



# Smart Refrigerator

## Introduction

This was a project within JD.com, China's famous e-Commerce company. The smart product department of the company decided to design and produce a new type of smart refrigerator in collaboration with Midea, China's famous home appliance manufacturer. And I was the lead UX designer for this project.



## Background: Smart Refrigerator

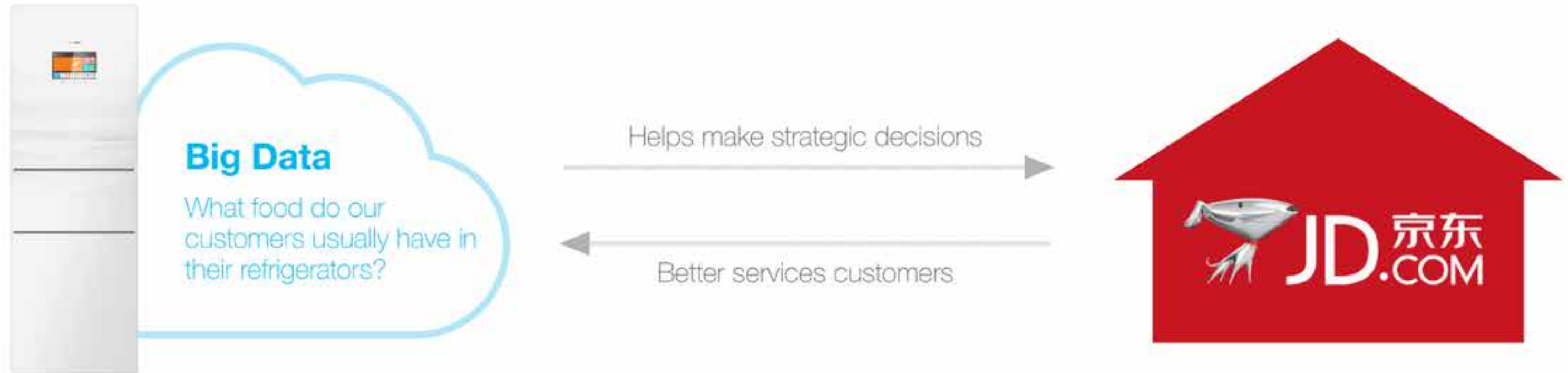
A smart refrigerator uses modern technologies of internet and digital computing to boost capabilities of a traditional refrigerator. It helps users make better decisions on food storage and management. Users may have more accesses to the information of their refrigerators and even give control remotely through the "cloud".



## Background: Why JD.com Did It?

JD.com is not a traditional B2C e-Commerce company, but an innovative company. As the world-wide smart-product fever hit the mainland of China, JD.com started to think of a new opportunity to expand its e-Commerce business. Because of the fast advance of computing technology, desktops, laptops, and mobile devices are no longer the only access to the internet. In the notion of IOT (Internet of Things), every digital product can be a media to the internet. That's the new online shopping experience that JD.com wanted to provide to its customers - Contextual Online Shopping Experience.

Refrigerator as an important home appliance that people interact with for food storage and management seemed to be a good start for JD.com to do its new exploration, since food is big part of JD's merchandise. JD.com wanted to create a smart refrigerator that food online shopping is one of its main features.





# Project Approach

I followed the following design philosophy for this project. I am an advocate for Design Thinking and the Lean UX approach. Design thinking helps us understand users problems and helps us provide valuable features for them. The Lean UX approach keeps us on the right track through continuous validation.

## Design Thinking



### Research

Research included both competitive research and user research, and both qualitative and quantitative research. It helped us frame design problem to solve.



### Analysis

Based on the information gained from the research phase, we tried to find out valuable insights, in order to help us establish project goals and directions.



### Ideation

Based on the insights, we started to generate initial concepts and UX strategies. Problem solving is the main theme in this phase.

## Lean UX



### Design

Based on the initial concepts, I started to create more detailed design concept, including sketches, wireframes, etc.



### Prototype Test

One principle is to let users try your concepts as soon as possible. Once I had the wireframes, I invited potential users to test the concept for validation.



### Refinement

Based on the feedback I got from prototype test sessions, I would refine my design accordingly. Then, I would test the new concept again and again til it was good enough.

## Research: Competitors

We started the project by doing research to learn about the existing smart refrigerators. We did online research, as well as visiting appliance stores to try the products. We mainly focused on the features, technologies, information architecture, UI design, etc.



### LG Internet Digital DISO

World's first internet refrigerator released by LG in 2010. It was a failure as the features were thought by consumers unnecessary.



### LG Smart ThinQ

LG's new smart refrigerator. Users can use its supporting mobile app to remotely check and control their refrigerator.



### Meiling Smart Fridge

Released by Meiling in 2014. It has cameras installed inside the fridge that recognize what food is stored in the fridge. It's very expensive, and failed.



### Haier Smart Fridge

The refrigerator has the entertainment features and allows users to shop online for food and other merchandise. The experience is bad, though.

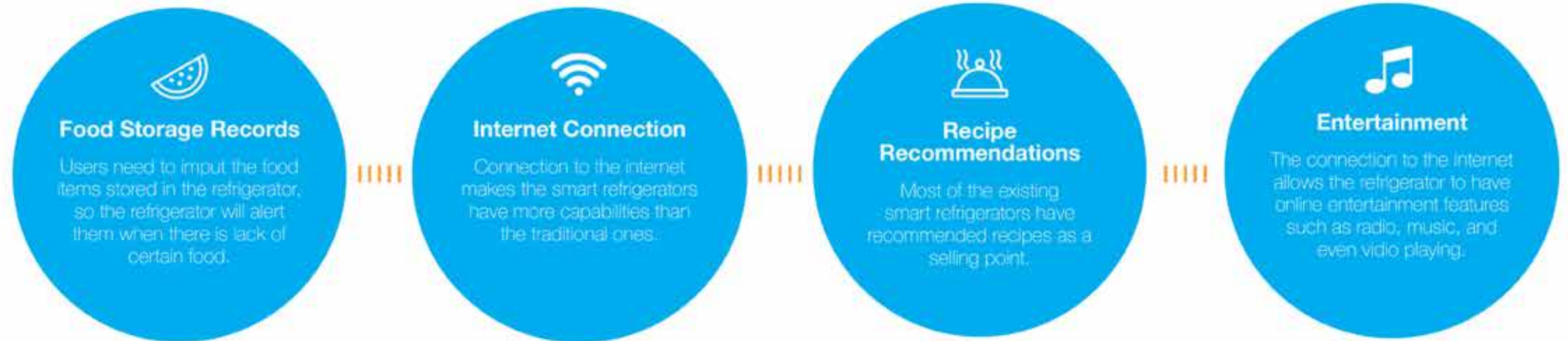


### Samsung Smart Fridge

Released in 2016. It's our biggest competitor. It has the best user experience among other products. Seamless experience between the refrigerator and users' mobile devices.

## Finding 1: Product Features

Based on the research we did on the existing smart refrigerators, we found that basically they all had the following features: **food storage recording**, **internet connection**, **recipe recommendations**, and **entertainment**. Some of the features, however, are not quite user-friendly.





## Finding 2: They're Expensive

Another thing we found was that these refrigerators tend to be very expensive, considering the purchasing capability of Chinese people. Since these refrigerators' features are considered unnecessary, and they are expensive, they are not selling very well.



LG Internet Digital DISO

**\$20,000**



LG Smart ThinQ

**\$2,948**



Meiling Smart Fridge

**\$1,800**



Haier Smart Fridge

**\$618**



Samsung Smart Fridge

**\$3,999**

## Finding 3: No Online Shopping

The most exciting thing we found was that most of these refrigerators do not provide online shopping services. Even though Haier does, its eCommerce service is way less competitive, and the user experience is also very bad. Samsung's new smart refrigerator also has grocery shopping feature, but the service is not available in China. This seems to be a big opportunity for JD's smart refrigerator.



LG Internet Digital DISO



No online shopping feature



LG Smart ThinQ



No online shopping feature



Meiling Smart Fridge



No online shopping feature



Haier Smart Fridge



Has online shopping feature.  
However, the shopping  
experience is bad.



Samsung Smart Fridge



Has online shopping feature.  
However, shopping service is  
not available in China.



## User Research: Goals

After the competitor research, a big question for me is how to create a better user experience for our users. In order to do this, user research is very important. I needed to learn through user research about the following things:

What **problems** do users have with their refrigerators?

What **problems** should we tackle?

Who are our **target users**?

How do they **use** their refrigerator?

What **mistakes** do they make?

How can we use the **internet technology** to create a better UX?



## User Research: Target Users

First, we established an assumption on who our target users could be. According to the sales data of JD.com, of all Media refrigerators (our partner manufacturer) sold on JD.com, more than 60 percent of them are three-door models. Since one of the project goal was to sell as many products as possible, so that we could promote the concept of contextual shopping experience, we believed that our smart refrigerator should be a three-door model in the same price range. This helped us determine who our target users are: young white collar people, for they are the main group who buy the three-door models.



**60%**

Of all the Media refrigerators sold on JD.com are three-door models.

People who tend to buy these models could be our target users



### Target Users

Young white-collar seem to be good fit for our potential target users. Not only because they tend to buy three-door refrigerators, also because they are educated, technology savvy, curious about new things.

This group is also the main customers of JD.com. They often buy products from JD.com. Due to their busy life style, they quite rely on online shopping, because they really have time to physical stores.

**Age:** 25 - 35

**Gender:** males and females

**Income:** 4000 RMB - 8000 RMB



## User Research: Approach

After the research on the existing products, we immediately conducted user research. We did three types of user research for different purposes: **online survey**, **user interview**, and **competitor product test**.



