

The Fridge Companion

Tarun Andrews

Department of Computer Science
University of California, Davis
Davis, California, USA
tpandrews@ucdavis.edu

Jason Doan

Department of Computer Science
University of California, Davis
Davis, California, USA
jdoan@ucdavis.edu

Christian Luis Abueg

Department of Computer Science
University of California, Davis
Davis, California, USA
cjabueg@ucdavis.edu

Govind Alagappan

Department of Computer Science
University of California, Davis
Davis, California, USA
galagappan@ucdavis.edu

Ralph Legaspi

Department of Computer Science
University of California, Davis
Davis, California, USA
rlegaspi@ucdavis.edu

Zahira Ghazali

Department of Computer Science
University of California, Davis
Davis, California, USA
zmghazali@ucdavis.edu

ABSTRACT

The Fridge Companion App is a cross-platform application that monitors the contents of a smart fridge through a fridge database and automatically updates nutritional information by items taken out by the user. The application also ensures the user can create grocery lists with the knowledge of what is currently present in their fridge or is missing. It was designed to allow people to have better control over their diet and the items within their fridges to help them achieve a healthier lifestyle. Design and conceptual choices made for the Fridge Companion revolve around these three key features identified through interviews and persona creation: fridge database, grocery list creation, and nutrition tracking.

Introduction

“The Fridge Companion” was created to provide a reliable way to track food intake for health or dietary purposes. An application like ours would allow one to know what they already have in their fridge and, thus, help eliminate food wastage. The application will provide statistical dietary suggestions and measure daily intake based on the user’s health goals. Furthermore, it’s important to help people with health and dietary restrictions, and such an application would allow people to make adequate life changes to thrive within their new health and diet lifestyle.

While many food tracking applications exist over the Internet, they mainly focus strictly on manually counting macros, simply for statistics rather than providing any additional aid for the user’s goal. This is where “The Fridge Companion” comes into play. By simplifying how users track their macros by automatically calculating daily nutritional values when users remove items from the smart fridge. Our application is an enhancement of pre-existing food-tracking apps by making full use of mobile and smart fridge capabilities.

The Fridge Companion App is a cross-platform application that functions on both smart fridges and mobile devices to give users better insight into the contents of their fridge and their nutrition.

The implementation of the app intermixes fridges and mobile devices into one ecosystem and thus allows users access to their refrigerator inventory on their mobile devices. The mobile and fridge app also share the same UI to keep things consistent for the user. Coupled with the built-in nutrition tracking features powered by a vast, reliable public food nutrition database called Nutritionix, users are able to acquire complete quantitative control over their diet. To help users plan their personal diet needs, the application also contains a grocery list feature that syncs between the mobile device and the fridge. These lists contain the nutritional information of the food, giving users maximal flexibility when it comes to making recipes and meals that can coincide with their diet.

One of the most common human errors is forgetting to buy certain items on our weekly grocery trips. With our application, users will no longer need to keep a mental note of their grocery list as the app allows them to have it in the palm of their hand. Eliminating the days of people leaving the grocery stores having forgotten their necessary items for the week. Whenever you decide to select certain food items, you can confirm their consumption in the application, which updates your current fridge inventory to reflect the number of used items, automatically updating your daily values such as protein, carbohydrates, fats, etc. Achieving dietary goals is easier than ever before as the application does all your macronutrient tracking, saving you time and hassle to focus on your health goals. Limiting food waste becomes a more doable task as well, as the Fridge Companion App provides expiration warnings to notify the user of any products nearing or past their expiration date.

Background

We looked at many different sources of information and other food-tracking and nutrition apps before we started work on this project. We started by finding sources that looked at the amount of food wasted by people in general and the amount of food wasted by people due to forgetting the food they had in their fridges. This was done to add merit to our motivation to reduce food waste. We then found information regarding the amount of food and nutrients needed for our target groups. This included recommended daily values of nutrients for an average user and also the recommended macros for bulking and cutting diets for our gym users. We used this information to model our nutrition tracking system. And finally, we looked at the potential backend databases we could use for our application and where we could get the necessary data to populate our database. We found information about relational databases and found the public food nutrition database Nutritionix. This became the basis of the framework of our application.

