PureFoods
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Overview

It’s hard for most people to maintain the quality and freshness of their foods. Most people experience their breads, cheese, and milk going bad after only a week of buying them. We plan on developing an app that will hold a database of all the foods in the user’s home. The app will also detect the temperatures and lighting source in the different sections in their kitchen such as the pantry and refrigerator. The user will be able to determine whether or not their kitchen’s temperatures and lighting source are negatively impacting their foods. Additionally, the app will be connected to a camera system that will categorize the different foods and detect any bacteria or molds growing on the user’s foods.

Related Work

There are tons of apps about food in mobile device market, but very few of them care about expiration date, food storage and food safety. This app called “Food safety”¹, allows people to scan bar code the list the expiry date. However, it requires foods to be registered and does not have any feedback mechanism remind people their food is going bad. Moreover, it requires people to do a scan for every food they purchase, which is a big burden to users. Our app only needs people to scan their receipts when they have finished shopping. Afterward, we will provide list of inventory with expiration dates and good feedback features. For the foods which are not registered, we will provide an approximate expiration date and storage suggestion base on “Safe Home Food Storage”², and other research. We will provide good feedback and reminder mechanisms to make sure users know their food is going bad.

Several apps such as “Chemical Cuisine”³ try to provide professional knowledge and concepts about food safety. But, they use huge amount of text without much visualization. All of the apps only support passive ways for people to learn the knowledge of food safety. Our app does not require people to read through a lot of text. Instead, we will provide a lot of visualized information, including temperature and light intensities within food storage areas. In that way, our users can keep their foods well-stored, pure and clean.

¹ Figure 1.0
³ Figure 1.1
Contextual Inquiry Participants

P.Z. is currently working in the IT field industry. She always enjoys cooking and cares about what she cooks and eats. However, since P.Z has a very intense working schedule every day, it is impossible for her to cook and eat fresh food every day. Instead, for most of time, she has to eat the leftover or the microwave foods. In order to obtain the comprehensive point of views on the food safety and handling from P.Z., we have taken some time to observe some usual practices before applying my interview method on P.Z.’s everyday life dealing with foods such as how she stores her foods in the refrigerator and what is her first recognition that to tell if the certain food has turned bad. Also, we tried to let P.Z. freely express her ideas rather than guiding her how she should answer my questions to achieve the goal of forcing her to examine and express the underlying reasons for her thoughts and attitude on food safety and handling.

D.O. is currently studying civil engineering, and she has been commuting to the University of Maryland for approximately two years now. She eats most of her meals at home with her family, so she is very careful about her food choices. Her parents are originally from Nigeria, so she eats most of her cultural foods such as authentic soups and foo foo (a flour, enriched food). We have seen both her and her mom cook several dishes and observe their food safety practices. They consistently wash all their foods, hands, and other equipments in the kitchen, and store each food in specific areas.

The contextual inquiry was conducted by applying the “Scenario” and “Narration” method from the IDEO Method Cards. Interviewee A.J. is currently studying computer science. He cooks food for his roommates several times a week. During the interview, we create a Scenario which A.J. has to buy and cook food for him and his roommate for a whole week. A.J. will speak out what he’s thinking when he takes action.
B.P. is a recent UMD graduate from the physics program. He works in a research lab on varied hours, but still attempts to cook at home for many of his meals in order to save money. Most of the cooking he performs is basic “college food”, heavily reliant on meats and pastas. After being interviewed in a basic survey, he will be observed from an outside “fly-on-the-wall” perspective.

B.G. is a recent chemistry graduate from UMD working in research for a government agency. Her work schedule is varied, but tends to cook rather than eat in town as she is a vegetarian and has special dietary needs. She is aware of her diet and ingredients, excepting dairy and eggs, has a diet which is largely resistant to infection.