### Online Survey

Online survey were conducted for understanding people's general understanding of smart refrigerator, as well as what features they would like it to have.



### User Interviews

We conducted Face-to-Face interviews with target users to understand their daily interaction with refrigerators and their pains and problems with their food preparation and management.



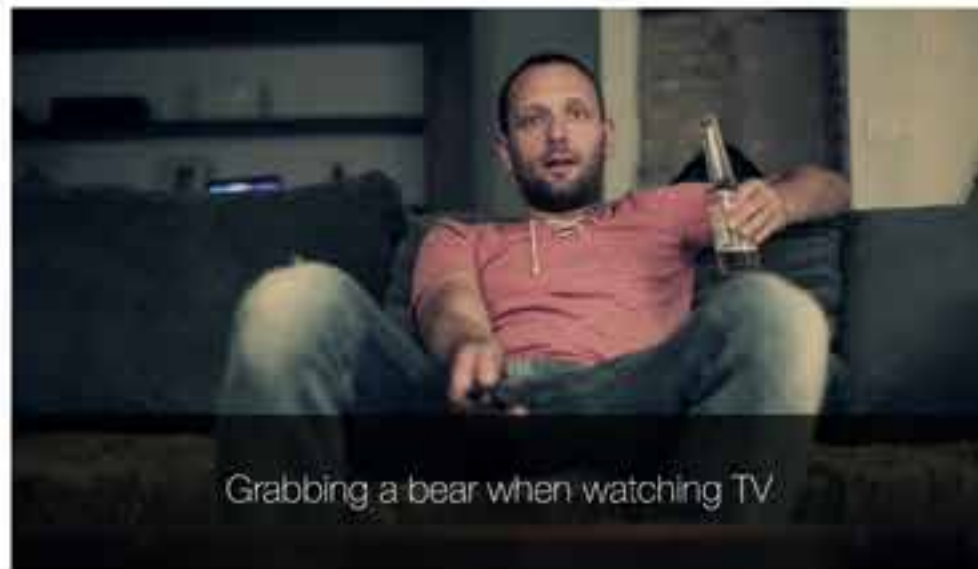
### Competitor Product Tests

To better understand what our competitors did good and bad, we let users have a try on one of the competitor product. As the smart refrigerator was still a new thing to most people, this activity helped us see how to better design the user experience.



## Insight 1: Short Interaction

The first thing we quickly learned was that **users won't spend too long with their refrigerators** for the following two reasons;



Reason 1:

### It's only a small step of a bigger task

The first reason we found why people usually won't stay in front of their refrigerator for too long is that whenever they use their refrigerator, they are actually doing something as a small step of a bigger task.

For example, when you are cooking, then grabbing the needed ingredients would be one of the steps you need to take to achieve your final goal of preparing your dinner. When you are watching TV, then grabbing a beer from your refrigerator would be a small step you need to take in order to have a better TV watching experience.

Using the refrigerator is never their goal. The refrigerator is only a tool to help them achieve their goals. The process of them trying to achieve their final goals should not be interrupted. That's why we needed to keep the interaction between users and their smart refrigerator as short as possible.



## Insight 1: Short Interaction

The first thing we quickly learned was that **users won't spend too long with their refrigerators** for the following two reasons;



Reason 2:

### **Using the touch screen on a smart refrigerator is awkward**

It's not like using your mobile phones or tablets that you can always find a comfortable position to use them. The screen on the smart refrigerator is not that comfortable to use for a long time.

Using the touch screen on the smart refrigerator requires users to stand in front of their refrigerators and keep their hands and arms raised whenever they need to operate on the screen. In addition, users have diverse heights, but screens are usually in a fixed height. This means for users who are too high, or too short, it's awkward for them to use the screen.



## Insight 2: Hard to Enter Food

Another thing we found out was that almost all our competitor products had very poor user experience of recording food items.



### It's not worth it

We already mentioned that using the touch screen on a smart refrigerator is not as comfortable as it is when using a computer or a mobile phone. However, all our competitor products had to have the users to manually record food items by either typing the names of the food items, or select food items from a list. What's even worse is that the users also had to manually input the expiration date of each food item in order to let the refrigerator remind them when the food was about to expire. It feels that it is not worth it to make such big effort to keep a changing food list just for the reminders. Even if users do it in the beginning, they soon get tired of it.



## Insight 3: Food Waste

What we also found was that people often forget about food in their refrigerators, and this causes unnecessary waste of food.



### **The deeper the food is in the refrigerator, the easier it can be forgotten**

We found this very frustrating to many people. Their refrigerators are often very packed and unorganized. This makes it easy for them to forget about food that is put deeply in the refrigerator and blocked by food in the front. People can forget easily about these food items. When they find them, they probably have been there for too long and no longer safe to eat. It's not only about the waste of food, but also about the waste of money. It's really a frustration.

## Insight 4: Bad Shopping Experience

One last thing, but not least, that we found was that the only one competitor product that had online shopping did not have a good shopping experience.



### Bad UI and Bad Service

It is really painful to use this competitor product's user interfaces for online shopping. It doesn't help users find what they want quickly, because it does not support short interaction.

Plus, the shopping service is also very awful. Users often got confused. Since the manufacturer of this product didn't partner with a good eCommerce company, it seemed to be a good opportunity to provide a better service to our customers.



## Ideation: How Might We?

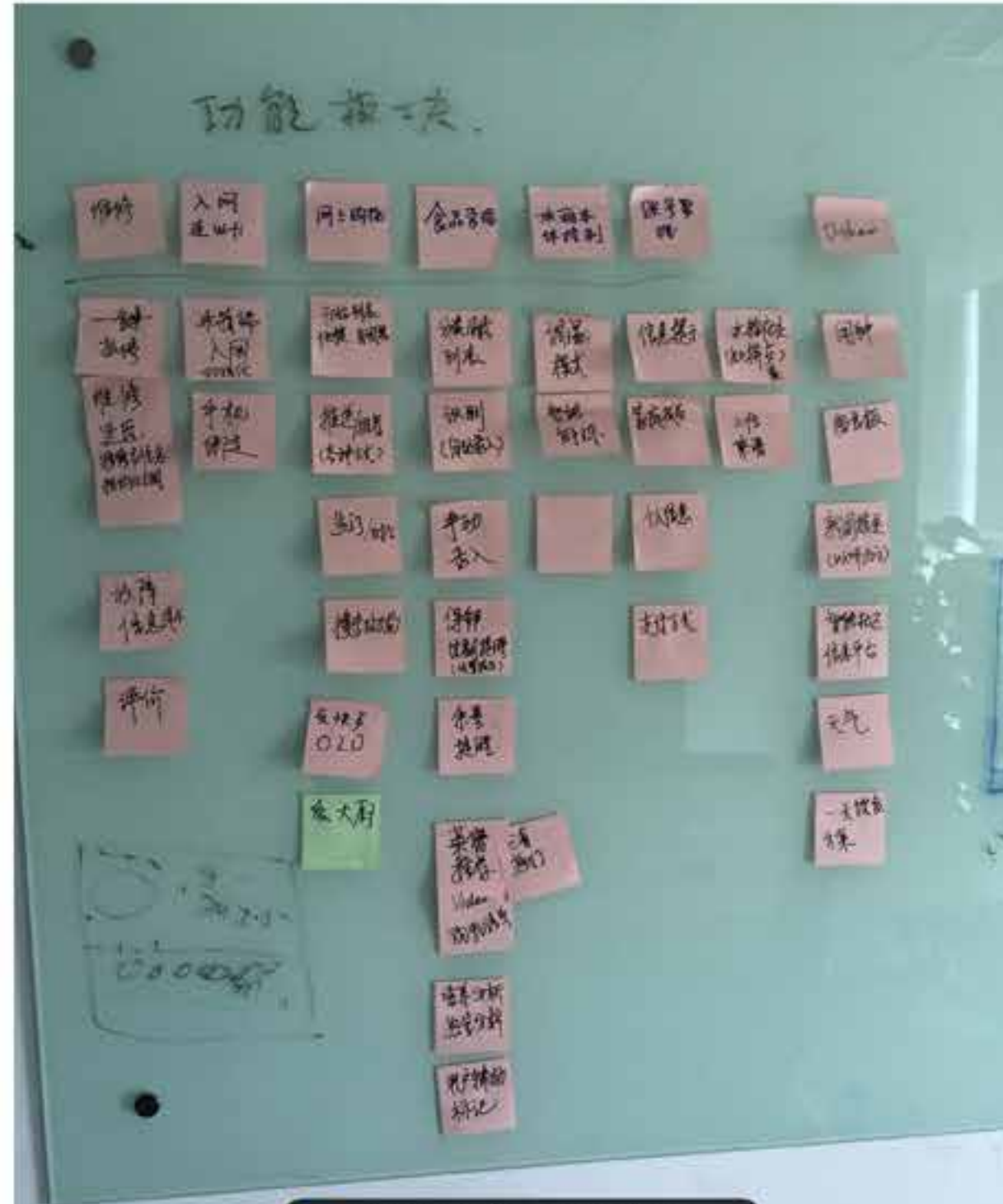
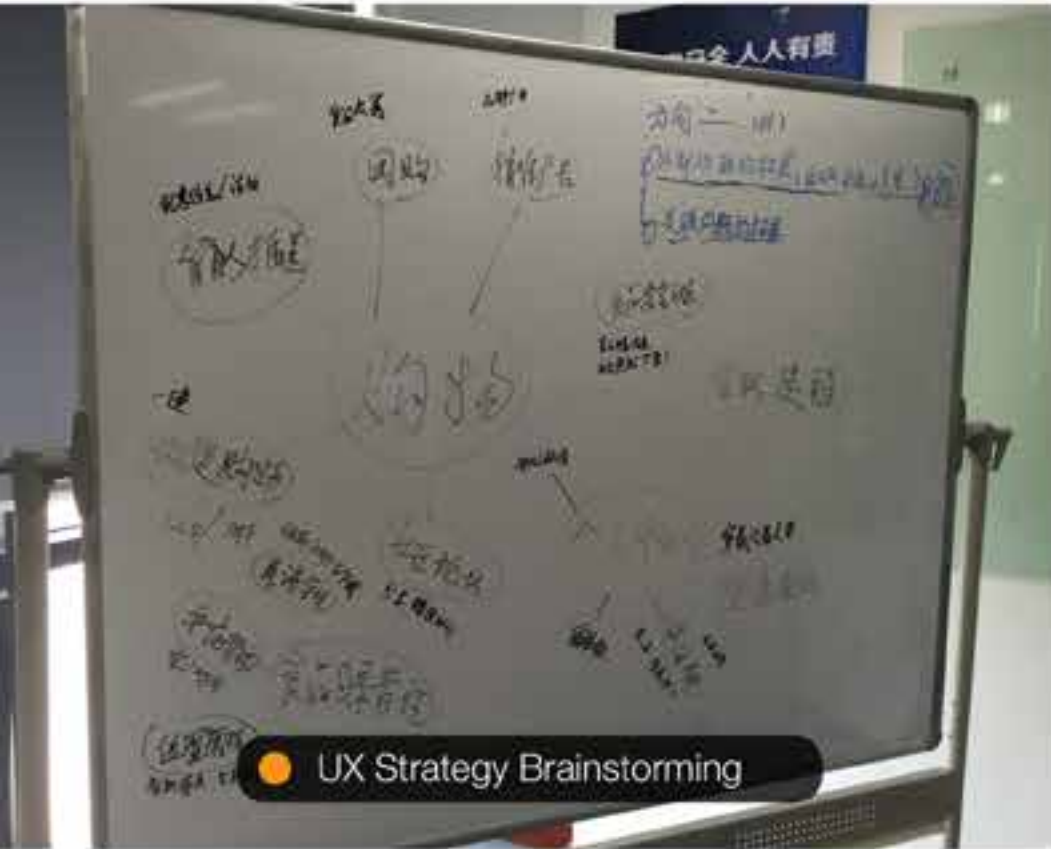
Based on the insights gained from the user research activities, we started to establish the strategy of the UX design:

1. How might we build a smart refrigerator that helps users **manage their food easily**?
  2. How might we help users **reduce food waste**?
  3. How might we build a smart refrigerator that really **supports short interaction**, so it can be **user-friendly**?
  4. How might we design the **online shopping experience** that users find **easy to use, desirable to use**?
- 
- A woman with dark hair, wearing a white t-shirt, is seen from behind, looking into an open refrigerator. The refrigerator is filled with various food items. The background shows a kitchen with white cabinets and a countertop.



# Ideation: Brainstorming & Discussions

After the project directions were established, the team immediately started to discuss more detailed UX strategy, features, and initial concepts.



## Ideation: Cloud Technology

We planned to use the cloud technology to enable data sharing and remote control, so that on one hand, users can use the mobile app to check their refrigerator, control their refrigerator whenever, wherever they need, and on the other hand, the cloud can provide users with much more information from the internet. It's also how we were going to collect data from our users.





## Ideation: New Technology

In order to make our product more competitive, we decided to apply a new technology - Automatic Image Recognition. This technology will use the cameras installed inside the fridge to recognize food items in it. This will be a big breakthrough for us to create a better user experience for food management.



## Ideation: Features

After tons of discussion, based on business goals and user research insights, we decided to have the following features for our first edition. And we expect to have more iterations in the future.



### Food Management

To help users keep an record of important food items in their refrigerators, set up reminders, so they can better manage their food.



### Contextual Shopping

Relying on JD's powerful O2O (online to offline, basically the delivery services), the online shopping function helps users buy food timely as they find that they need to.



### Recipe

Recipe recommendations with online ingredient shopping.



### Radio

Entertainment in the kitchen.



### Message Pad

Leaving message for family.



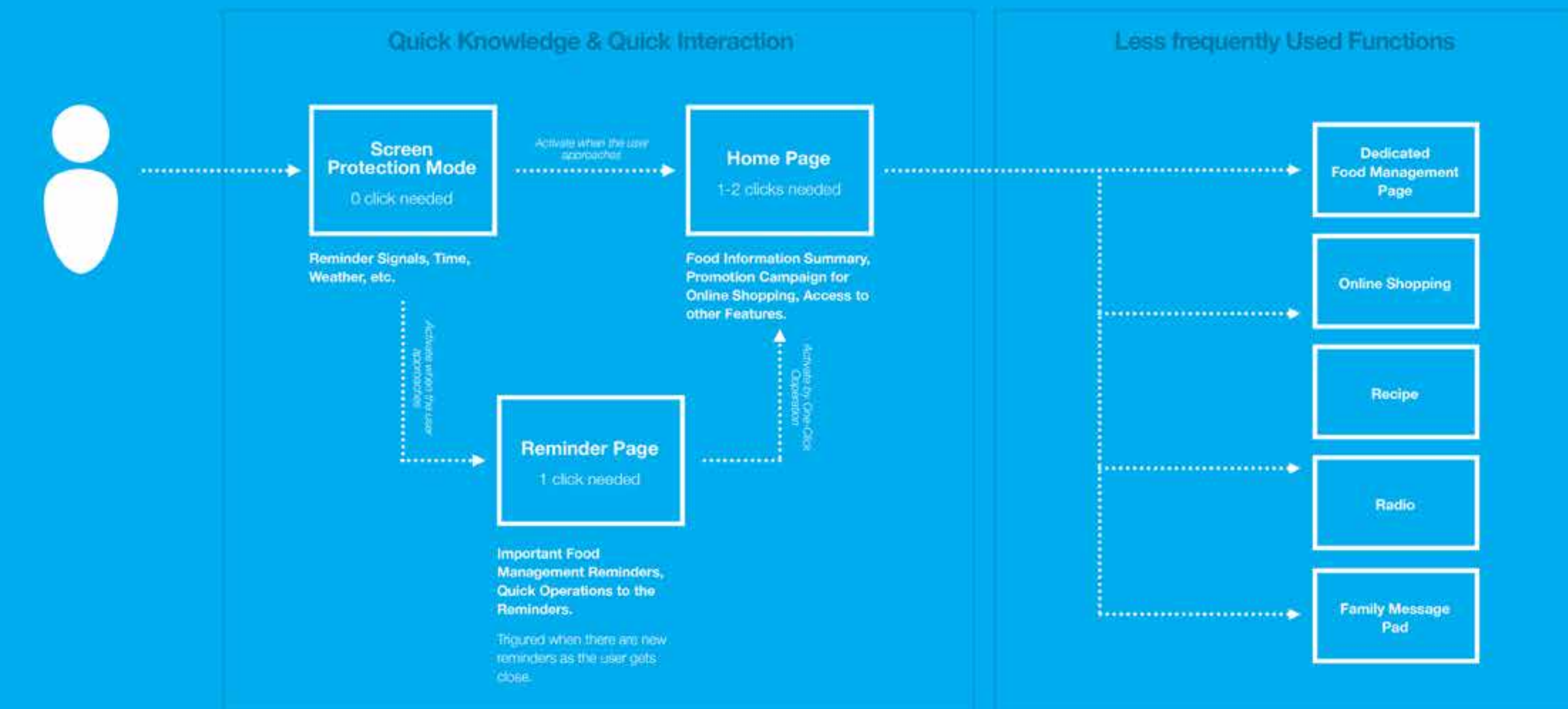
### Mobile App

Remote fridge check. Remote control. Always know what you have in your fridge.