Method

Following the Stanford d.school Design Thinking Process, we started in the “Empathize” stage with data collection to familiarize ourselves with the contexts of the topic. Our research was established on two target user groups: average people and physically active people. For average people, we researched sources on fridge inventory, family versus individual diets, and food expiration. For the physically active group, we researched the differences in bulking and cutting diets. In the last part of this stage, we interviewed members of these two user groups to understand their situations as the last part of user data collection. Our questions revolved around their diet, their food tracking methods, food waste rate, and more.

Next, we began the “Define” stage to formulate the problem statement. We created two subgroups for our two main groups: average individuals and family users for the average group and bulking diets and cutting diets for the physically active group. From interviews and data collection, we created personas for these four subgroups, which helped us understand the needs of our users in terms of their goals, motivations, role objectives, and decisions. In terms of pain points and challenges, we realized our lack of information in the areas of mobile application characteristics, smart fridge capabilities, and the database component for nutritional information. Therefore, we revisited the data collection stage to expand on the application’s features after performing extensive research on our target user groups. Most importantly for our database, we found an accurate nutritional database called Nutritionix that our application will pull from. It is available to the public and provides nutritional values for many food and restaurant items with a search. To finish off the “Define” stage, we completed our problem statement, which was to design a smart fridge with mobile companionship to provide a nutritional tracker for specific target groups, limit food wastage, and track fridge supply.

Then, we worked on the “Ideate” stage. As a rule of thumb, at the beginning of every meeting, we would discuss our findings from the previously completed stages, building off of the previous stage

of the design process. We prioritized and settled our project’s goals of creating a robust tracking system for food and a way to plan future grocery plans in order to enhance the users’ food and nutritional management. The group settled on the following application features: fridge supply tracker, nutrition tracker, and grocery list creator. We also reduced the scope of our user groups. For every application feature, we brainstormed on how to connect the users’ needs and the implementation of the feature.

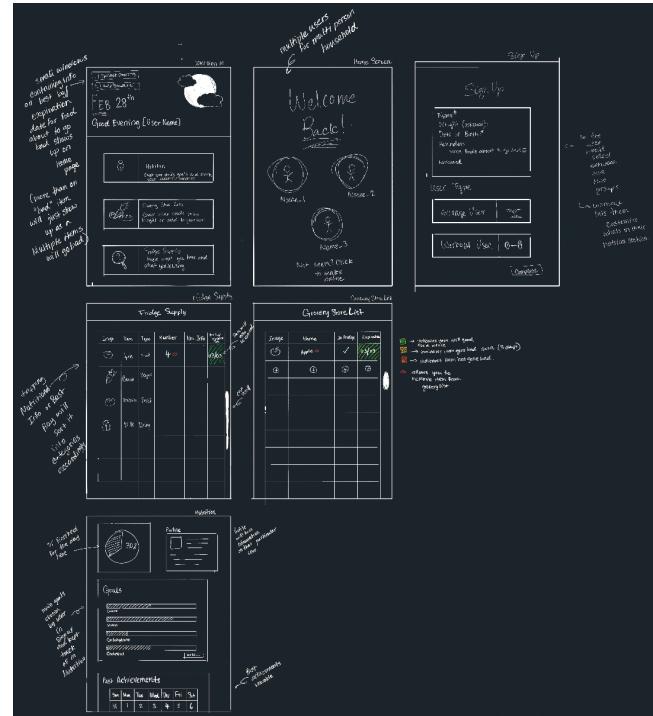


Figure 1: The original paper prototype. Includes brainstorming ideas as to the functionalities of each of the different buttons and functions and sketches of the three main pages.