**Contextual Inquiry Results**

The contextual inquiry was conducted by applying the “Five Whys?” method from the IDEO Method Cards. During this interview process, in order to obtain more detailed and relevant answers from the interviewee P.Z., we have carried out “Five Whys?” questions to ask P.Z. that related on the temperature of the refrigerator, cause and consequence of the light on the foods, different ways to store different foods, and what would be a better way to track the foods freshness in the refrigerator. From most of the questions that P.Z. has answered, it indicated that P.Z had a basic knowledge on the food safety, but she lacked other critical food handling knowledge such as light effects on foods, proper temperature for each type of food and the shelf life of a certain type of food that was stored in the refrigerator. Also, from the contextual inquiry, it showed a common misleading on the “false theory” about as long as the foods were stored in the refrigerator, they would never turn bad. On the other hand, since it is so hard to remember when or what type of foods have been stored in the refrigerator, P.Z. thinks it is better to have such a device to help her keep track of her foods and can automatically inform her the wrong temperature of her refrigerator right away. (Detailed interview can be found in Appendix C)

Common people do not have clear ideas about how long foods can last. They can separate roughly and put them into refrigerator, but they don’t know the best way to store certain kinds of foods. They don’t have any tools to test their food’s condition, so they judge their foods by specific time lengths and their experiences or knowledge. People sometimes ignore the expiry date even though they know it is important. In a more extreme case, one interviewee even forget what foods they store for a long time.

From these methods, we found out most people store their foods in similar places such as raw meats in the freezer and vegetables in the refrigerator. Most of the participants were not aware of the temperatures that their foods were stored in, but they agreed that both temperature and lighting could either negatively or positively impact the quality of their foods. One participant specifically mentioned how she stores any leftovers from their cooked meals in the freezer in order to maintain the freshness of her foods.

For an interest survey, we used multiple subjects to get a better amount of information. The two sample subjects, Bobby and Brenda, are new graduates from UMD. First, we asked a sample
battery of questions to get an initial idea of what was likely to work with the project. The results can be found in Appendix B.

We casually observed B. P. prepare his food as a “fly on the wall”. As expected, he spent longer with the door open than polled, and was far less adamant about avoiding cross contamination. Part of the time spent with the door open was due to trying to find out what sort of food to cook. After gathering the food, he had to check several things for freshness, and for one of the items he resorted to smelling the food for freshness and guessing. Cooking was thoroughly performed, and cleanup was appropriate as well. Food preparation was actually decreased compared to estimations, from 45 min to approx 30 min.

**Existing Tasks**

In the real world, most people merely prepare and eat their foods when cooking, without much active thought into the production process. For some, the extent of their culinary prowess is limited to microwaving leftovers from the nearest fast food restaurant. A size-able portion of food preparation time is spent deciding what to cook, seeing what is there, determining how old the ingredients are and even if the recipe is viable. Currently in food preparation and storage, people are forced to search for expiration dates on labels that may have peeled off, gotten water damage, etc. After exhausting all other options, a rough guess can be made of when the food is purchased.

**New Tasks**

We will be seeking an aggressive yet non-intrusive system to monitor relative food freshness within the average kitchen. This will be implemented initially via a three part system: a temperature monitoring system that will alert the user in case of a refrigeration failure, a light sensor to allow the user to monitor the light input on their food, and an in-depth inventory system which will alert users to rough expiration dates on their food.

The temperature module will be largely transparent to the user. This is the simplest method, as it will be the least intensive on the user. Once installed, the user will not have to do anything more than occasionally change batteries to maintain constant coverage. A thermometer and signal system will be installed in a refrigerator and linked to the internet via standard wi-fi in the home. From there, if the temperature rises above a certain threshold, an alarm will trigger, sending a message to the user via email or text message. It will include a time stamp, and allow the user to at least know that the temperature was elevated for a certain amount of time to unhealthy levels. In addition, a regular update schedule would be kept so the user can monitor average temperature levels on a visual display.

