



Home Gizmos Inc.

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October 17, 2002

Dr. Andrew Rawicz
School of Engineering Science
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Re: ENSC 340 Project Functional Specifications

Dear Dr. Rawicz:

Attached is the Home Gizmos group's *Functional Specification for the SmartFridge Home Inventory System*, which outlines the functional plan for our project for ENSC 340. We are in the process of designing and implementing a unit that will scan in common bar codes in in conjunction with a home computer. The SmartFridge helps to keep an easy and accurate inventory of items identified by bar code.

The purpose of this functional specification document is to outline the required parameters for the Smart Fridge system. This is broken down into two sections: the scanning wand hardware, and the custom database and user interface software on the PC.

Home Gizmos consists of five fifth-year-engineering students, whose imagination and technical skills will be of great value to the SmartFridge. Michael Nelson, Alexander Dunfield, Cameron Kenny, Colin Knight, and Shaun Jackman make up the core of Home Gizmos. If you have any questions or concerns about our proposal, please do not hesitate to contact me by phone at 604-929-6611, or email our group at home-gizmos@sfu.ca.

Sincerely,

M. Nelson

Michael Nelson
President and CEO
Home Gizmos



Functional Specifications for the SmartFridge Home Inventory System

Revision 1
October 14, 2002

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Executive Summary

People everywhere endure the chore of shopping. The SmartFridge is aimed to simplify the shopping process by allowing the user to effortlessly create shopping lists that they can either take to the store, or use to order groceries online. The SmartFridge will even track the age of items with a limited shelf life and make recipe suggestions based on the current contents of the refrigerator, pantry, or freezer.

There are key hardware and software components for the SmartFridge. Firstly the hardware is comprised of the SmartFridge scanning wand and all other non-host computer software functionality. The function of the hardware is to:

- read the bars of a bar code, generating an electrical signal
- convert this electrical signal into the corresponding numeric bar code value
- store the values read from the bar codes
- transfer the bar code values to the host computer software

All the other SmartFridge features are implemented though the host computer software. These features include:

- matching the bar code values to the actual product
- tracking the current inventory of the kitchen
- printing a shopping list
- ordering needed groceries online
- making recipe suggestions based on the current inventory
- managing the inventory to account for mistakes and miss-scans

A working prototype of the SmartFridge will be completed in December 2002.



The Scanning Wand from the SmartFridge Prototype



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Glossary

Home Inventory: The actual products present in the user's refrigerator, pantry, etc.

Inventory Management Browser (IMB): A structure that allows the user to browse categories of food as well as see the products in each category. In addition, the quantity of each product and the date of the oldest instance of that product will be displayed in the IMB.

Product Library: The list of all of the different possible products that could be added to the user's Virtual Inventory. Ideally, the Product Library would contain all possible products. However, for the initial revision, we will be working with a product library that has 20-50 products in it.

Product Library Browser: A structure that allows the user to browse the categories of food as well as see the available products in each category.

Scanner: A synonym for "Scanning Wand". Refer to the Scanner Wand entry.

Scan (Scanned) out: The process of using the scanning wand to scan the bar code of an old product that is ready to be discarded. When the Scan Workspace in the SmartFridge Software is entered and the Download Scanning Wand button is clicked, the codes of the products that were scanned out are transferred to the SmartFridge software and the quantity of the appropriate products is decreased.

Scan (Scanned) in: The process of using the scanning wand to scan the bar code of a new product that has just arrived in the Home Inventory. When the Scan Workspace in the SmartFridge Software is entered and the Download Scanning Wand button is clicked, the codes of the products that were scanned in are transferred to the SmartFridge software and the quantity of the products is increased appropriately.

Scanned Items List: The list in the Scan workspace that shows the user what items were scanned in and scanned out recently and allows the user to adjust the quantity. Once the Save and Return button is pressed, the Scanned Items List is cleared and the items are added to or subtracted from the Virtual Inventory.

Scanning Wand: The portable device that is used to scan in and scan out items by being passed across the bar code. The scanning wand is connected to a personal computer through a serial cable, and the product codes that were scanned can be stored into the virtual inventory.

Shopping List: The region in the Shop window containing the list of items to shop for.

SmartFridge: A bar code scanner based home inventory system.

User: Any person who is using the SmartFridge scanning wand or graphical user interface.

Virtual Inventory: The inventory of the kitchen according to the SmartFridge software.

Wand: see Scanning Wand.

Workspace: The screen in the user interface that allows the user to apply a specific function. For example: the Shop workspace.



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Window: A pop up screen that is reached by clicking on one of the function buttons in the active workspace.

Acronyms

EAN: European Article Numbering System

GUI: Graphical User Interface

UPC: Universal Price Code

IMB: Inventory Management Browser

PC: Personal Computer

PLB: Product Library Browser



1 Introduction

The SmartFridge consists of a handheld bar code scanning device and software running on a host PC. The scanning device reads and decodes a bar code and sends the information to the host computer. The software on the host computer is then used to implement many of the features of the SmartFridge. Features include: generating shopping lists; ordering groceries online; tracking item age; and suggesting recipes to match the food currently in the kitchen. A block diagram showing the basic functions of the SmartFridge is shown below in Figure 1.