In the “Prototype” stage, our first step was a simple paper mockup of our prototype with its three main components: nutrition, the grocery list, and the fridge supply, which all had their own respective UIs. After finalizing our features, we performed storyboarding to visualize our animations. After reviewing our first iteration, we utilized failing fast techniques to simplify our complicated features and added additional features we believe our users need. Then, we applied features from Nielsen’s Ten Usability Heuristics, such as error prevention and recognition rather than recall. Lastly, we began on the lo-fi Figma prototype. One key benefit of the lo-fi prototype was the ability to iterate quickly. Through our feature planning and creation of prototypes, we were able to simulate the design and aesthetic that our team envisioned would help users accomplish their dietary management needs.

Then, we worked in the “Test” stage, performing heuristic evaluation and re-interviewing through real user testing. We compared our prototype in regards to Nielsen’s Ten Usability Heuristics and other characteristics such as feedback, constraints, etc. We noticed our successes in these areas were evident due to

support from our real user testing results. Lastly, we repeated the five design stages once more to finalize our prototype and project as a whole.

Understanding the Users

Our initial plan was to target users with health conditions like high cholesterol and diabetes, but we were faced with issues regarding the interviewees. Interviewing these users presented privacy issues as medical information is sensitive. Unable to find an adequate amount of users willing to disclose their health information, we narrowed our scope to focus on two primary groups, average daily users and physically active users.

Needfinding was the focus of our interviews. When interviewing the average users, we asked how they currently track what is in their fridge and what would make it easier for them to keep track. For the grocery list, we asked users how often they go to the grocery store and how often they forget to buy something they needed, and when we found out that most users tend to forget a few things, we decided to implement the grocery list feature in the app. We also asked how much food wastage is produced, and after finding out that most people tend to throw out at least some food, we implemented a function that will let the user know if the food in the fridge is close to the expiration date. Specifically for the physically active users, we asked what basic macros they would want to view in the app and decided to implement a feature to view daily values for each type of nutrient. We also included a pie chart to track the calories consumed per day, as most users said that it would be helpful to keep track of how many calories they have in a day.