The light sensor is very similar to the temperature monitoring. Via an array of photo-receptive diodes, each one calibrated to a specific wavelength of light, they can trigger the same sensor and send alerts when certain spectra of light are present. These can be made into a form of heat map, depicting exposure to the individual colors of light. Should the light be dangerous to
certain types of food, an alert such as a “did you know?” or “hints” window can pop up to inform the user of the possible ramifications and offer hints to store their food better. As it will take some analysis on the user, this will be a moderate difficulty act on the part of the user.

Finally, a major component of the program will be the personal food inventory. After shopping, all the user will have to do is take photographs of the receipt. An automated text recognition system will parse the receipt and produce an inventory of items that are commonly used, and prompt the user for input should they not be found in the database. At the normal cooking time set by the user, a prompt will appear to ask if they are cooking, and if so, give them an option of ingredients which they can highlight to show they have utilized completely. At set intervals, the menu will pop up to alert them of food approaching or past expiration as well. This will be the most user intensive option. Getting the scanner to work properly, as well as the menu propagation for the different options and items should be the most difficult portion for the user to perform.

Another option that can be utilized is a graphic depiction of the food storage areas themselves. Often times people purchase items and store them in out of the way locations, forgetting they exist. At regular intervals, pictures can be taken of these areas. After comparing subsequent photos, areas which remain the same for long periods of time can be a heat map, with red being the color for inactivity as it will also denote danger for the user. Also, this will demonstrate to the user areas of inactivity, so they can realize where NOT to put easily perishable goods. This is another moderate difficulty interface, as the user will have to become acquainted with the menus to find this option, as well as the output produced. Further, any areas that are NEVER used, such as the edges of the pantry or refrigerator, must be taken into account.
temperature control.

Main

- temp
- Light
- INVENTORY
- Usage Stats

#2

- Temp control

#3

- Sensor 1
- Sensor 2

#4

- Temp

- Time
red potato
keep 1 Weeks
in refrigerator
under 10°C

inventory
receipt
Browse
search
Monitor

days expired
1 potato  x 10
3 catfish  x 1
4 milk  x 1

Temperature:
Light:
XX:
It's 5:00 PM Wed 3/18/2015
Message: You still have:

- 2 Potatoes
- 3 Milk
- 5 chicken

Alert:
3 Potatoes are going bad! You have 3 days still.
Alert: Your Potatoes Probably Bad! Conditions: (Green)

drum it.

Alert: Notice your refrigerator temperature: too high.

50°C 122°F
At 8 AM:

- High
- Normal
- Low

Sense via Wi-Fi

10 PM:

- High
- Normal
- Low

Sense via Wi-Fi

My Fridge
Sun. 8 AM

38°F

Your fridge's temperature is on the normal scale. Your foods are happy.

My Fridge
Sun. 2 PM

50°F

Your fridge's temperature is beyond the normal scale. Recommend to check your fridge right away.
1. Light sensor sending alerts.

2. Options:
   - Click MORE
   - Click HINT

3. Light Analysis's Analysis Result
   - Heat Map

4. Light Analysis's MORE
   - Your food has been exposed under extreme high light scale in two hours.
   - Your food is in danger!

5. Light Analysis's HINT
   - Remove Your Food
   - Remove The Light
   - Check The Food Statuses
   - Analyze Again
1. After taking a pic. → Food Inventory Database.

   - Food Inventory
     - Storing Items
       - Into Inventory
         - Processing...

   - Food Inventory
     - Ingredients
       - (Cooking) (Details)

   - Food Inventory
     - Chosen Items
       - (Recommended)
         - Recipe
         - Directions

   - Food Inventory
     - Details
       - Suggestions:
         - Proper way to store
         - Proper way to cook
         - ...
Sketch

Pure Foods

- thermometer sensor
- camera, video (computer vision component)
- scanning recips (foods)
- lighting, wavelength

Pure Foods

- Database updated
- Recip display
- Add/view

Pure Foods

- Lighting
- Temperature
- Current display

Add/view

Pure Foods

- Lighting
- Temperature

Add/view

34°F
Pure Fruits
"you are what you eat"
Appendices:

Appendix A:

Scenario & Narration

Interviewee has to cook food for the whole family.