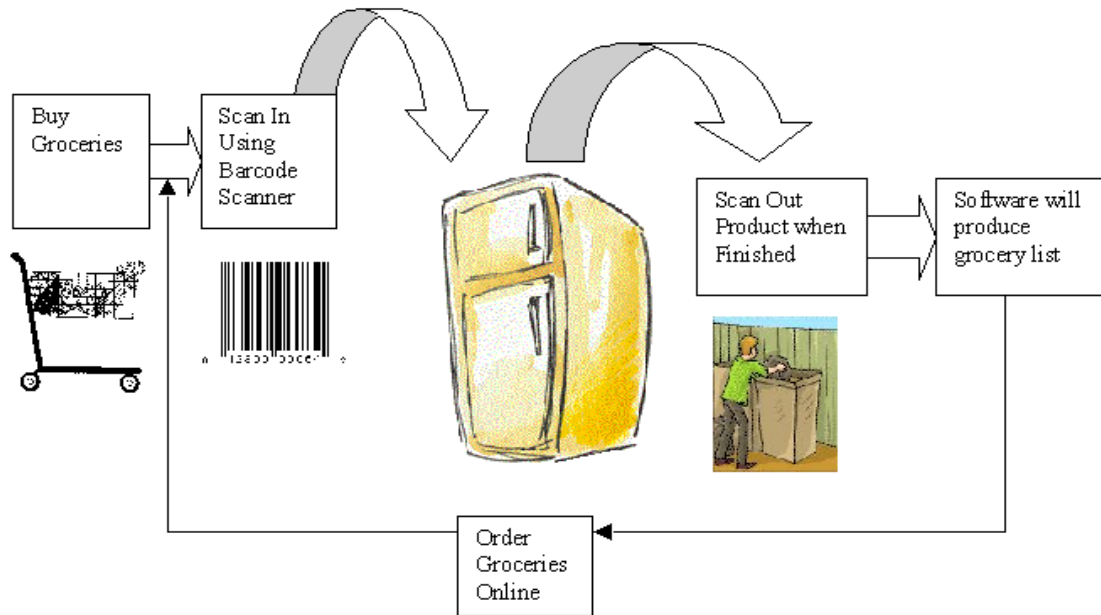


Figure 1 - System Block Diagram

1.1 Scope

This document outlines the functional requirements of the SmartFridge and the test procedures to be used to ensure these requirements are met. The SmartFridge design team will use this document as a framework from which a working prototype will be built. Though comprehensive, these specifications need not cover all requirements that will be imposed on the Smart Fridge when it reaches production. However, these specifications will consolidate the necessary requirement of the device and ease the development.

1.2 Intended Audience

This document is primarily created for the SmartFridge design team to provide direction in the design of the SmartFridge and ensure that there are not oversights in the design. The Home Gizmos management team will use this document as a measuring tool to evaluate the SmartFridge as it develops to ensure that the project lives up to its expectations.



1.3 Requirement Notation

The following notation is used throughout this document:

[#] Functional Requirement

This means that the requirement listed is the SmartFridge's [#]th requirement and the text following this number indicates the specifics of the functional requirement. A * next to a functional requirement number denotes a critical requirement.

2 The Microcontroller

The scanning wand will be a simple, hand-held device that is used to scan in bar codes, give some feedback, and interface with the software. The wand will consist of a lens and LED/photodiode pair interfaced to an Atmel AT90S8515 microcontroller. The scanning wand will store the bar code in memory, and will be able to output the codes to a personal computer through a serial port. Figure 2 contains a block diagram of the scanning wand.