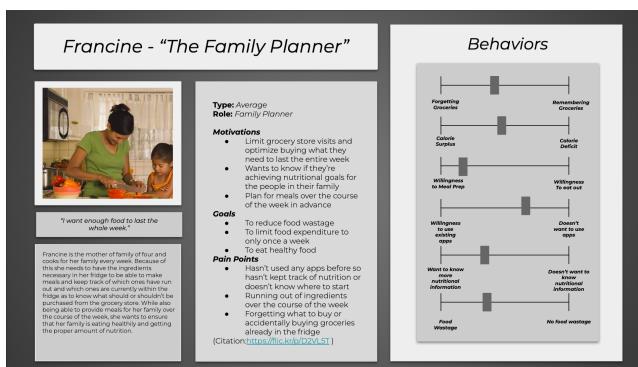


Figure 2: Persona for Family Individuals

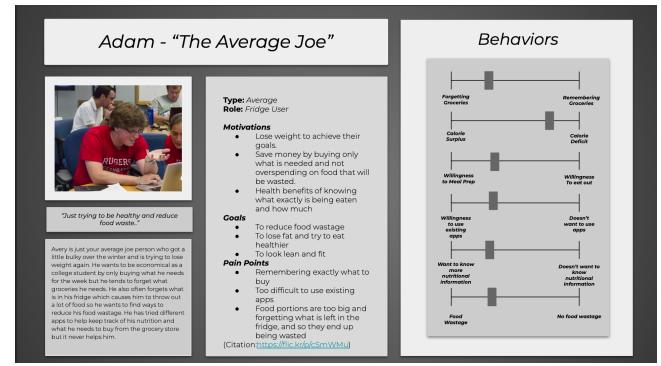


Figure 3: Persona for Average Individuals

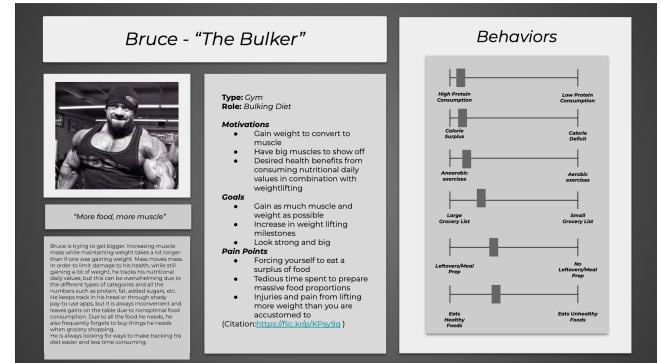


Figure 4: Persona for Bulking Diets

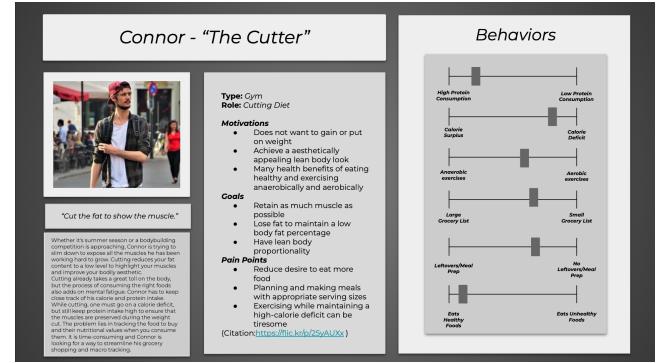


Figure 5: Persona for Cutting Diets

Conceptual Model

The three main problems we are trying to solve are ease of use for our target groups, reduction of food wastage, and tracking user progress toward their health goals. The way we have attempted to solve these problems is by creating a food tracking application that syncs with a smart fridge that one may have at home. This choice was made as it made it far more convenient to use our application to track food use as compared to typical food tracking apps, which solved the first problem. Secondly, the use of a food tracking app in itself allows users to have complete control and knowledge of what is in their refrigerator. When it is coupled with

our implementation of an expiration date tracking system, it leads to a massive reduction in the amount of food wasted due to a lack of knowledge of what is in the fridge and its associated expiration dates. And finally, we have implemented a nutrition tracking feature within the same app that uses the data from the fridge tracking section to note what has been eaten by the user. This nutrition tracking section uses nutritional information from the public database that we utilize to track a user's progress toward their goals.

Prototyping

Again, through interviews and persona creation, we were able to isolate three key functions the application needed to be able to support: a fridge database that maintained information about the items within the fridge, a grocery list creator which is able to add and delete items, and a nutrition tracker that was able to record information on food waste and user nutritional intake.



Figure 6: The home screen page as it appears on the prototype. Alerts on items that are near expiry date or past expiry date will appear as small pop-ups in red and yellow respectively, in upper left hand corner. FAQ and logout button can be found in upper right corner. All three main pages - nutrition tracker, grocery list, fridge supply - can be accessed through this page.