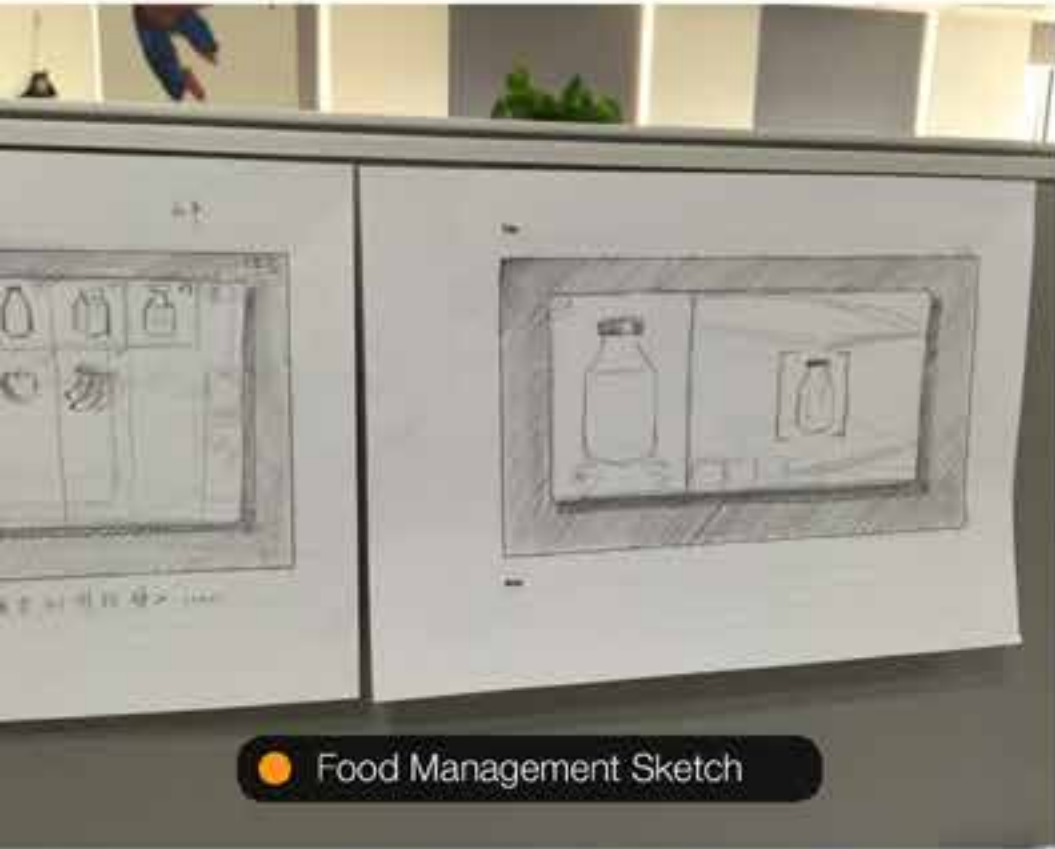
## Design: Information Architecture

I started my design work by designing the information architecture. The biggest question that I had was how to support short interaction. The principle that I followed was to make sure that important information and features should be easily and quickly accessed by users with smallest effort.

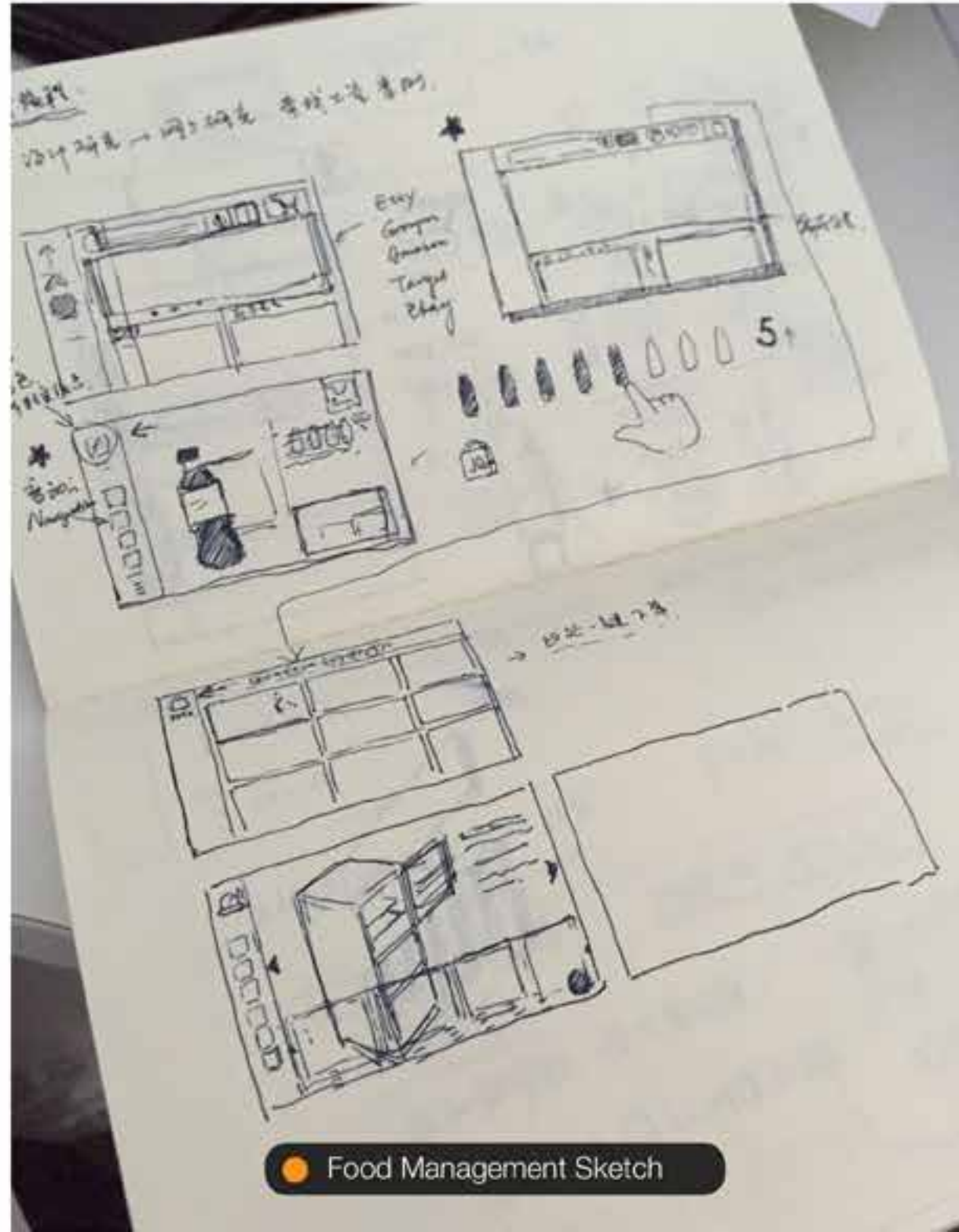


# Design: Concept Sketches

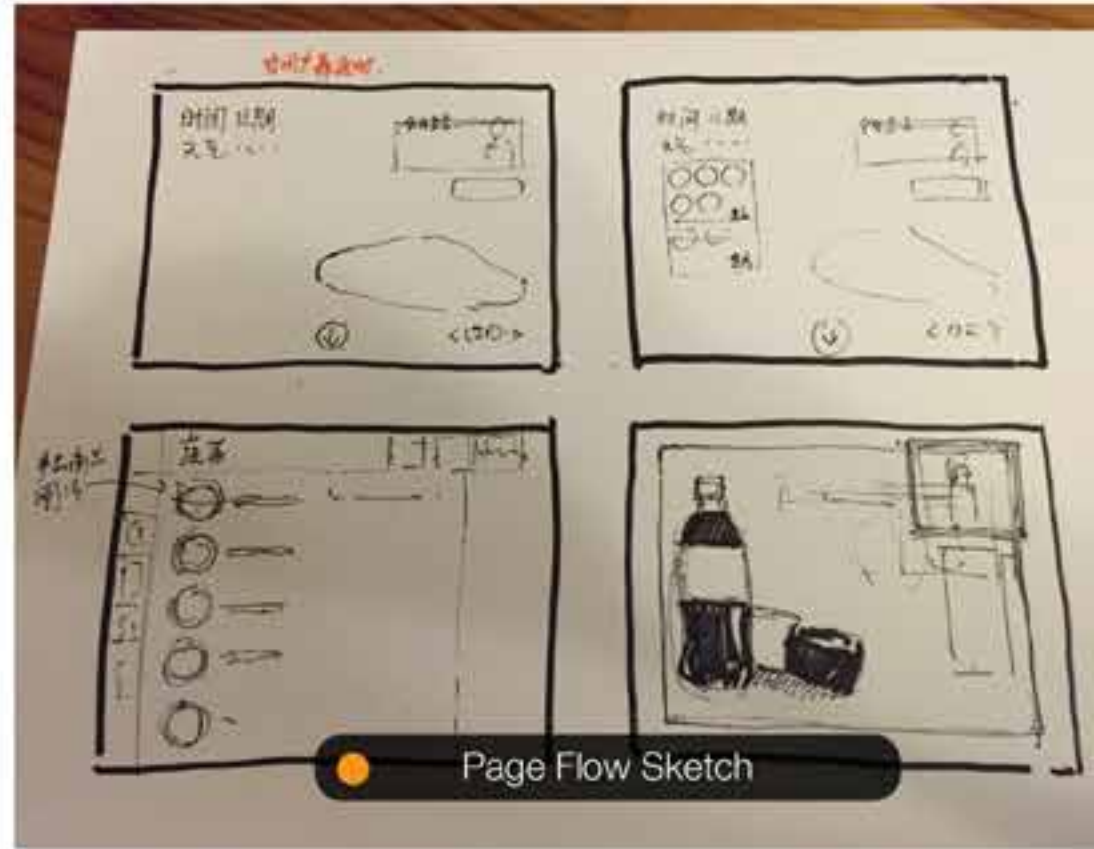
Based on the information architecture design, I started to sketch out some UI concept. During the process, I went back and forth to adjust both the information architecture and the wireframes.