1. Interviewee goes to supermarket to buy the food.
   - Given 3 kinds of potatoes: russet, red, and white. Interviewee chooses russet ones. Says: I think red and white ones is used for special dishes. Another reason is the skin of white potatoes seems to be thin, that may causes them going bad quickly. Interviewee chooses 8 potatoes. He thinks it can keep good for 1 week or more. (It can keep more than one mouth if they are well stored, said by people next to him.)
   - Given 3 kinds of onions: russet, red, and white. Interviewee chooses russet again. Says: I think they can keep good for the same amount of time, so I just choose the color I like. Can keep good for one week.
   - Asked to Choosing milk: I will by 1.5 – 2 (L). Organic milk, with good brands. Of course I will look at the production data and expiry date. (But this comes out when the interviewee was asked by me.)
   - Pick meat: a whole chicken, some wings, drumsticks, some pork and beef. I want all kinds of meet so that I can eat different every day.
   - Seafood: one fish, some shrimps. They are fresh
   - Other vegetables.

2. Store food into refrigerator.
   - “Seafood, eat at the first day, so I don’t need to put them in fresh food layer, put all the other meats and fish into freezer.
   - “All the vegetables can be put into fresh food layer.”
   - “If the refrigerator is not large enough, I will put potatoes and onions out.”

3. Planning what food to cook.
   - Milk is mentioned at first, “I will drink milk every morning.” But the interviewee doesn’t remember that until he used up all the food. “Drink milk for the rest two days.”
   - Foods are judged to be “bad” if they are kept in refrigerator for more than one day. “I will dump the leftover on the second day.”
   - “If there is any sign that food might be bad, even if I’m not sure, I will dump them.”
Appendix B:
Observation - Fly on the Wall

<table>
<thead>
<tr>
<th>B. P.</th>
<th>B. G.</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>10</td>
<td>Number of times food is prepared</td>
</tr>
<tr>
<td>45 min</td>
<td>20 min</td>
<td>Food preparation times</td>
</tr>
<tr>
<td>All the time</td>
<td>Somewhat</td>
<td>How cautious are you of freshness?</td>
</tr>
<tr>
<td>5 min</td>
<td>4-5 min</td>
<td>Time door is spent open</td>
</tr>
<tr>
<td>Yes, extremely well</td>
<td>Not always</td>
<td>Are you careful to avoid cross-contamination?</td>
</tr>
<tr>
<td>4.0</td>
<td>3.5</td>
<td>Maintains inventory of current ingredients (1--&gt;5)</td>
</tr>
<tr>
<td>2.0</td>
<td>3.5</td>
<td>Do you clean the fridge on a regular basis(1--&gt;5)</td>
</tr>
<tr>
<td>Never</td>
<td>Never</td>
<td>Would you create an inventory via scanning each item?</td>
</tr>
<tr>
<td>Definitely</td>
<td>Yes</td>
<td>Scan receipt once for auto inventory</td>
</tr>
</tbody>
</table>

Appendix C:
Five Whys?

1. Why do you think the temperature of the refrigerator will affect the foods freshness?

Since refrigeration slows bacterial growth, it is important to maintain a proper temperature in the refrigerator so that it can maximize the shelf life of the foods. Also, different foods need to be stored in the different temperatures. For example, meats and poultry are needed to store in the freezer. Conversely, vegetables and fruits can be stored in the regular refrigerator. Also, I do not think it is a good practice to place the just cooked foods into the refrigerator since the hot foods will rise the temperature of the refrigerator which will affect other foods’ freshness.

2. Why do you think the light will affect the food quality?

I do not really know how the light will affect the foods quality, but I have noticed that the light indeed will change the color of the foods. For example, once I bought some deli meats and I forgot put them in the refrigerator. Instead, I placed them directly under the light. After a few hours, they actually turned their color darker. So I guess that probably was a sign to warn me that the deli meats had started to turn bad because of the light. Maybe?

