity settings). Our main upgrade will be a new dashboard home screen. This will have all the important information such as zone temperatures, notification/nudges, what sections haven't had movement recently, etc. Hopefully the addition of this design feature will facilitate and further optimize the app usage.



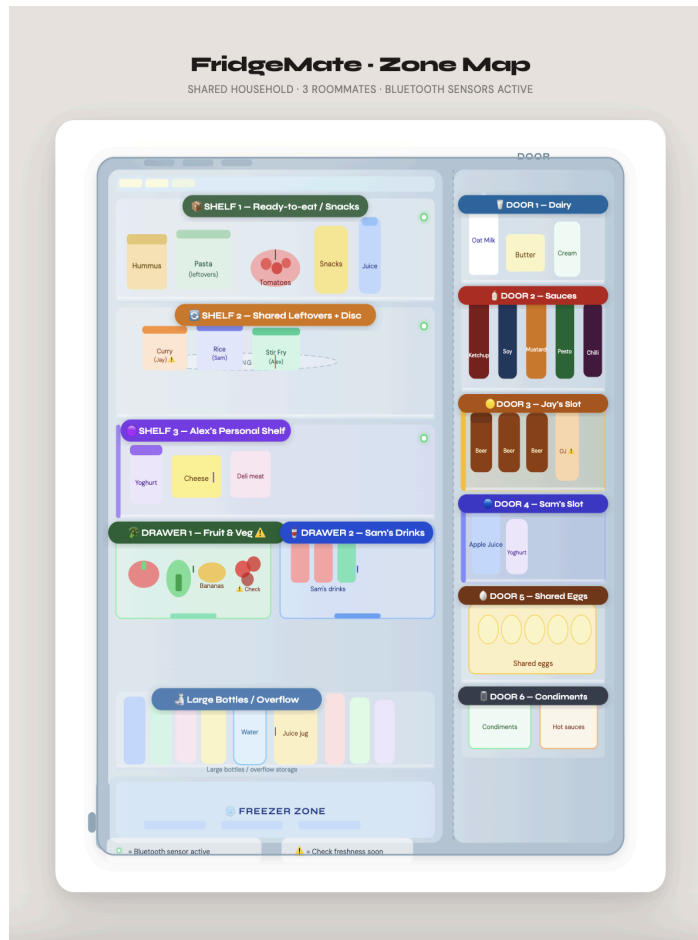
## Final Design

### Digital App Pictures

Main Dashboard:



Digital Twin Example:



# Conclusion: Limitation & Future Directions

FridgeMate demonstrates that meaningful reductions in food waste come less from adding capacity and more from redesigning visibility, flexibility, and shared coordination in the refrigerator. Grounded in interviews with college students and supported by secondary research on household food waste, our project reframes the “smart fridge” from a screen-heavy gadget into a hybrid system where modular physical structure does most of the work and lightweight digital support fills in only where human memory and coordination routinely fail. By combining reconfigurable, visibility-focused storage with a minimal companion app, FridgeMate aligns refrigerator design with the realities of shared student living: irregular shopping, inconsistent routines, and low tolerance for complexity.

Our current solution also has important limitations that shape where the project should go next. Because our research and testing focused on a small group of college students in shared apartments, our findings may not generalize to other demographics such as families with children, older adults, or households with different cooking and shopping patterns. Our prototype is also low-fidelity and constructed from cardboard, so we have not yet addressed questions of durability, manufacturability, cost, or integration with existing refrigerator hardware and insulation. In addition, our sensing and app concepts remain largely conceptual; we have not validated battery life, Bluetooth reliability through fridge walls, or long-term user engagement with reminders in real-world conditions.

Another limitation lies in behavior change and sustainability impact. While our design aims to make visible food more likely to be eaten and forgotten items harder to ignore, we have not conducted longitudinal studies to measure actual reductions in waste over weeks or months. It is also possible that users will gradually ignore notifications, remove dividers, or stop logging items, which would weaken the system’s effectiveness over time. Finally, our current app design assumes reliable smartphone access and comfort with basic settings, which may not hold for all users or all contexts, and we have not yet examined data privacy or security implications of logging household food patterns.

These constraints suggest several future directions. First, we plan to develop a higher-fidelity functional prototype using realistic materials, embedded sensors, and actual Bluetooth connectivity, then test it in multiple shared apartments over an extended period to track real behavior and waste outcomes. Collaborating with appliance manufacturers or hardware engineers could help us explore retrofit kits for existing fridges, making modular dividers, rotating platforms, and sensor units that can be installed without buying a new appliance. Second, we want to refine the app with more flexible notification settings, clearer zone metaphors, and low-effort interactions—potentially reducing manual logging by leveraging simple defaults or occasional check-ins instead of item-by-item tracking.

In the longer term, FridgeMate could expand beyond single family homes/shared apartments. One direction is adapting our modular-zones-plus-digital-twin approach for family households, where ownership, dietary restrictions, and children’s access raise new design questions. Another is to explore gentle integrations with grocery planning and recipe suggestions that use only high-level zone information rather than detailed inventories, preserving our commitment to low cognitive load. Finally, future work should evaluate the environmental trade-offs of added hardware and electronics versus reduced food waste,

ensuring that “smart” features remain minimal, targeted, and genuinely beneficial rather than adding complexity for its own sake.

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Tab 2