Food Management Sketch



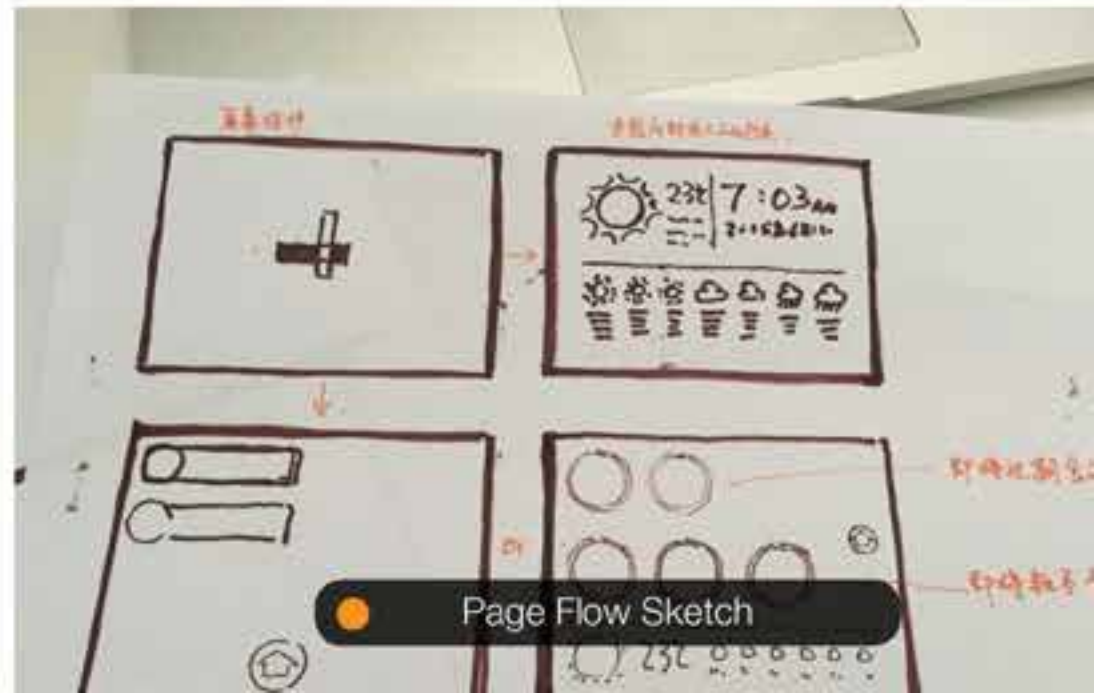
Food Management Sketch



Page Flow Sketch



Page Flow Chart Sketch

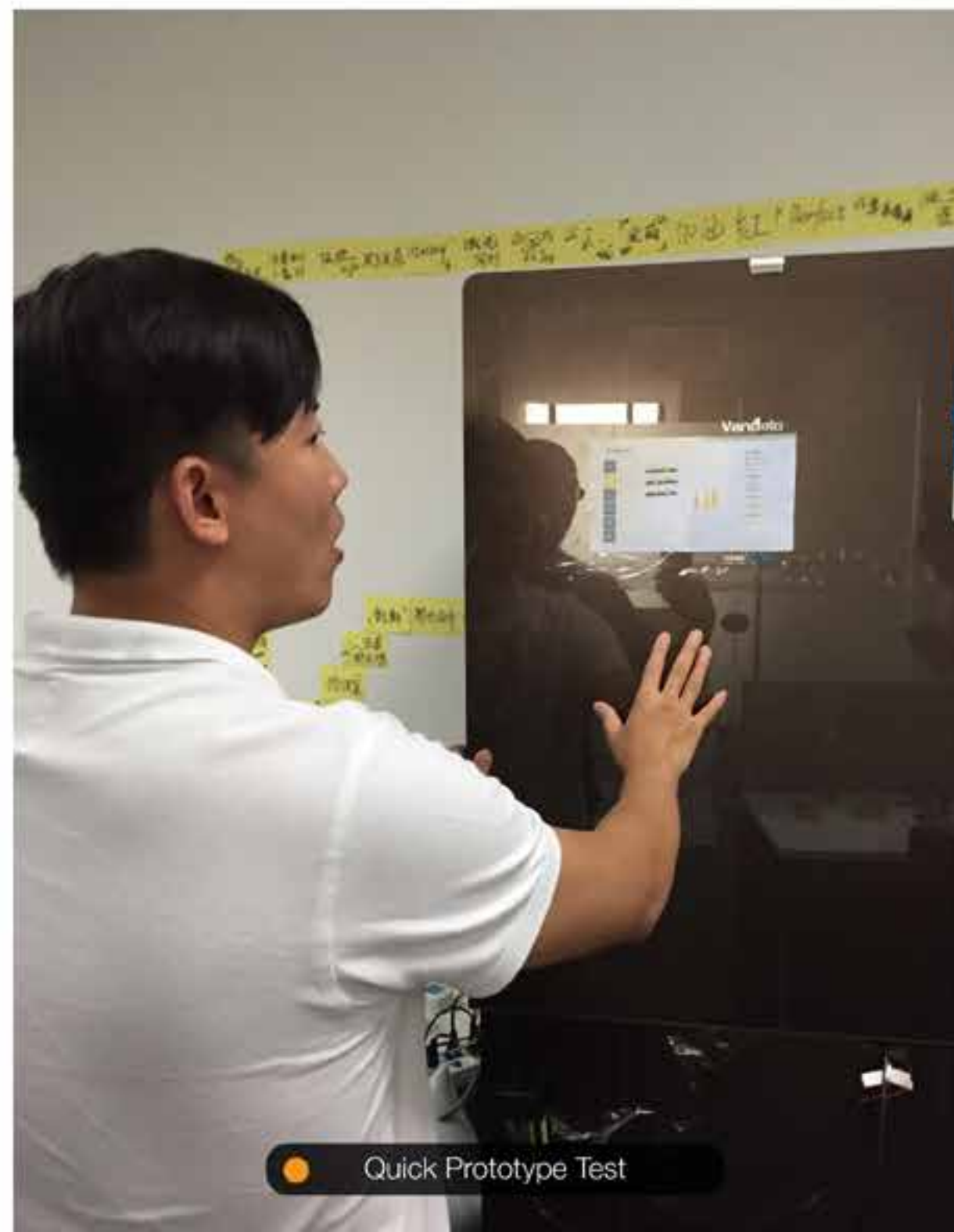


Page Flow Sketch



## MVP Prototyping Testing

Once I generated wireframes, I quickly conducted prototype testing sessions to validate my concept.





# Wireframing

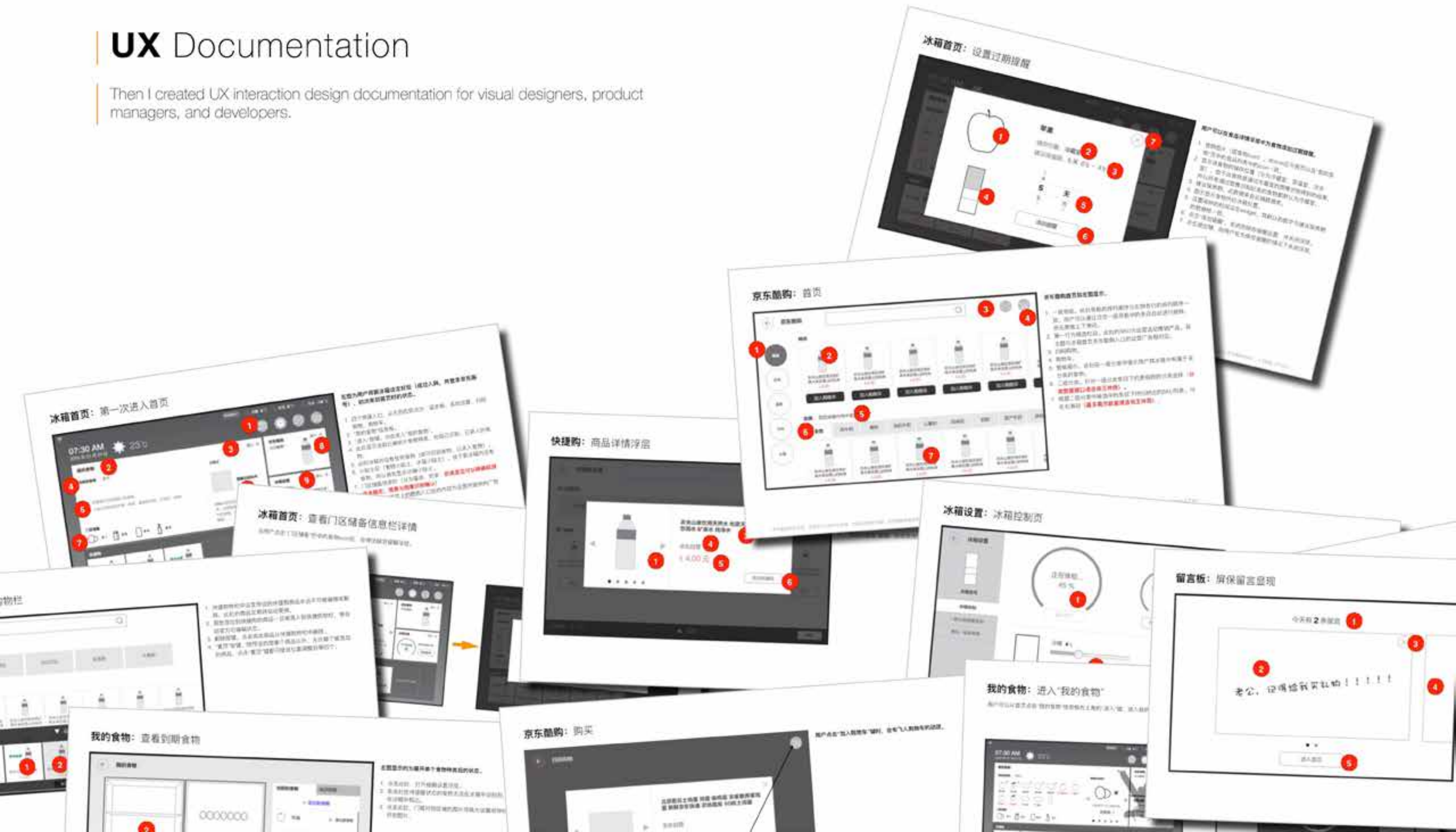
As more and more testing sessions were conducted, my concept got more and more mature. Based on the feedback, I created high-fidelity wireframes using Adobe Illustrator.