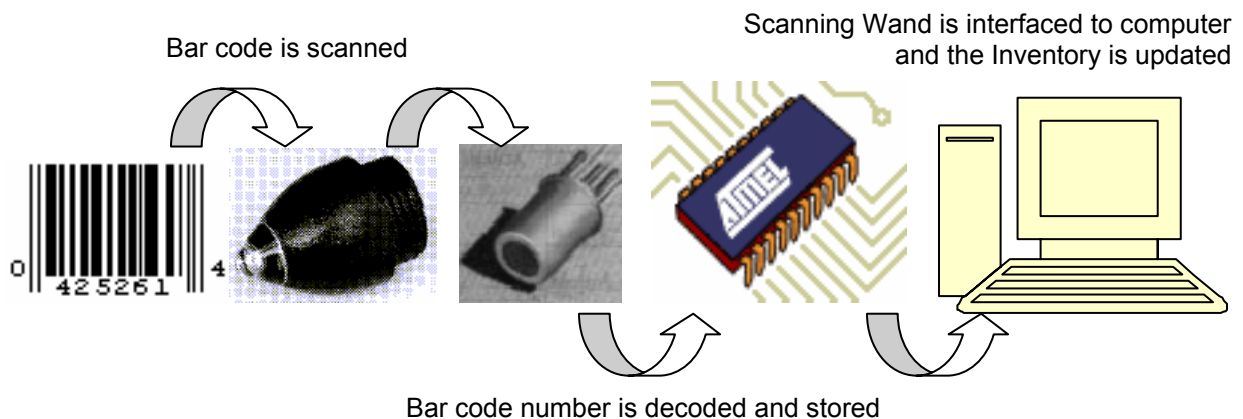


Figure 2 – Hardware block diagram

2.1 Scanning Barcodes

The primary function of the scanning wand is to scan in bar codes. This process should be as simple and easy-to-use as possible.

- [1]*** The scanning wand will be capable of reading in standard bar code schemes, namely EAN-13/8 and UPC-A/E standards.
- [2]*** The scanning wand will be able to scan in bar codes with a minimum spacing of 0.10 mils, which is the industry standard.
- [3]** The scanning wand will be capable of scanning in bar codes on the first read with a greater than ninety-nine percent success rate.
- [4]*** The scanning wand will be able to correctly interpret the bar code, without mistaking it for another valid bar code, at least 99.9% of the time.
- [5]** The scanning wand will be capable of scanning bar codes in both the forward and reverse directions.



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- [6] The scanning wand will be capable of decoding bar codes with up to 40% ink-spread distortion and 10 % system noise distortion, which is the main cause of errors in bar code reading.
- [7] The scanning wand will be capable of reading in bar codes at different speeds, as well as readings that are not made at a steady speed across the bar code.
- [8]* The scanning wand will be capable of storing at least one hundred products in memory.

2.2 Hardware User Interface

One of the most important considerations when designing any product is its ease of use. Since the scanning wand is of great importance to the system, it is important to give feedback to the user while scanning occurs.

- [9]* When a bar code is successfully scanned in, the scanning wand will emit a short audible beep so that the user knows whether or not to rescan an item.
- [10]* There will be a button on the scanning wand to cancel the last scanned item in case of an error.
- [11] When the bar code memory is nearly at capacity, there will be visual feedback to let the user know that they need to upload the data to their computer.
- [12]* There will be visual feedback when the battery is running low.
- [13]* The scanning wand will have a slide-switch to designate if the item being scanned is being put into the refrigerator or being taken out.

2.3 PC Interface

After the bar codes are read into the scanning wand, the data needs to be sent to a PC. This process should be reasonably fast and easy to use.

- [14]* For the scanning wand prototype, the data will be transmitted from the scanning wand to the PC using a standard serial port interface.
- [15] For the production scanning wand, the data will be transmitted from the scanning wand to the PC using a Universal Serial Bus port.
- [16]* The transmitting data will be able to sustain a transfer rate of at least 19.2 kbps.

2.4 Battery Powered Operation

When in production, the scanning wand will be portable, so battery power will be necessary. It is important to users that the battery life be reasonably long.

- [17] The scanning wand will be capable of scanning in at least 1000 items on one set of batteries.
- [18]* The battery will be able to last at least four weeks while sitting dormant.



2.5 Environmental Requirements

Although the scanning wand is intended for indoor use, it should be able to function properly in a variety of environmental conditions.

- [19] The production scanning wand should be able to operate properly within a temperature range of 0°C to 70°C.
- [20]* The production scanning wand should be able to operate properly between 0 and 100% humidity.

2.6 Physical Requirements

The device should be handheld and portable. To achieve this, the scanning wand will have to be relatively small and modular.

- [21] The scanning wand will have a mass of less than 100 grams.
- [22]* The scanning wand will fit comfortably in any normal adult hand.
- [23]* The scanning wand should be durable and resistant to impact.

3 Host Computer System Requirements

The software will execute on a computer system with the following minimum specifications:

Windows 98/2000/ME/XP Operating System
200 MHz Pentium
16 MB RAM
1 RS232-compatible serial port
100 Mb Free Hard Drive Space

4 Software Performance

- [24]* The maximum delay for any response to a user command through the GUI will be 5 seconds, or else a status box must appear.
- [25]* The maximum amount of time for the software to download all codes from the scanning wand, store them in the database, and update the Scanned Item List will be 60 seconds.
- [26] The maximum amount of time for the program to start up is 10 seconds.

5 The Graphical User Interface

The user interface will be consistent with the standard Windows User Interface look and feel, including a close button, a minimize button, a maximize button and a drop down menu. All features in the GUI will have appropriate affordances, and the layout of the buttons will follow standard and natural mappings.



