PureFoods
Will Smallwood, Mengyi Miao, Kerese Wright, Haoyue Wang

Credits

Will Smallwood - In charge of mobile development and video editing, he also assisted in writing storyboards for the previous projects. Will also helped with user testing, report editing, and user interface design. Not to be underrated, he also provided comic relief during late night editing sessions.

Mengyi Miao - Do research on the background and past works, assisted design and sketch UI, Cameraman during the user testing. Helped in web application programming, writing reports and presentation.

Kerese Wright - Kerese organized the Google Docs and Presentations and set up meeting outside of class. Kerese assisted in the video making process, writing the reports, made the website, made the web application (non-interactive), recruited participants, encourage ideas and changes, and help people stay on track with assignments.

Haoyue Wang - The original idea creator. Assisted the lo, mid and high fidelity design as well as the sketch of the storyboard. Did research on problem motivation and description. Helped with some functions in the web application (warning message, table and graph). Also, helped with the user testing and summarize what the team has accomplished and achieved.

Mission Statement

"To assist users in maintaining the quality of their foods by providing beneficial tasks and services." - PureFoods

Overview

Foodborne illnesses are steadily rising and spreading among people everyday. It is difficult to track the quality of foods without important dates such as expiration dates, sell by dates, and other similar dates labeled on foods. Although some foods are labeled with these dates, there are many food processing companies that do not label their food’s dates. We have created a mobile app that will hold all the user’s refrigerated foods in a database. Along with this feature, the app will inform the user about any upcoming expired foods, and temperature and lighting settings in the user’s refrigerator. High lighting and temperature levels can negatively affect the quality of the user’s foods, so this feature will help maintain the freshness of their foods for a longer period of time.

Background and Past Work

Each year, 1 in 6 Americans (or 48 million people) gets sick from and 3,000 die of foodborne
diseases. Reducing foodborne illness by just 10% would keep 5 million Americans from getting sick each year. Preventing a single fatal case of *E. coli* O157 infection would save an estimated $7 million.¹ There is no doubt that unsafe foods are life threatening for every people in today’s society.

People eat expired, toxic food mainly because lack of food storage knowledge, or they judge their foods’ freshness by their intuition. They usually have no idea about what’s going on in their refrigerator and they even don’t know what kind foods they purchased. Many foods are totally forgotten in the refrigerator for weeks before people eat them. “Although approximately 60% of consumers claim that they check food labels and expiration dates on food packages, only one-third of them know what to do with food when it is one day past its "use by" date” (Whitworth 2001).²

Our team researched through numerous food safety websites and mobile apps. They only focus on food itself and ignored the environment and method to store food. While our “PureFoods” app will provide real-time data and history of user’s refrigerator. Several apps such as this android mobile app called “Chemical Cuisine” (See Figure 1.1 & 1.2) provide professional knowledge and concepts on food safety. But it is a passive way for people to acquire information, it provide limited way for people to interact. Our app, instead, will provide inventory list for user so that user can add, order, remove foods they purchased. They can also view food details and recommend recipes for their food if they are wondering how to cook these perishable foods.

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Figure 1.3 shows a USDA website, it supports many detailed information about food safety, however, most of its links connect to textual paragraphs or PDF files, user may end up searching and reading through all web pages which may not contribute to their specific question. Our app with clean and clear layout will eliminate the time user cost for searching and reading irrelevant information.
“Food Safety” (See Figure 1.4) is another android mobile app 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 to remind people their food is going bad. Our “PureFoods” app will push warning into warning list and user can also check the food status if they order their food by expiration date. Our database will keep track on all the food and compute the expiration date based on “Safe Home Food Storage”\(^3\) so almost all kinds of food can be include into our inventory list.

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Interactive Prototype Description

The interactive prototype was built using the lessons learned from prior user testing to shape our android application. It consisted of a main program application with several sub-menus to represent the tasks that were determined to be important to the user. All user tasks were generated using the android programming language with Eclipse running the Android Software Development Kit. The data was stored and accessed on each device independently using the SQL interface that is naturally supported by android. As the program requires several notional sensors to detect the light and temperature levels in a user’s refrigerator, this data had to be simulated. To do this, a random number generator was used to produce numbers that were within reasonable bounds for the qualities that were to be measured. Given data as such, the graphs generated were good representations of what would have been produced from genuine data, with complete functionality depending on the sensors. The warning system was also faked; because the warning information was a nothing more than a set of information, it didn't make sense to have any warnings be generated using fake sensors or food that didn't exist, so they were simply written before compilation and stored in the SQL database rather than generated by the program. The important point was to allow the user to interact with them, not to generate them. Any other information was to be entered by the users as needed, or recovered from previous entries.
The above fig. 1.5 is the home screen from which all other menus are accessed.
The first task covered was the Warning System. Labeled simply as "Warnings" for the user, it was a list of warnings that the application had "generated" that the user must act upon as problems with their food had been revealed. After selecting the proper menu from the "home" screen, a list of all active warnings is displayed. When a warning is selected, a flash information screen appears, showing details about the warning selected. Behind the scenes, a warning is simply an item which contains a name, date, and description of the information associated with the warning. The flash message is only active for a short duration, allowing the warning to be read.