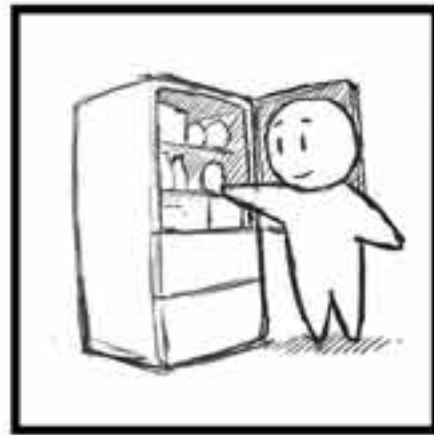
# UX Documentation

Then I created UX interaction design documentation for visual designers, product managers, and developers.

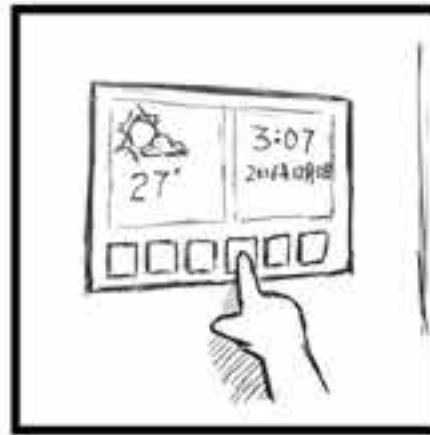


# Food Management: Problem to Solve

Why are the existing smart refrigerators so bad in terms of their user experience for food management? The story board below explains why.

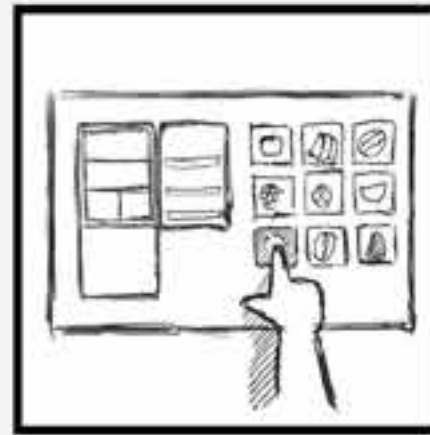


1. Put food items into the refrigerator.



2. Open the food management app.

For the FIRST food item...

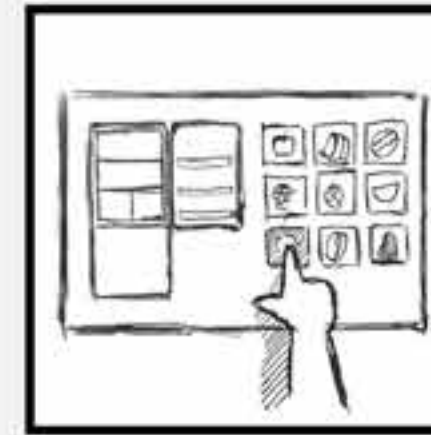


3. Enter food item by either selecting from a list, or by typing the name of it.



4. Set up reminder for expiration date.

For the SECOND food item...

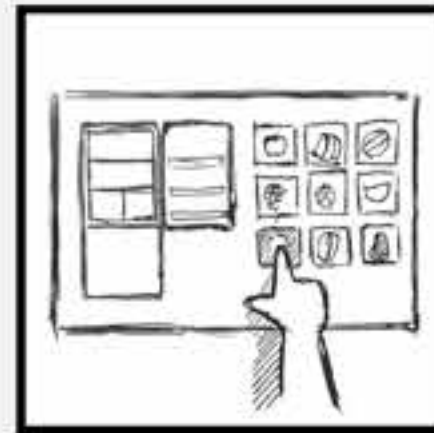


5. Enter food item by either selecting from a list, or by typing the name of it.



6. Set up reminder for expiration date.

For the THIRD food item...



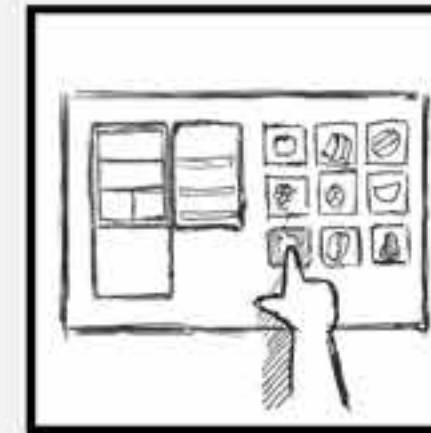
7. Enter food item by either selecting from a list, or by typing the name of it.



8. Set up reminder for expiration date.



For the Nth food item...



$2n+1$ . Enter food item by either selecting from a list, or by typing the name of it.



$2n+2$ . Set up reminder for expiration date.



## Food Management: Problem to Solve

### Why is it a bad user experience?

Obviously, the problem is that users have to make too much efforts to setup the reminders. The effort is much bigger than the reward. To the users, it's not worth it.

Bad Experience

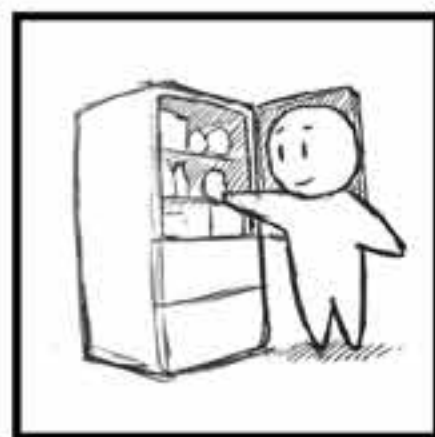
**Effort** > **Reward**

Good Experience

**Effort** < **Reward**

## Food Management: UX Concept

With the automatic image recognition technology, it eliminates the process of manually entering food names for many kinds of food items. Below shows how this technology simplify the food management experience. It reduces most of the effort that the user would have to make with the competitor products.

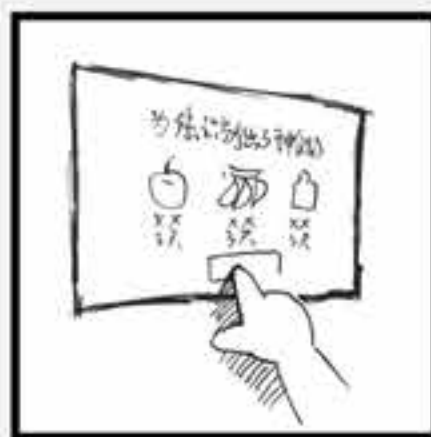


1. Put food items into the refrigerator.



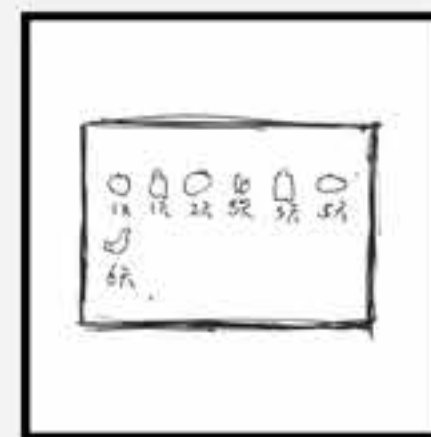
2. Seconds later, the screen shows the new recognized food items and recommended period for eating.

### Effort

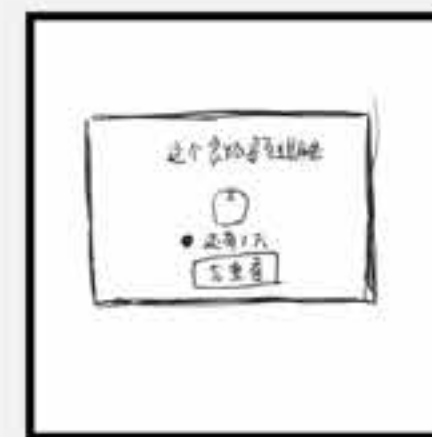


3. The user can simply press the "one-click reminder set up" button to set up reminders for all the newly recognized food items.