5.1 Main Menu

5.1.1 General

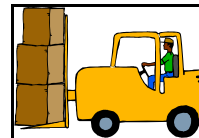
When a user finishes scanning items with the scanning wand and is ready to update the inventory system on the computer, he or she simply starts up the SmartFridge software, connects the scanning wand through the serial port, and clicks the Scan button. In addition to using the Scan function, the user can also make a shopping list, manage the inventory, or get recipe ideas. The user interface will have the following properties and features:

- [27]* A size-adjustable rectangular window with a blue background and containing a picture of a refrigerator. If there is sufficient time, the main window will be stylized with skins to take on the appearance of a refrigerator.
- [28] The Home Gizmos logo will be in the top left corner of the screen and the SmartFridge logo will be in the bottom left.
- [29] The current date will be in the bottom right corner and will be visible in all screens of the SmartFridge user interface.
- [30]* The main menu will consist of four pictorial buttons located on the freezer of the refrigerator. When one of the button icons is clicked, the refrigerator will open and reveal the appropriate workspace. The buttons are as follows:

- **The Scan button:**



- **The Manage Inventory button:**



- **The Shop button:**



- **The Recipe button:**



5.1.2 Features

- [31]* Detailed labels next to each button will describe the button's function. Alternatively, these labels could be implemented as floating text boxes that appear over the button.



- [32]* It will be possible to implement all functions in the SmartFridge software using only the keyboard. All windows must have appropriate responses to tab commands to insure all tasks can be accomplished with only a keyboard.

5.2 Drop Down Menus

- [33] The drop down menus will be docked to the top of the application window and will contain the following options:

<u>F</u> ile	<u>E</u> dit	<u>O</u> ptions	<u>H</u> elp
<u>V</u> iew Old Shopping List	C <u>u</u> t (<u>X</u>)	<u>S</u> can	SmartFridge <u>H</u> elp
<u>P</u> rint	<u>C</u> opy (<u>C</u>)	<u>S</u> hop	<u>A</u> bout SmartFridge
<u>Q</u> uit	<u>P</u> aste (<u>V</u>)	<u>M</u> anage Inventory	
		<u>R</u> ecipe	
		<u>C</u> ustom Codes	
		<u>S</u> ettings	

- [34] When the mouse cursor is held over one of the functions on the drop down menu, a description of the function will appear in the status bar.
- [35]* All options will be selectable by using the Alt key and by typing the underlined letter in the menu.

5.2.1 The Settings Menu

The Settings Menu is found under the Options heading in the pull down menu and allows the user to enter personal information so that he or she can purchase goods from an online grocer. The Settings Menu will have:

- [36]* Fields for the user’s Name, Address, and phone number.
- [37]* A field for the user’s primary email address.
- [38] Fields for the user name and password for the Online Grocer.
- [39] Radio buttons to select between Visa and MasterCard.
- [40] Fields for credit card number and expiry date.
- [41] A field for the user’s default delivery instructions.

5.2.2 The View Old Shopping List Menu

The View Old Shopping List menu can be used if the user wants to refer to an old shopping list. This option is located under the File menu. The View Old Shopping List menu layout and functions will:

- [42] Appear as the standard Windows load file screen.
- [43] Have files named *ShoplistYYYYMMDD.SMT* that are automatically generated depending on the date that the shopping list is printed or ordered online.



5.3 Scan Workspace

5.3.1 General

The Scan Workspace is reached by clicking on the Scan icon in the main menu or by selecting the Scan function from the 'Options' drop down menu. Once the Scan icon is selected, all of the codes are read off of the scanning wand, and the data is processed. The Scan workspace will perform the following functions and have the following properties:

- [44]* A Download Scanning Wand button will retrieve the scanned codes from the scanning wand and clear the scanning wand memory. The user will be notified that the wand is being cleared. Scanned codes are stored in the Scanned Item List.
- [45]* Display the Scanned Item List – a list of the items that were just scanned in or out.
- [46]* Display a list of bar codes that were not recognized during the scan.
- [47]* Beside each item in the scan list, the quantity of that item will be displayed. Each item will be displayed once only, but the quantity will be adjusted as additional identical items are scanned in.
- [48] Plus and minus buttons beside each item in the scanned list will allow the user to adjust the quantity. With this feature, the user can save time and avoid errors. For example, if you have 12 of the same item and you choose not to scan all 12 items, you could scan only one and adjust the quantity using these buttons. As well, this feature will allow you to correct for errors by observing any items that were accidentally scanned twice.
- [49] A Custom Codes button will invoke the Custom Codes window and allow the user to create bar codes for products that do not have bar codes.
- [50]* An Edit Unknown Items List button will allow the user to add descriptions to unknown items.
- [51]* A Save and Finish button will commit the changes to the inventory and return the user to the main menu.
- [52]* A Cancel button will allow the user to exit the workspace without having the scanned in items added permanently to the database. The scanned items will temporarily be stored until the user returns to the Scan workspace.

5.3.2 Features

In addition to the general layout and functionality described in the previous section, the Scan Workspace has the following features:

- [53]* When the Download Scanning Wand function is invoked, if the scanning wand is not connected to the serial port of the computer, a pop-up window will request that the user connect the wand to the serial port .
- [54]* The user can click on any unrecognized bar code in the list of unrecognized items to invoke the Identify Unknown Items window.