Nutrition Tracking

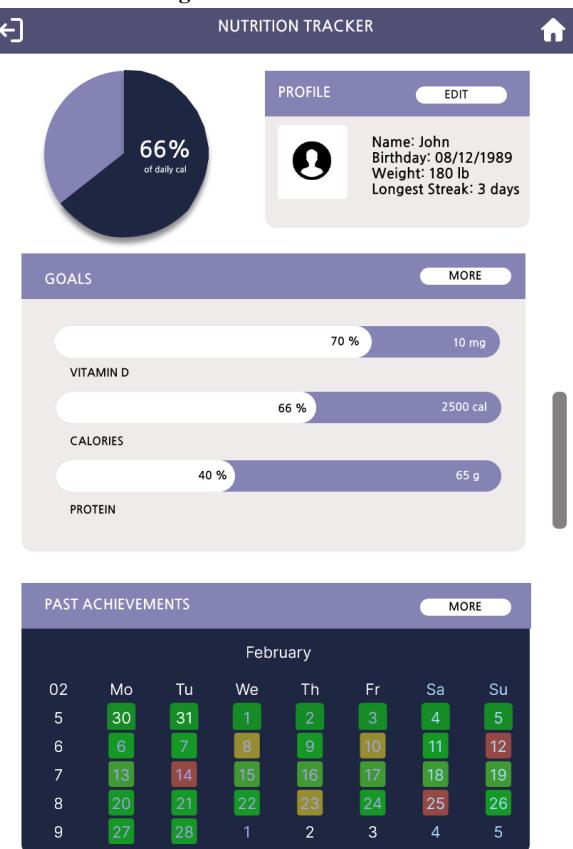


Figure 7: The nutrition tracker page as it appears in the prototype. The three main functions - profile, goals, and past achievements/records - can be seen on this page. Each leads to different pages - editing profile, editing goals, viewing past records - to best allow the user to track their progress.

The main features of the nutrition tracking feature are the editing of the user's profile, editing of nutritional goals, and viewing of past achievements.

The user profile contains base statistics about the user including weight, birthdate, etc. The user's profile is treated as a "state" for that particular day. This means that the profile can be updated later to more current information and past profile information (so past records of weight, height, etc.) can be viewed in the past achievements section.

The nutritional goals section shows the progress on specific aspects of the user's nutrition that they wish to track. Additional items that the user wishes to track can be added by toggling them in the "more" section either by toggling them or by adding them manually; this is so users can freely control specific aspects of their nutrition that they're interested in. Inexperienced users who don't have knowledge of how much of a particular item they must consume will be given a recommended value that to input as a goal to achieve when toggling or adding goals they'd like to track.

The past achievements section allows the user to view past records for previous days including the goals accomplished, food waste, and the profile that had been present on that day. There is a color system implemented (red, yellow, green) on the calendar to show how much of the user's nutritional goals had been accomplished that day: red means the user had accomplished very little, yellow means the user had accomplished roughly half of their goals, and green indicates the user had accomplished most of their objectives.

Fridge Supply

IMAGE	NAME	TYPE	NUMBER	NUTRITIONAL INFO	EXP
	APPLE	FRUIT	4 ●	Calories and other things (if clicked then it brings up a more detailed pop up window)	3/3
	SPINACH	VEG	1 ●	Calories and other things (if clicked then it brings up a more detailed pop up window)	3/1
●	●	●	●	●	●

Figure 8: The fridge supply page as it appears in the prototype. Add and delete buttons can be seen on the top right, and items can be sorted by type. Expiration dates of items and item nutritional info can be accessed as well.

The fridge supply or fridge database functions to keep track of the items present within the fridge. As such, it allows the user to add and delete items from the fridge and also sort the items by type (e.g. vegetable, fruit, dairy etc.). The nutritional information tab allows the user to view the label pulled from the nutrition database. For expiration, there is a similar color scheme present here as it is in the grocery list feature with green for three days or more, yellow for less than three days, red for one day). When deleting an item from the fridge database, the user is able to select whether the item was thrown away or eaten; either selection will update the corresponding information in the nutrition tracker page with thrown away updating that day's food waste and eaten updating the goals section.

Grocery List

IMAGE	NAME	TYPE	NUMBER	IN FRIDGE?
	APPLE	FRUIT	2	4
●	●	●	●	●
●	●	●	●	●
●	●	●	●	●

Figure 9: The grocery list page as it appears in the prototype. Similarly to fridge supply, add and delete buttons can be seen in the upper right hand corner. The "In Fridge" button alerts the user as to whether the item is in the fridge or will expire soon by color and number.

When creating the grocery list in the app we wanted to make sure that the user can see all relevant information and it should be effective and easy to use. The grocery list has two main functions which are: allows the user to add items they want to buy and also delete items off the list. The grocery list page has the add and delete buttons which lets them edit the list. The list has two columns, one indicating whether it is in the fridge and another indicating how close the food is to expiry. The expiry column is also color coded with green indicating that the food is good for 3 or more days, yellow indicates that the food will expire in 3 days or less and red indicates that the food has gone bad. This makes it easier for the user to realize what they need to get on their next trip to the grocery store.