### Reward



4. Users can see the food items lined up in the order of expiring date.



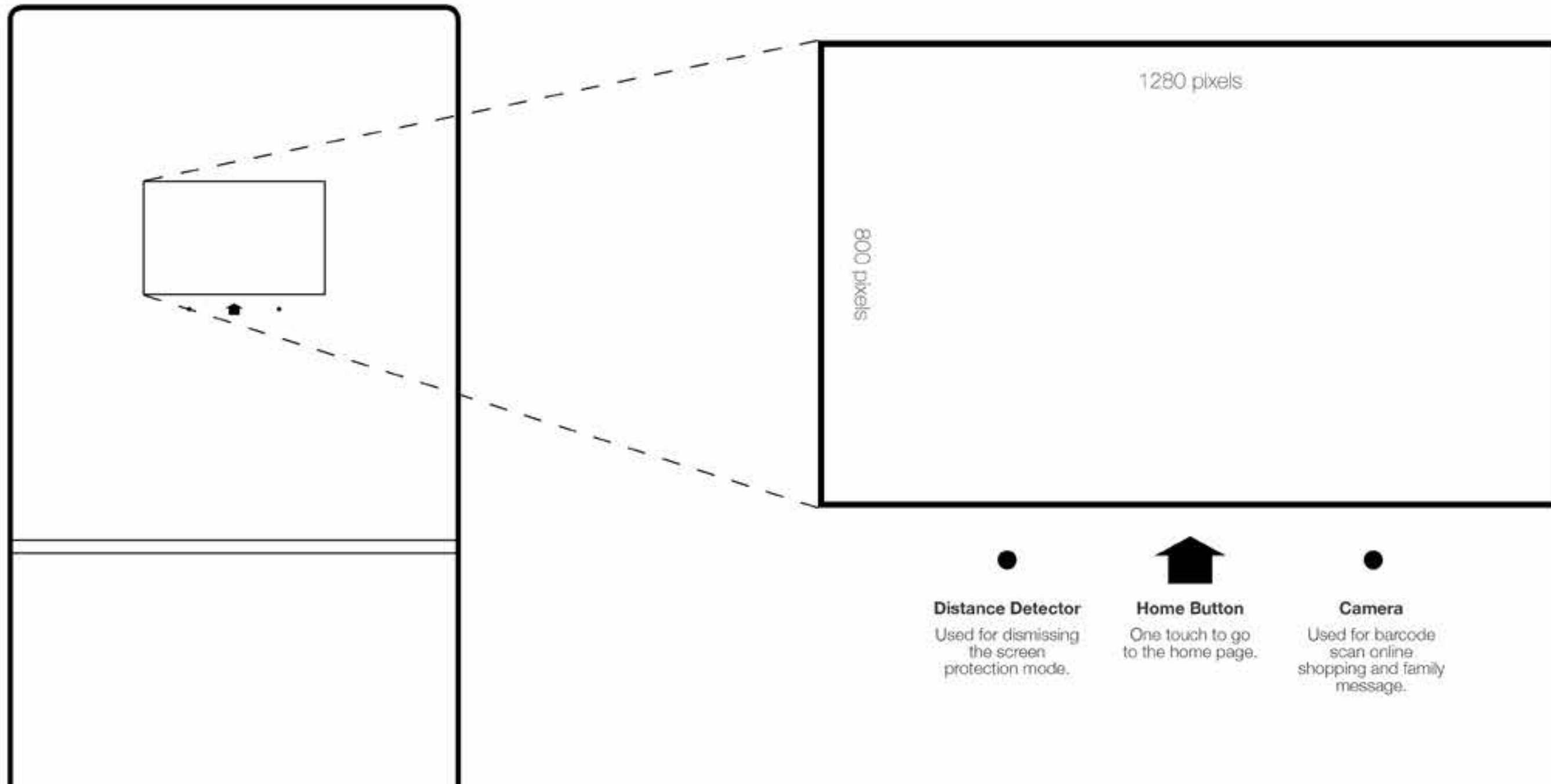
4. When the food is expiring, the user will get reminders from the screen protection mode.



# Food Management: UX Concept

## The screen and the distance detector

Below is the dimensions of the screen. Underneath the screen, there is a home button in the center. To its left, there is a distance detector for sensing if the user is around the fridge. When the user is around, the detector will sense him, and then dismiss the screen protection mode. To the right of the home button, there is a camera.



## Food Management: UX Concept

Below is the screen protection mode screen design.



### Screen Protection Mode: When there are no reminders

This mode will be activated when the user is not standing in front of the refrigerator. This mode will be dismissed when the user gets close enough to the refrigerator and the detector senses him.

The screen protection mode provides basic general information to the user. When the user is far from the refrigerator, he can have a quick knowledge of some basic information such as time, date, weather, fridge mode, and the temperature of each refrigerator compartment.



## Food Management: UX Concept

Below is the screen protection mode screen design with reminders.



### Screen Protection Mode: When there are reminders

When there are reminders, brief information will be shown at the bottom of the screen protection mode screen. The reminders come with a short beep sound, to help the user notice the change.

1. Reminder for expiring food items.
2. Reminder for food items that are about to be out of stock.

## Food Management: UX Concept

When there are new food items recognized by the refrigerator, the screen will display the reminder message below as the use gets close enough to the screen.



### Quick knowledge of new recognized food items. One click to set up reminders.

The automatic food recognition technology relies on data from the internet. With this technology, the user can get result in seconds. This means, right after the user close the refrigerator's door, he will immediately get the result.

With the data online, the refrigerator can also provide the user with best time ranges for different food items recognized. The user can set up reminders by one click.

1. Messaging that tells the user "There are three new food items recognized."
2. Recognized food items with food icons, food names, and best time range for eating.
3. One-click reminder set-up button.
4. Close button.



## Food Management: UX Concept

When there are reminders to inform the user that there are food items about to be expired, the screen will display the reminder message below as the use gets close enough to the screen.



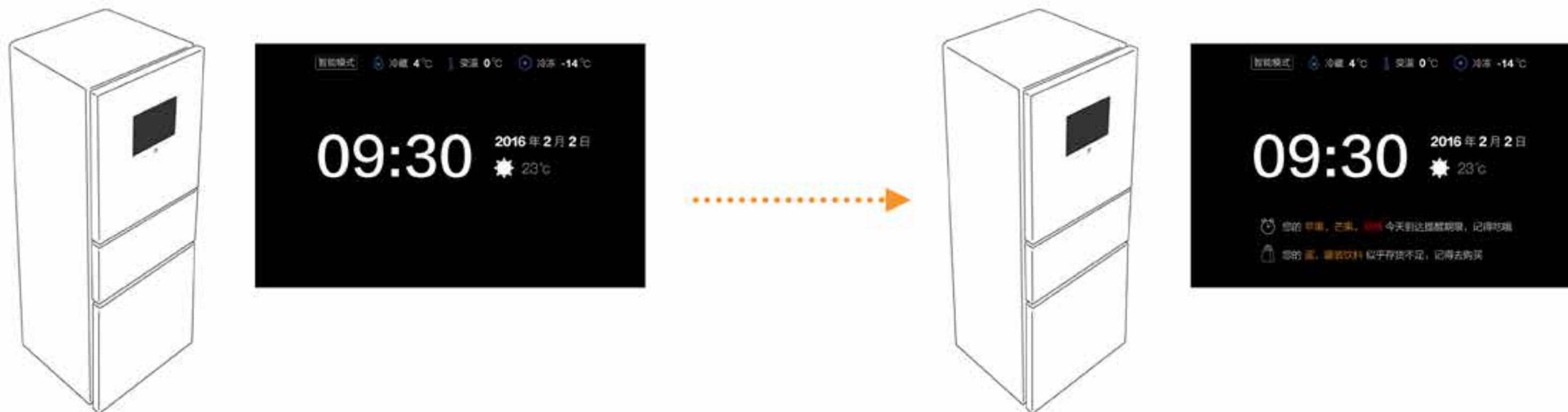
### Quick notice of expiring food items.

Without any interaction, the user can have a quick notice about expiring food items, and decide how to use the food accordingly. This helps the user reduce food waste.

1. Messaging text that tells the user "You have 4 expiration reminders today."
2. Expiring food items with food icons, food names, and expiration date.
3. "Details" button.
4. Close button.

## Food Management: UX Concept

In order to let you have a better understanding of how the reminders work, the chart below shows the user flow.



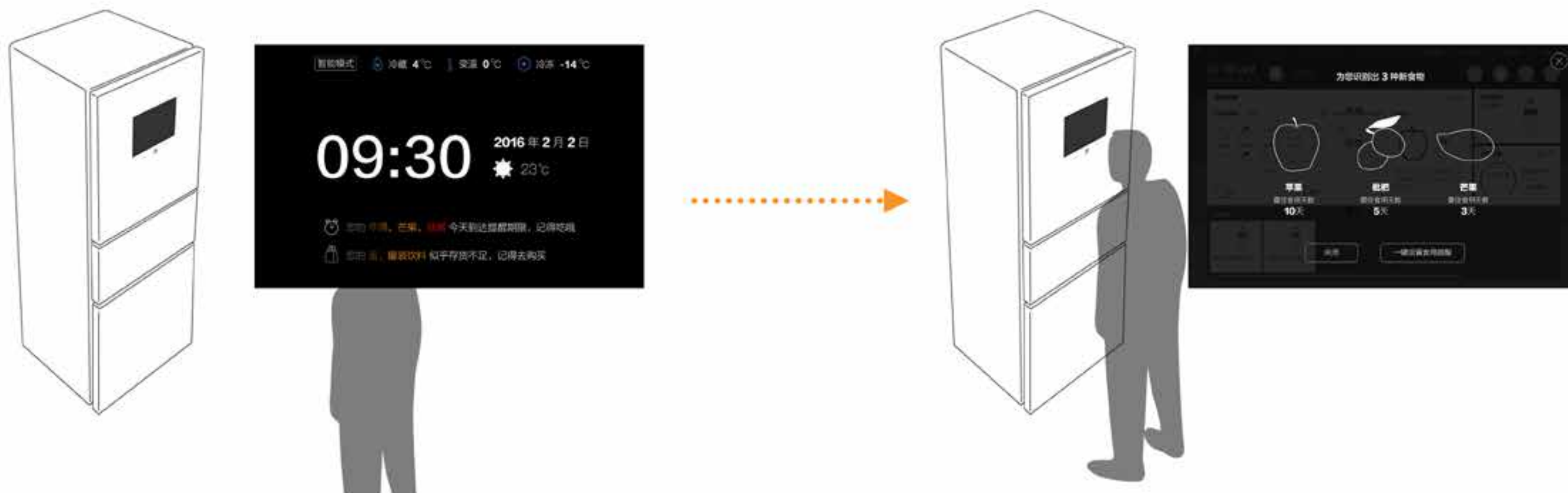
When the user is not around, the screen protection mode will be activated. When there are no reminders, the screen only display general information.

When there are reminders, brief reminder information will be displayed at the bottom of the screen as a way to first notice the user from the distance.



## Food Management: UX Concept

In order to let you have a better understanding of how the reminders work, the chart below shows the user flow.



When the user notices the brief reminder information from a distant spot, he can come closer to see more details.