5.3.3 Identify Unknown Items Window

When the user clicks on an unrecognized bar code, the Identify Unknown Items window will be brought up. The purpose of this screen is to allow the user to manually describe the products in the unrecognized items list. If the user adds a description to any code, and clicks the Save and Return button, the updated items will be added to the product library. The items which were not updated will remain in the Unknown Items list and will not be added to the inventory. The Identify Unknown Item window will have the following properties:

- [55]* A list of all of the unknown items as well as the date that they were scanned in.
- [56]* A text edit box for each unknown item where the name of the item can be entered. The default value for the text box will be “unknown item”.
- [57] A text edit box for each unknown item with the size of the item. The acceptable values are between 0 and 600,000.
- [58] A pull down list with a selection of units for each unknown item. One of the selections will be “other.”
- [59] A pull down list that allows the user to select the category for each unknown item. A Category tree view will present a list of all food categories.
- [60]* A Cancel Without Identify button to cancel the changes made and close the window.
- [61]* A Save and Return button to save the changes to the database. The modified items will be moved from the Unknown Items list to the Scanned Item List in the Recipes workspace.

5.3.4 The Custom Codes Window

The purpose of the Custom Codes window is to allow the user to create bar codes for items that do not have pre-existing bar codes. Fruits and Vegetable rarely have bar codes, and occasionally an item will lose its bar code or have a bar code that refuses to scan. In order to manage a list of custom codes in addition to the pre-defined bar codes installed with the software, the Custom Codes window will:

- [62] Contain a tree view of all user-defined bar code associations. The tree view will be sorted according to the same food categories as defined in the Product Library.
- [63] The tree view will present a menu of options when right clicked. The menu will contain the option to add a new category, delete a category, and add new item. The Add New Item option will bring up the identical window to the Identify Unknown Item box. Items can also be dragged into a new category.
- [64] Have a Print New Bar Codes button. It will invoke a printer dialog box and provide instructions for the user to print a sheet of bar code labels. The bar code labels will be custom codes, prefixed with the number 4, and not used in the current system.
- [65] Contain a button to Erase All Custom Codes. The button will have a confirm dialog prior to deletion. The result will be to remove all items from the custom Codes tree view and the database, freeing up all custom codes for reuse.



5.3.5 Limitations of the Scan Workspace

- [66]* The maximum number of items that can be scanned in at one time will be equal to the maximum number of codes that can be stored in the memory of the scanning wand: 100 codes.
- [67] The maximum number of custom codes that the user can create will be 1000.
- [68] Users will be unable to reload any codes back into the scanning wand.

5.4 Shopping Workspace

5.4.1 General

Clicking on the Shop button in the main menu accesses the Shopping workspace. The layout of the Shopping workspace will contain:

- [69]* A shopping list showing every product that has been scanned out since the last time the shop function was used, as well as items from previous shopping lists that were not purchased and scanned in.
- [70]* Check boxes used for disabling items from the current order will be located next to each item in the shopping list (the default is checked).
- [71]* Text fields correspond to the quantity of each item that the user would like to purchase. The text fields are located to the right of each item on the shopping list and the quantity can be updated manually or by using arrow buttons next to the field.
- [72]* An Add item button will add products that are not on the shopping list that the user would like to purchase. The Add item button will open the Add Item window.
- [73]* A Print Shopping List button will open the Print Shopping List window.
- [74]* An Order Online button will open the Order Online window.
- [75]* A Cancel with Save button will save changes and return to the main menu.
- [76]* A Cancel without Save button will return the user to the main menu and revert the shop screen to the previous state.

5.4.2 Features

- [77]* Items that appear automatically in the shopping list and are not purchased within 30 days will be removed from the shopping list. A confirmation query will verify this with the user.
- [78] When a shopping list is printed or sent over the Internet to order online, a backup copy of the list is made and saved by date.

5.4.3 Add Item Window

Clicking on the Add Item button accesses the Add Item window. The function of the Add Item window is to allow the user to add items to their shopping list that he or she does not purchase regularly. Remember that observing which items were used up and scanned out



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generates the shopping list. Therefore, if the user has never purchased a particular product before, it is necessary to use the Add Item function. The Add item window contains the following:

- [79]* An instance of the Product Library Browser that contains a tree of all product categories, as well as the products for each category.
- [80] As items that the user wishes to purchase are clicked on in the Product Library Browser, they appear in the area below the Product Library Browser. When an item appears in this area, a quantity field will appear to the right.
- [81]* A Cancel button will return the user to the Shopping workspace without adding any items to the shopping list.
- [82]* An Add These Items button will return the user to the Shopping workspace and add the selected items to the shopping list.