3. Why do you think it is important to store different food in different ways in the refrigerator?
Since foods such as meats and poultry are most likely carrying more dangerous bacteria, they should be stored in the freezer where are separated from fruits and vegetables. Also, for the leftovers, they should be stored in airtight, leakproof clear containers or wrappers and should not place in the refrigerator immediately after cooking.

4. Why do you think it is better to keep tracking on the food that was stored in the refrigerator? Such as how many days did the certain food store in the refrigerator?

That was a really good idea. I have never thought about that because I am always busy on my work, it would be very difficult for me to remember when or what type of foods that I have stored in the refrigerator. Also, I think it would be very helpful to remind me and give me a warning that what type of foods I need to cook right away or what type of foods I need to throw out to stop me wasting my foods.

5. Why do you think if you can monitor your food in your refrigerator at all times, it would help you to keep tracking on the food freshness?

That is also an excellent idea. I doubt if there exists such refrigerator, but I think it would be much beneficial to me because I can always have a right clue about what is going on in my refrigerator and be my refrigerator guard remotely. Are there any foods needed to cook or throw out right away? Is my refrigerator’s temperature setting right? Did I completely close my refrigerator’s door this morning?

**Five Whys?**

1. How do you store your raw, cooked, and processed foods? Why?

Regarding raw foods, I store them in the freezer until I am ready to use them. I store them in the freezer because I want to make sure that they are close to fresh when I want to use them. Sometimes when my mom cooks meat, she stores them in the freezer for the next time we will use it. We store the cooked foods in the freezer because we do not like to waste foods and knowing my siblings, someone will eat it without even asking me.

2. How long do your raw, cooked, and precessed foods last? Why?

When we store the raw foods in the freezer, they usually last for about a couple months before they become tasteless. In my house, we usually buy a lot of meat, cook them, and store them in the freezer so that we are not lacking in the future when we will need it. Cooked foods, other than meats, are stored for about 4-7 days, so that others have an opportunity to eat it and so that it does not go to waste. After that, they go to trash, most times depending on the food.

3. What temperature do you keep your raw, cooked, and processed foods stored in? Why?
Since the raw foods are in the freezer, they are stored under 0 degrees Fahrenheit or less because that is standard temperature and that seems like the temperature that works. We have been using the same freezer for more than a decade. Cooked foods, depending on when they are used, are stored in the refrigerator at about 40 degrees Fahrenheit. This is so that the foods that we store do not freeze and this is also in consideration of the other foods that we place in the fridge.

4. Do you think placing foods under a light source will negatively impact the foods? Why or why not?

Yes. The light source emits heats and will essentially cook/heat the foods whether raw or cooked. Foods that are not ready to be consumed should be placed in the fridge to preserve its freshness and so that unnecessary molds and bacteria do not have a chance to grow on the foods.

5. What ways do you determine whether or not your foods are expired/spoiled? Why do you use these ways?

Well...depending on the food, I smell it, or by inspection we can tell whether it is expired or spoiled. If the food smells bad, has mold, or looks different from the time when first stored we throw it away because then we know that it is probably tasteless or just down right dirty. I use these methods because I am not a scientist or anything so when I see that something is not correct or does not look right about what I want to eat, I have no choice but to do something about it so that it does not make me sick in the long run.

6. How do you prevent food poisoning? Why do you use these methods?

I check my food before I eat it. If the food smells bad or if it looks different from when I first cooked it, I will not eat and instead will throw it in trash. I have never had food poisoning before so I guess I will continue to test and check the foods before consuming them.

Appendix D:

Draw the Experience

Sketch images of spoiled (bacteria filled) foods and fresh foods.
Sketch images of your methods on how to keep your foods fresh.
Sketch images of what kinds of foods you put in your refrigerator, cabinets, and freezer (include lighting and temperature details).
Kilk chwirkey
Fresh milk

Spinach  zucuni  cucumber
Broccoli  Cauliflower  Cabbage

goat meat??  chicken  fish  frozen pams
References