As he comes close enough, the distance detector will sense him, and dismiss the screen protection mode to show a detailed reminder screen.

# Food Management: UX Concept

Below is the homepage of the screen. From here, users can have more detailed information for food management.



## Home Page: a portal for all important information

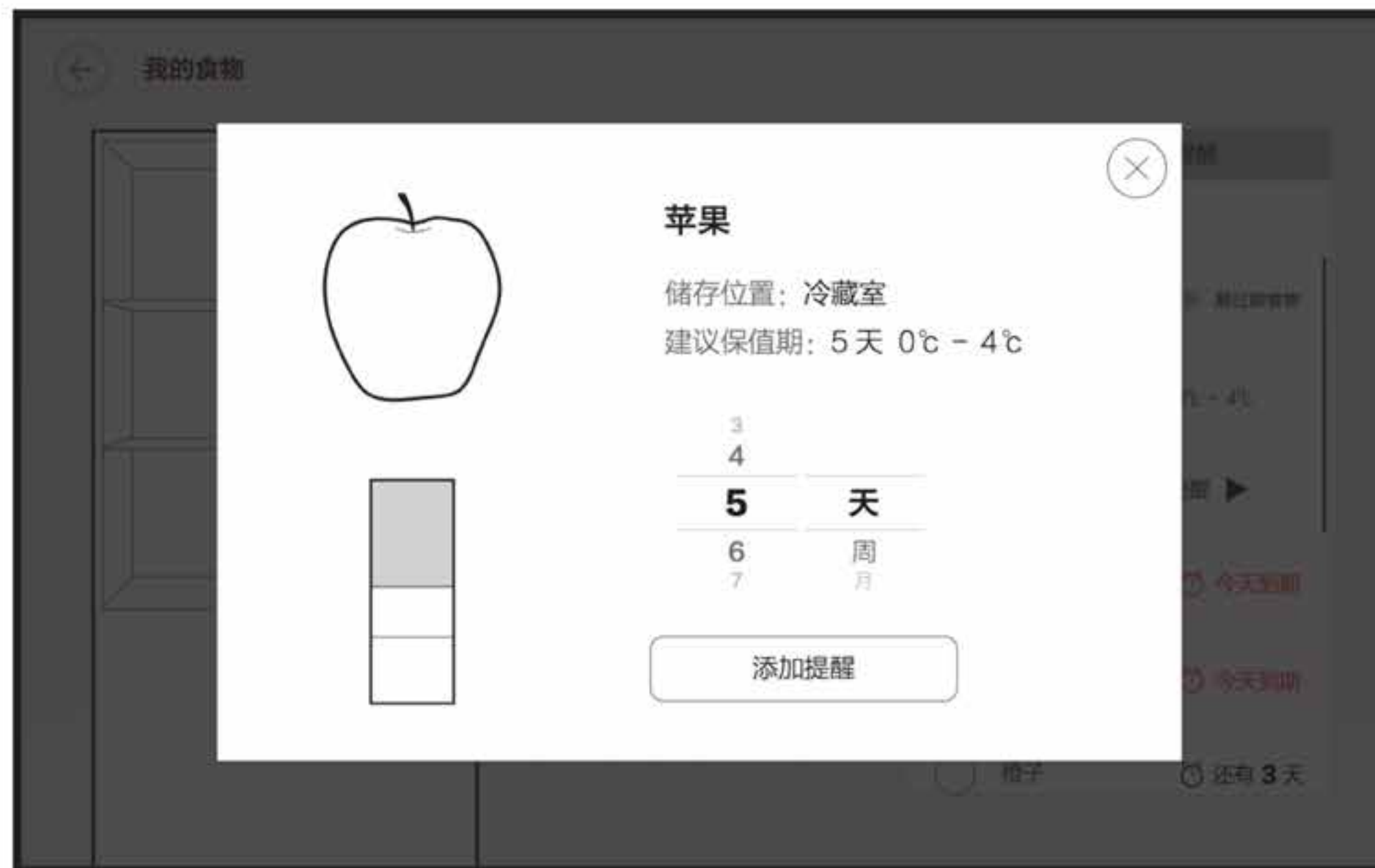
The principle that I followed when designing this page was still to support short interaction. Based on the user goals, behaviors and the context, I put all the important information on the home page.

1. Recorded food items lined up in the order of expiration dates.
2. "Cool Buy" entry with promotion banner.
3. Refrigerator condition summary.
4. "One-click purchase" set up by the user (concept removed later).



## Food Management: UX Concept

Below is a food item modal for more details of an individual food kind. The modal can be opened from the home page.

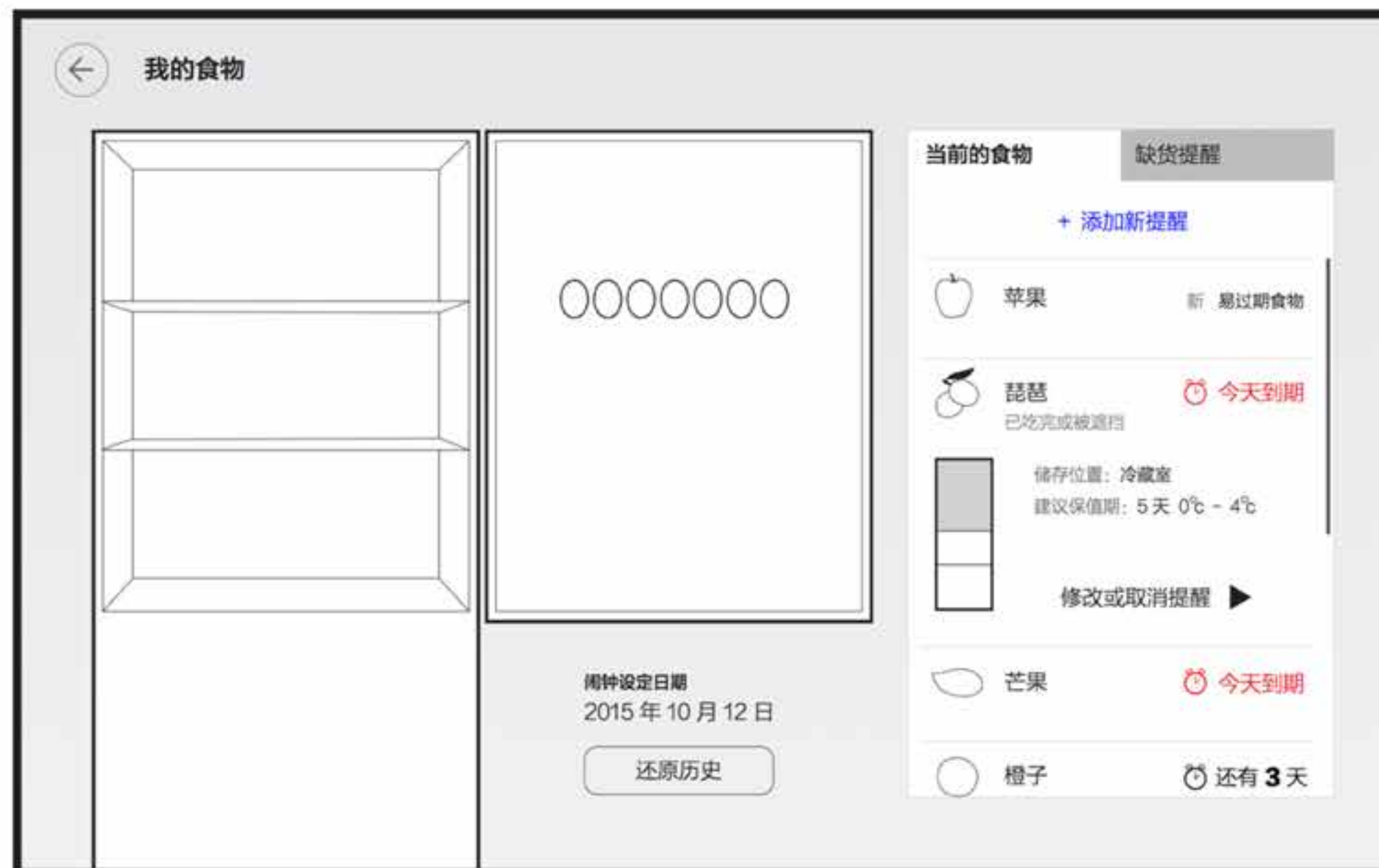


### Food Item Modal: quick reminder setup for individual food kind

From the food item summary section of the home page, the user can also click on each food item icon to open a dedicated modal for that food kind. In here, the user can set up a reminder for this kind of food.

## Food Management: UX Concept

Below is the dedicated food management page. This page can be accessed from the home page.



### Food Management Page: Everything about your food is all in here.

If the user wants to see more details of his food, he can come to the dedicated food management page for all the information of the food items, all the reminders. He can even see a picture of the fridge space taken at the moment the user closed his door last time.





## Online Shopping: UX Concept

Below is the online shopping page. This online shopping application is named "Cool Buy". It's designed for express online shopping experience.



### JD Cool Buy: Curated food items for express, convenient shopping experience

The concept of "Cool Buy" was brought up by me. Again, due to the user's context and goals, we needed to design a different online shopping experience that supports short interaction. Basically that means to help users find what they want quickly and easily.

"Cool Buy" only sell food. Having only two page levels makes it much simpler than regular eCommerce websites.

# Product Release Announcement

Finally, at the CES Asia conference, JD Smart announced that the product would be available shortly in the future. Since then, the product has got a lot of attention.



**所知即所见**  
实时感知箱内食材数据

- 门幅互动
- 图像识别
- RFID识别
- 光谱分析