5.4.4 Order Online Window

The Order Online window allows the user to purchase the goods automatically from an online grocer. Using the setup command from the drop down menu, the user is able to set up their profile. When the user clicks on the Order Online button, the following events (in sequential order) will occur:

- [83] The order will be compared against the product codes of the online grocer. If there are products on the order that are not available from the grocer, a message will appear that identifies the unavailable products, and the user will be returned to the Shopping workspace. However, the unavailable items will become highlighted in the Shopping workspace. The user can either discard the items from the list, or choose different ones.
- [84]* If the items are all available from the online grocer, a confirmation message will appear that lists all of the requested items, the cost of each item as well as the subtotal, the user information, and the grocery delivery time.
- [85]* When the user gives the final confirmation, the SmartFridge software will create an email with the required information and send it to the online grocer. The online grocer will respond with an email to the user specified email account.

5.4.5 Print Shopping List Window

The Print Shopping List window allows the user to print out a shopping list so that he or she can purchase the required items from a local grocery store. The Print Shopping List Window will:

- [86]* Open the standard Windows print screen that allows the user to select the printer, paper type, print quality, and page layout.
- [87] A copy of the shopping list will be archived with the date and time so that the user can access the list later using the “File → View Old Shopping List” command.

5.4.6 Limitations of the Shopping Workspace

- [88] A maximum of 200 different items may be stored in the shopping list at one time.



5.5 Recipe Workspace

5.5.1 General

The purpose of the Recipes workspace is to allow the user to add recipes, look up recipes, and get suggestions of recipes that can be made using the ingredients in the inventory. The Recipes Workspace will have the following:

- [89]* An icon display to represent categories of recipes. The icons can be clicked on to reveal subcategories of recipes, which in turn will display icons to represent recipe titles and further sub-categories of recipes.
- [90] A Back button will allow the user to return to the higher category.
- [91] A New Category button will allow the user to add new categories of recipes.
- [92]* A New Recipe button will invoke the Add/Edit Recipe window.
- [93] A Delete button will allow the user to remove categories or recipes.
- [94] A Suggest Recipe button will open the Recipe window for a random recipe that can be made with the current inventory ingredients.

5.5.2 Features

- [95]* When a recipe title is clicked on, the Recipe window will appear with the ingredients and directions for creating the dish.

5.5.3 Recipe Window

The Recipe window is used to look up a recipe. By clicking on the recipe title in the Recipe workspace, the recipe window is opened and the user can edit, read, or print the recipe instructions. The Recipe window will:

- [96]* Display a list of the required ingredients, including the quantity required and quantity available.
- [97]* Display a list of instructions.
- [98]* Contain a Print button so that a hard copy of the recipe can be obtained.
- [99] Contain an Edit Recipe button that will open up the Add/Edit Recipe Window with the information about the recipe already filled in.
- [100]* Contain a Close button that will close the Recipe window and return to the Recipes workspace.

5.5.4 Add/Edit Recipe Window

The Add/Edit Recipe window will be similar to the Recipe Window, but will have no initial ingredients (or only the pre-existing ingredients in the case of the edit function) and a text box for the directions. In addition, the Add/Edit Recipe window will:

- [101]* Contain space for ingredients to be added. Ingredients are added using the Add/Remove Ingredients button.



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- [102]* Contain an Add/Remove Ingredients button that will invoke the Add/Remove Ingredients window. When the Add/Remove Ingredients window is exited, the ingredients added will be displayed in the Add/Edit Recipe Window.
- [103]* Have a multi-line text box that will be used to input or edit the recipe directions.
- [104]* In the case that the recipe requires an ingredient that is not in the Product Library, there are additional fields at the bottom of the window so that extra ingredients can be entered manually. Ingredients that are entered manually will not be searchable by the Suggest Recipe function.
- [105]* Contain a save button that will cause the recipe to be saved in the database.
- [106]* A cancel button will close the window without saving changes. Before canceling, the user will be asked to confirm that the recipe data will be lost.

5.5.5 Add/Remove Ingredients Window

The Add/Remove Ingredients window is used to enter in the ingredients that are required for the recipe that the user is working on entering. The top half of the window contains an organized view of all of the available ingredients (from the Product Library), and the lower half of the window contains a list of all of the ingredients that have been added. The format and features of the Add/Remove Ingredients window are as follows:

- [107]* The list of available ingredients will contain a tree view, referred to as the Product Library Browser, to allow the user to navigate the Product Library and choose the ingredients for the recipe.
- [108]* As ingredients are selected from the Product Library, they appear below the Product Library Browser. When an ingredient appears, there will be a check box that appears to the left (default checked), a quantity field that appears to the right, and a drop down menu that appears to the far right that is used to select the units.
- [109] The text edit boxes will allow the user to enter the quantity of each item.
- [110] Pull-down menus will allow the user to select the units of measurement for each ingredient.
- [111]* When the checkbox is checked, it indicates that the ingredient is to be included in the recipe. However, if the user unchecks the box, the ingredient to the right of the box will not be included in the Add/Edit Recipe window. Thus the remove ingredient function is implemented.
- [112]* A Save Changes and Return button will cause the ingredients to be added or removed from the recipe.
- [113]* A Cancel Without Saving Changes button will close the window without adding the ingredient.
- [114] Each time that the Add/Remove Ingredients window is accessed, all of the ingredients that have been added so far will appear in the list below the Product Library Browser. In addition, any ingredients that have been removed from the recipe in the last day will be present in the list, but will be in an unchecked state.