The second task is the History section. This section requires a bit more thought on the part of the user. As during the preliminary testing the multiple options presented to the users proved to overwhelm users, it was decided to simplify this section as much as possible. As such, we kept only the two most crucial items to the storage of food, the refrigerator temperature and lighting graphics. We opted to plot simple line charts for each one so users could get quick information at a glance. In order to access the historical information, the user must select "History" from the main menu. From there, the option of "Lighting" or "Temperature" is given to the user. After their choice, the appropriate graph is shown to the user, as well as a brief flash message to explain the graph’s legend and what is being displayed. The graphs are able to be scalable and scrollable. They had clearly labelled axis values in order to help the user better understand the information presented, correcting for common complaints in the earlier testing.
The last, and most difficult task, was that of the Inventory. This is also the central task to the application. It enables the user to define and modify their food inventory, which will in turn show warnings if they are not careful with the expiration dates on their food. This is implemented as a list of food items, each of which is unique. Multiple items of the same name can exist, as food purchased at different times will have different expiration dates. The task is contained in a screen with a single menu at the top, from which different options can be selected. The options available to the user are “view”, “add”, and “remove”. The “view” option displayed all food items entered in the SQLite database in a simple list form. If a food has an image associated with it, it will display a small icon, if not, the default android icon will show. When an item is selected, a flash message displays all information associated with the item. The “add” option adds a food item to the inventory, one item at a time. Initial testing had the user enter the date purchased in long form, but this was confusing to the user. Final implementation had the date entered as three separate int values separated by spaces. Lastly, the “remove” option keeps the same display as the “view” option. However, when an item is selected, rather than displaying information for the item involved, a pop-up window is displayed confirming the choice to remove the food item from the database. When the item is removed, the list is updated.
The above figures 1.9-1.11 show the natural progression of the interactive prototype’s inventory sequence.

**Interactive Prototype**

http://db.tt/4B2EtntK

**Testing Method**

1. **Participants**

   Our participants are randomly selected individuals from the food court in the Adele
H. Stamp Student Union building. We have three participants for our second user testing experiment and their names are Daniel, Katherine, and Nicholas. They are all undergraduate students at the University of Maryland. Nicholas mentions his lack in technology usage, then shows his old nextel phone. Additionally, none of the participants wanted their faces in the video. So, we only videotaped their hands while they performed different tasks on the interface. The participants also did have a few questions and comments about our interface in terms of navigation and the meaning behind certain components.

2. **Study Environment**

We conduct our user testing in Baltimore room at Stamp (See Figure 2.1 & 2.2). It is a good place, we can get participants in different gender, ages and cultural background. We have our participants seated on the desk so that they can play with the tablet easily. Our participants are very relaxed when they are performing tasks.

![Baltimore room at Stamp](image)

**Fig 2.1-2.2: Baltimore room at Stamp**

3. **Tasks**

We had our participants perform four different scenarios on our mobile application. Each scenario covered important tasks in our interface. Firstly, the participants had to add milk and eggs to their inventory. The inventory is the main component in our interface. It holds all the user’s foods. The users can insert, remove, view and sort their foods in their inventory. Secondly, the participants had to check their refrigerator’s temperature. Under the temperature section, our mobile application will show the user a current graph displaying the current temperature and time. The user would find the temperature section underneath the History component. Thirdly, the user had to check to see if they had any warnings on expired foods. The warnings table included a few details about the upcoming or current expired foods. Specifically, the user say information about the expiration date, name and quantity. Lastly, the users had to remove milk from their inventory. The last task was to get the user more familiar with our main structure in our application.
4. **Procedures**

First, Kerese will invite participants to the table. She will give participant some brief idea about our project and the purpose of user testing. Then, we inform our participants that we are video taping, but we will only take their hands' action. At the same time, Kerese will hand out our user consent form. As soon as participants read through it, agreed and signed the form, Mengyi will set up the camera. Will and Haoyue will start observe and take notes.

When Mengyi begin taping, Kerese will first give participants instructions on how to operate tablet and then give a brief introduction to our “PureFoods” app. Then, she will give a task for user to complete each time. After user completed all three tasks. We will have play around with our app and ask them for general thoughts about our app.

5. **Test Measures**

Our measures focus on the time participants cost to accomplish each tasks and how many errors they make during they accomplish each task.