Heuristic Testing

We, as a group, sat down and did a heuristic evaluation of our own product in order to get a better understanding of what we had done correctly and what may need to be improved upon. Following Neilson's Usability Heuristics, we start with the visibility of the system status. Our app will always state which section it is currently on and clue in the users on what would happen. For the system and the real world, we included a home and back button in order to allow users to quickly go back whenever they want. The third heuristic, User Control and Freedom, was approached correctly as the app supports goal numbers for users, as well as the ability to change any nutritional info for food. This allows the user to use the app for their own target goal and achievements.

Consistency and standards were followed closely on our app, as it has similar and consistent color schemes to many other apps and uses a "stop light" color approach as well. There were also confirmation buttons for whenever the user wanted to make an action, which helps in the fourth heuristic, Error Prevention.

With so many confirmations, our app doesn't do as well with the fifth heuristic, Recognition and Recall, as the user has to recall the amount of confirmation windows and steps in order to take actions. Recognition is very good, due to the ability that the grocery list and fridge supply to handle many of the operations for the user, reducing the cognitive load on them. Our app partially adheres to heuristic seven, Flexibility and Efficiency of Use. There are back and home buttons, along with simple functions that allow users to go back and easily change something for the fridge supply or grocery list. However, the efficiency of use takes a hit with the great number of menus and confirmation screens that the user has to go through to complete their action.

In terms of testing, we received feedback from users on aspects of the prototype on improvements that could be made. For instance, for selecting items to delete or to add, interviewees said a drop-down menu would be more helpful. An interviewee also stated that having both the item's photo and the name seemed somewhat repetitive as they could identify or recognize the object with either one of those items.

Discussion

With the "Empathize" stage being an integral part of the project, the difficulty in finding our initial interview groups held the group's progress back tremendously. With the health problems group at a standstill, a decision was reached to cut that part out of the user audience. While the health issues management was an integral part of our motivation and cutting it out was disappointing, not being able to find interviewees allowed us to narrow our scope and continue work on the project. Proceeding to iterate on that area without getting user context would have been detrimental to our design process as we would not have their full experience in mind while designing the features that are, in theory, supposed to address their issues. All in all, while our user data collection had a rocky start, it allowed us to focus on the aspects of the project that the group had plenty of material to create and iterate on responsibly and effectively.

As for what the group learned about the design of our project, there are a lot of crucial design decisions that have to be made. For example, HCI concepts reminded us to make sure that error prevention was provided for users through confirm actions buttons to ensure that a user was intentionally performing an action. But the problem is that the group was unsure of how robust to make the error prevention due to fear of making it excessive and unintentionally wasting the users' time with unnecessary prompts for anything they want to do in the application. Overall, design decisions are difficult, and the group decided to trust the HCI principles and rely on user testing to try to perfect the design for functionality and ease of use for the users

Future Work

Possible improvements to our work can include the implementation of our product with code. There was some discussion as to what frameworks to use, and the majority decided that React Native with Expo would be the best option for our project. We did use the Nutritionix API in order to get nutritional information for our product, but it would be preferable if there was a better way to do it. The solution that was found was to use a

relational database, and the one that we had the most experience with was PostgreSQL.

Peer Rating

Christian Abueg, 16.67% – contribution to personas of the cutting group, Figma, and participation in the writing of the progress/final report.

Govind Alagappan, 16.67% – contribution to interviews and personas for daily users group, participating in writing of progress and final report.

Tarun Andrews, 16.67% – contribution to interviews and personas for daily users group, participation in data collection and group ideation, helped write the progress and final report.

Jason Doan, 16.67% – contribution to interviews and personas for physically active user group, data collection for normal diets and nutritional database, prototype features, and meeting leader

Ralph Legaspi, 16.66% – contribution to interviews and personas of physically active group, physically active group idea development, participating in data collection

Zahira Ghazali, 16.66% – contribution to interviews and personas for daily users group, personas creation, creation/animation of Figma Lo-fi prototype and paper prototype, participation in data collection, participation in the writing of the progress/final report

References

Nutritionix. 2023. Retrieved from <https://www.nutritionix.com>