5.5.6 Limitations of the Recipe Workspace

- [115]* The maximum number of hierarchical levels is 5.
- [116] The maximum number of characters to be used in the instructions per recipe is 2000.
- [117] The maximum number of ingredients per recipe is 80.
- [118] The maximum quantity of a specific ingredient is 600,000 units.
- [119] The tree view will allow a maximum of 500 items.

5.6 Modify Inventory Workspace

5.6.1 General

Although the SmartFridge Interface is easy to use, due to the sheer volume of a large grocery load, it is possible to make mistakes. The Modify Inventory workspace allows the user to update the program data to reflect the actual state of the home inventory. The Modify Inventory workspace will have the following functionality:

- [120]* An Inventory Management Browser (IMB) will occupy the top half of the workspace. The table will be organized by a category tree on the left, and the right side will contain information on each product that is present in the inventory, as well as the quantity, and the date that the oldest instance of each product was scanned in.
- [121]* The user will be able to adjust the quantity of an item by finding the item in the IMB and using the arrow buttons next to the product name to adjust the quantity, or by changing the quantity manually in the quantity field.
- [122]* An Add Items button will open up the Add Items window and allow the user to enter any inventory items that were not scanned in.
- [123] To the far right of each product there will be a date that represents the scan in date of the oldest instance of that product. If a user would like to know if a product in their home inventory is still good, he or she looks up the product in the Modify Inventory workspace and can determine if the object has expired.
- [124]* A Save Changes and Return button will make the changes to the inventory.
- [125]* A Cancel Without Save button will discard the changes made to the inventory and return to the main menu.

5.6.2 Features

- [126] An Undo command that will return the user to the Modify Inventory Workspace and recover the lost changes if the user accidentally clicks on the Cancel Without Save button.
- [127]* The Add Items window will only update the quantity of items if the product that is added is already present in the inventory.
- [128]* There will be categories for custom codes so that the inventory can be managed completely.



- [129] Can add multiple new items at one time using the Add Items window so as to avoid repeated entering and exiting of the Add Items Window.

5.6.3 Add Items window

The Add Items window opens each time the user clicks on the Add Items button in the Modify Inventory workspace. The Add Items window will:

- [130]* Contain a copy of the Product Library Browser.
- [131]* Have product names appear below the Product Library Browser as the user clicks on products.
- [132]* A quantity field will appear next to each product name below the PLB, and the default quantity will be zero.
- [133]* Contain an Add Items to Inventory button will make the changes to the inventory and return the user to the Modify Inventory workspace.
- [134]* Contain a Cancel button that will return the user to the Modify Inventory workspace without adding any products to the inventory.

5.6.4 Limitations of the Modify Inventory Workspace

- [135] The maximum number of different products that can be added at one time is 50.

6 The Database

- [136] The Database will store a maximum of 700,000 food items.
- [137] The Database will store a maximum of 10,000 custom bar codes.

7 Test Plan

7.1 Hardware Test Plan

The hardware's main functions are to read and interpret bar codes, store these bar code values in memory and to upload these bar code values to the host computer. As such, these steps are the focus of the Hardware Test Plan.

Before testing, 10 samples of each supported bar code type (UPC-A, UPC-E, EAN-13 and EAN-8) need to be gathered. Also 10 samples of unsupported bar codes and 10 samples of plain text need to be gathered.

Test procedure is as follows:

Set SmartFridge to scan in products.

1. Read each of the 10 sample UPC-A bar codes forwards using a quick, constant velocity sweep and ensure the bar code is read correctly.
2. Read each of the 10 sample UPC-A bar codes forwards using a slow, constant velocity sweep and ensure the bar code is read correctly.