<table>
<thead>
<tr>
<th>User 1</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time cost</td>
<td>52.9s</td>
<td>9.7s</td>
<td>22s</td>
<td>15.4s</td>
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<tr>
<td>Number of errors</td>
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<td>0</td>
<td>2</td>
<td>1</td>
</tr>
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</table>

<table>
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<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
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</thead>
<tbody>
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<td>30s</td>
<td>6s</td>
<td>19.5s</td>
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<tr>
<td>Number of errors</td>
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<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User 3</th>
<th>Task 1</th>
<th>Task 2</th>
<th>Task 3</th>
<th>Task 4</th>
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</tr>
<tr>
<td>Number of errors</td>
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<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Form 1: User testing measure result

6. **Testing Results**

**Android Operating System:**
There was only one of the three participants who had experience with the Android operating system. As for the other two participants, one was not familiar with the Android operating system while the other merely had prior experience neither with a smart phone nor a tablet.
Home Button:
All three participants had difficulties to navigate back to the home screen after performed some task actions. They had to keeping press the “back” button several times in order to reach the home screen.

Font Size:
All of our text font size were too small to read. Also, because of the small label font size, two participants were hard to touch on the right spot in order to perform the action they intended to do.

Icon Size:
Similarly like the font size issue, the icon size was also too small to realise it was touchable. All three participants misunderstood the icon description which was the command to perform instead of an icon.

Remove Item Functionality:
The remove item functionality was too complicated and confusing for all three participants. Instead of navigating to the remove screen to remove a certain item, all three participants directly selected the item in the view screen and waited for the successful removal message.

Submit Functionality:
In the input screen, two participants tried to submit the data they entered to the database before completing the required fields such as the date they purchased the item, which was not allowed. The user is required to enter information in all the textbox fields due to our back end implementation.

Ease of Usability:
Two participants were happy about the PureFoods app. They said it was easy to use and easy to understand overall. Since the other participant did not have much background in technology, she had to keep asking questions in every task that she applied.

Recommended Interface Changes

After performing the final round of user testing for the interactive prototype, several potential problems and changes were identified that will be changed in later versions. Please refer to Appendix A, found at the conclusion of this report, for a graphical representation of the major issues.

One item that emerged was the ease of navigation. In preliminary prototypes, the "back" button would jump to the home screen after being pressed. During mid-fidelity prototyping, this model was found to be confusing, as several users complained it did not return to the immediately previous screen. During interactive prototype user testing, however, several users complained that it did not go to the home screen. This prompted us to add a "home" button to the layout.

The font size was found to be a bit small on the tablets as well. This problem is not apparent while using cell phones, but the larger screen necessitates a further stand-off distance, and should be scalable to separate devices. While not a serious problem, it was the most often complained about. The small text also added a difficulty in selecting items in a list, as the precision of the touch screens was shown to give difficulty to some. Also determined was that a simple list was not sufficient, either the entire row of entry needs to be selectable or a new
icon display must be implemented as most users attempted to click in the dead space to avoid mistaken selection of items in the list.

The remove/delete functionality was unduly complicated for some. Instead of selecting the items from a remove menu and deleting, many users tried to select the item or hover over it, showing the information instead. We are still debating on how to fix this. A simple "garbage can" icon could be used, similar to the functionality of the Android OS homescreen. Additionally, a context menu with a remove option could also be used. Both ways should be implemented to allow for both styles to be used.

Lastly, some users failed to fill out all the fields while entering data. This could be rectified by a combination of making it more apparent which fields need to be filled out before attempting to add a record and auto-filling as much as possible, such as the dates, quantity etc.

Summary

It has been fulfilling and challenging to see the final PureFoods application workable. Even though it still needs some major improvements, the process of starting from the scratch to the interactive prototype will always be our invaluable academic learning experience.

From previous work of PureFoods, we have been spent considerable time to design the blueprint of PureFoods such as deciding what main tasks we should focus on in order to make PureFoods more practicable with limited approaches. For example, we have given up the biosensor for detecting the toxic food because it was not applicable for us to implement it.

Next, for the lo and mid fidelity prototype design and testing, we have learned the lesson from our users’ feedbacks. For example, we have changed some names of our prototypes buttons that were not intuitive enough so that users can have a basic clue about the actual purposes of those buttons. Also, we have removed some ambiguous functions such as pop windows and made it more user-friendly by reorganize and re-categorize some screens.

After all the design, the lo and mid fidelity prototype have done, we finally arrived at the most exciting part – interactive prototype. For our PureFoods interactive prototype, we have implemented a mobile app version and a web app version and used the mobile app for the user testing. Even though we have made some improvements since the last lo-to-mid fidelity prototype, our users still have given us many suggestions to point out the flaws of PureFoods. For instance, there was no home button. Instead, users had to press the back button many times in order to go back to the home screen. Also, another big issue was the font size was too small to read. Finally, two users were struggling on the order of the remove item process. Should they click the item first and then press remove or the other way around?