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3. Read each of the 10 sample UPC-A bar codes forwards using a steady increasing velocity sweep and ensure the bar code is read correctly.
4. Read each of the 10 sample UPC-A bar codes forwards using a steady decreasing velocity sweep and ensure the bar code is read correctly.
5. Read each of the 10 sample UPC-A bar codes forwards using a constant velocity angled sweep and ensure the bar code is read correctly (angled sweep starts near top of bar code and finished near bottom of bar code covering the bar codes full length).
6. Set SmartFridge to scan out products.
7. Repeat steps 2 through 6 (ensure the indication that memory is nearing capacity occurs after step 5 is repeated).
8. Read each of the 10 sample UPC-A bar codes forwards using a quick, constant velocity sweep and ensure the bar code is NOT read correctly (memory is full).
9. Set SmartFridge to scan in products.
10. Read each of the 10 sample UPC-A bar codes forwards using a quick, constant velocity sweep and ensure the bar code is NOT read correctly.
11. Upload the SmartFridge data to the host computer and ensure all 100 entries are received correctly (by doing so the SmartFridge scanner wand memory will be cleared).
12. Repeat steps 1 through 12, this time scanning the UPC-A bar code samples backwards.
13. Repeat steps 1 through 13 using UPC-E bar codes.
14. Repeat steps 1 through 13 using EAN-13 bar codes.
15. Repeat steps 1 through 13 using EAN-8 bar codes.
16. Repeat steps 1 through 8 this time reading unsupported bar codes forwards, ensuring bar codes are NOT read correctly.
17. Repeat step 17 this time reading the unsupported bar codes backwards, ensuring bar codes are NOT read correctly.
18. Upload the SmartFridge data to the host computer and ensure 0 entries are received correctly.
19. Repeat steps 17 and 18 this time only sweeping half of a valid UPC-A bar codes, ensuring bar codes are NOT read as valid bar codes.
20. Repeat steps 17 and 18 this time using an angled sweep that starts on a valid UPC-A bar code but finishes off the bar code, ensuring bar codes are NOT read as valid bar codes.
21. Repeat steps 17 and 18 this time sweeping samples of printed text, ensuring text samples are NOT read as valid bar codes.
22. Upload the SmartFridge data to the host computer and ensure 0 entries are received correctly.



7.2 Software Test Plan

Although it is very important to identify any hardware bugs in the SmartFridge, it is just as important to test the software functionality and performance. Thorough testing is necessary to catch obscure errors. If the testing is not done in an organized and orderly way, the results can be disastrous. We at Home Gizmos intend to follow the directions below in order to ensure a virtually bug free software application and a successful product. Note that this is a cursory overview of how we will implement the software testing – further detail requires a separate Test Plan document. Finally, note that for more complete testing, the testers of the software will not be the same individuals who wrote the code.

7.2.1 Testing the Host Computer Requirements and Software Performance

The host computer requirements can be tested by installing our software on a system such as specified in section three. Phenomena such as start up time, response time to a button click, and other requirements should all be met by this minimum system. All requirements stated in this document should be met by every system supported. Those requirements that are not met will be specified in a formal bug report to be made available to customers.

7.2.2 Testing the GUI

The GUI will require extensive testing in order to guarantee that the SmartFridge software is easy to use, and that all functions work as designed. Each button, screen, and function must be tested in as many ways possible, and feedback from focus groups will be used to improve the functionality and usability of the SmartFridge.

Home Gizmos does not have a partnership with any online grocers. In order to test the online shopping capability of the SmartFridge system, a simple test program will be written to simulate an online grocer and generate a response to the order. By investigating the purchasing methods of quick.com, an online grocer, it was determined that sending a fax or an email was a suitable way of ordering groceries. Therefore, the online test program will receive an email from the SmartFridge software and send a response so that we can confirm that the order was processed correctly.

To test each of the workspaces, appropriate data will be entered in order to fully test each function. As well, unexpected and non-intuitive (at least to the designers) actions will be implemented, and we will ensure that this does not cause data or functionality to be lost.

7.2.3 Testing the Database

To test the capabilities of the Database, a visual basic or C++ script will be written to fill up the data base with simulated values. Tests will be implemented to ensure the system operates when processing the maximum data volume stated in the functional specifications in order to ensure that performance does not degrade to the point where the SmartFridge is unusable or not user friendly.

In addition to testing the database when it is full, tests will be carried out with an empty data base to ensure that appropriate messages are generated when there is no data to process. The applications ability to recognize and correct errors in the data base will also be tested.



7.2.4 Additional Software Testing

To make certain that prospective users find the SmartFridge software practical and accessible, focus groups will be formed using a selection of people from the nearly computer illiterate to the confident user. User problems, comments and suggestions will be considered seriously and will be used to further improve the SmartFridge product.

To guarantee a robust application, all major functions will be tested using empty lists, recipe indices, etc. and the lists etc that are full.

Integration testing between hardware and software will insure that UPC codes can be reliably read in through the serial port. The UPC codes scanned as part of the hardware testing will be uploaded to the host computer, and must be properly received by the Scan workspace.

Computer crashes or power failures are a potential trouble spot. To simulate these problems, the test computer will be reset while testing each major function. If the computer is reset, we ensure that the amount of user data that is lost does not exceed any amount stated in the functional specifications. Careful analysis should be made to determine the degree of data loss and to further improve the program to avoid mishaps.

Conclusion

In this document, we have outlined many specific requirements that need to be met by the SmartFridge Home Inventory System. With the benefit of this framework, we will be better able to budget our time and resources towards what needs to be done. For the scope of our SmartFridge project, we will complete every function mentioned, with the exception of the functions that specifically are aimed at a production model. Therefore, for the SmartFridge project, we will have a working scanner wand and GUI software that will interface via a Serial Port.



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