Due to the time constraint, we did not achieve the perfect result of what we expected since PureFoods still has plenty of room to grow and improve. Overall, we have learned remarkably from this project and believe with future care and modification, PureFoods will be easy and helpful to use for everyone.

Website
http://www.terpconnect.umd.edu/~kwright7

Website Report
Our website includes all the reports, videos, prototypes, and applications completed in the creation of PureFoods Mobile Application. There are five subsections on our website which are Home, Mission, About, Process, and Application. The Home section gives a brief description of our application. It mentions the main purpose of the mobile application and its features. The Mission section just displays our application's mission statement. The About Us section talks about the different people involved in the PureFoods Project. It gives details on the different tasks and positions assigned to each person. The Process section lays out all the documents and videos that provides information about the different stages throughout the project. Finally, our Application section provides links to the PureFoods Mobile and Web applications. The web application is currently not interactive because it needs more work in the back end functionality. While, the mobile application is interactive, but it needs more visuals and an updated layout design.

Video

http://www.youtube.com/watch?v=jf2yRtb_3F8&feature=youtu.be

Appendix

Appendix A

<table>
<thead>
<tr>
<th>Rank</th>
<th>Description</th>
<th>Suggested Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>repeatedly go back to previous screens in order to get back to home screen</td>
<td>add a home screen button</td>
</tr>
<tr>
<td>4</td>
<td>strain eyes to see words</td>
<td>make font size bigger</td>
</tr>
<tr>
<td>3</td>
<td>click on selection bar instead of words</td>
<td>make selection bar selectable</td>
</tr>
<tr>
<td>2</td>
<td>click item and then remove instead of reverse</td>
<td>make applicable for both ways</td>
</tr>
<tr>
<td>1</td>
<td>submit item without completing all fields</td>
<td>include * for required fields</td>
</tr>
</tbody>
</table>

The table above shows all the major incidents or problems experience from our users. The table categorizes each incident based on the severity and popularity of the problem, gives a description of the incident, and suggests future changes for the interface.
Appendix B
Consent Forms
The images below are the consent forms given to our participants before creating our videos.
Consent Form

The PureFoods application is being produced as part of the coursework for the University of Maryland, College Park Computer Science course "CMSC434 Introduction to Human-Computer Interaction". Participants in experimental evaluation of the application provide data that is used to evaluate and modify the interface of PureFoods. Data will be collected by interview, observation, and questionnaire.

Participation in this experiment is voluntary. Participants may withdraw themselves and their data at any time without fear of consequences. Concerns about the experiment may be discussed with the researchers (Will Smallwood, Mengyi Miao, Kerese Wright, Hao Yue Wang) or with Professor Jon Froehlich

The instructor of CMSC434:
Dr. Jon Froehlich
Computer Science
University of Maryland, College Park
jonf@cs.umd.edu

Participant anonymity will be provided by the separate storage of names from data. Data will only be identified by participant number. No identifying information about the participants will be available to anyone except the researchers and their supervisors. I hereby acknowledge that I have been given an opportunity to ask questions about the nature of the experiment and my participation in it. I give my consent to have data collected on my usage and opinions in relation to the PureFoods experiment. I understand I may withdraw my permission at any time.

Name: Danielle Horn
Date: 5/1/12
Signature: Danielle Horn
Witness name
Witness signature
Consent Form

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Name: Katherine Stout  
Date: 5/11/12  
Signature: [Signature]

Witness name: Will Smallwood  
Witness signature: [Signature]
Consent Form

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The instructor of CMSC434;
Dr. Jon Froehlich
Computer Science
University of Maryland, College Park
joef@cs.umd.edu

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Name

Date 5/11/18

Signature

Witness name

Witness signature
User Testing Notes
The notes below show the different tasks performed by each participant and notes on any
problems, questions, or comments revealed during our user testing experiment.

User Testing Tasks - Raw
1. Add "Eggs" or "milk" to your inventory
2. Check your refrigerator's temperature
3. Check to see if you have any warnings or expired foods
4. Remove "milk" from your inventory

User Testing Notes - Raw
- Uncertainty navigating through pages
- delay to find back button
- Confused by back to (add item) page
- highlight remove item delete more versus click item own remove more specifics w/ tasks
- More specifics w/ demonstration
- Users ask questions while performing tasks
- Need a home button
- User click on house icon; home of table
- Technical issues at back end
  for user input that's incomplete
  for the "add item" Section

- Words are too small
- Cannot highlight the whole
  selection bar