Healthy Shelf: Interactive Nutritional Labels

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Abstract
"Healthy Shelf" is an interactive nutritional label system. User-centered design process was used to create the labels with HTML and JavaScript for deployment on kiosks attached to supermarket shelves. Users change the serving size on the nutritional labels and the labels then calculate nutritional values. The interactive labels also display comparisons of nutritional values. We evaluated a prototype of the system and found that participants liked the idea of using interactive nutritional labels while shopping and they make more accurate serving size.

Keywords
Health management, nutrition, nutritional label, interactive label

ACM Classification Keywords
H5.2.Information interfaces and presentation (e.g., HCI): User Interfaces--Prototyping

General Terms
Design

Introduction
Nutritional labels support healthy eating by providing nutrition facts about food products such as calorie

content and recommended daily values of nutrients. Health Canada has stated that healthy eating is a key component of personal health management, and can lead to better management of chronic diseases [7]. For some consumers, better choice of food products is especially important. For example, diabetic patients are encouraged to measure the amount of carbohydrates in their food using nutritional labels [2].

However, many people find contemporary nutritional labels hard to read and understand. They struggle to calculate changes to nutritional information on the labels according to serving sizes adjustments [8]. People often adjust the serving sizes when comparing products, since serving sizes are not consistent. In a survey of 200 patients visiting a health clinic, misinterpretation of the serving sizes and calculation errors were responsible for 601 out of 970 errors in half of the survey [8]. The survey was conducted with the US nutritional label design, which has a similar design to the Canadian nutritional label. When asked to make a serving size change, only 32% respondents correctly calculated the amount of carbohydrates in a bottle of soda [8].

Based on the shortcomings of printed nutritional labels, we designed the Healthy Shelf labels for display on kiosks next to supermarket shelves (Figure 1). Using a user-centered design process, we designed the labels for a wide range of users such as the primary grocery shopper for a family, students, new immigrants, and people with dietary restrictions. We evaluated a prototype of the labels to see if serving size calculations performed by the labels could help people to choose food products. We discovered that people may calculate more accurate daily values of nutrients in food products when using Healthy Shelf.

Figure 1. The interactive label on a supermarket shelf

Related work

Interactive labels present digital information about physical objects on electronic displays. Since digital information is in close proximity to the corresponding physical objects, Paul Yarin suggests that interactive labels are better at supporting tasks involving real-world objects than conventional desktop information systems [9]. Museums have used interactive labels to enrich exhibits with digital information for over twenty years [6].

A variety of technologies that are similar to interactive labels can present information about food products. Packaging manufacturer Graphic Packaging created "interactive packages" for chicken products that are scanned with a mobile phone for information [3]. People can use web sites like Nutri-Facts to make serving size calculations for food items [4]. But many people do not have powerful smart phones and web sites may not be designed for mobile web browsers.

Other than interactive labels and similar technologies, researchers have investigated ways to assist people to make food choices. The "Smart Kitchen" [1] displays nutritional information for meals by calculating the weight of ingredients added to meals. However, this system is not available when users make purchasing decisions among food choices. "NutraStick" [5] is a handheld barcode scanner that flashes a green light if scanned food is suitable for a user, but the device provides no nutritional details about the food.

Formative Study

We surveyed 22 adults, ranging in age from 19 to 59, using a questionnaire. Most respondents (59.1%) said that they compared two food products by holding nutritional labels side by side. About 50% said they had trouble recalculating daily values for serving sizes. The survey also revealed that the majority of respondents did not fully understand which nutrients are healthy or unhealthy for them. Additionally, sixteen respondents said they would like alerts for high sugar and fat, and thirteen were in favor of customizations for daily calorie intake based on their body type. When asked about the modality of a system to present nutritional information, 45% of respondents preferred interactive labels on the shelf while shopping.

User-Centered Design

Based on the formative study, we conducted a user-centered design of an interactive nutritional label.

We observed and interviewed three university students choosing food with nutritional information. The students narrowed down their choices of food items by personal preference, product marketing, and "rules of thumb", such as "avoiding chemical sounding ingredients". They turned to nutritional labels to assist with their final decisions among shortlists of food items.

We identified two important tasks that people perform when choosing food: (1) comparing products, and (2) avoiding specific ingredients. To address these tasks, we developed the following requirements for interactive labels:

- The user will be able to specify a variety of serving sizes for food products.
- The user can compare the nutritional details for two products, for a common serving size.
- The user will be alerted if the food product has a high content of "negative" nutrients, such as trans-fat or salt.

We developed a low fidelity prototype of an interactive label, based on these requirements, on small (5 by 3 inches) slips of paper. The low fidelity prototype provided several features: (1) serving size adjustment, (2) calorie diet adjustment, (3) text size adjustment, (4) explanations of label nutrients, (5) "drill down" for detailed nutrient content, (6) highlighting for high sodium, and (7) comparison of products. We evaluated the prototype in a supermarket with three participants, with ages ranging from 18 to 38. Each participant responded to two prompts:

- "Please find a breakfast cereal that you think is healthy and that you do not normally eat"
- "Please select some of the ingredients for a pasta meal such as noodles, sauce and a can of vegetables. Try to make this meal as healthy as possible, aiming for high fiber and low sodium"

The participants found the comparison feature intuitive. They found the feature to adjust serving sizes useful because serving sizes on contemporary (printed) labels were unrealistic and often required calculations. Two participants commented that they liked the existing black and white color scheme of contemporary (printed) labels because it made the label simple and easy to read. Based on the results of the low fidelity prototype evaluation, we concluded that adjusting serving size and performing comparisons were the most important features for a higher fidelity prototype. Since the participants liked the simplicity of a black and white label, we decided that a higher fidelity prototype should preserve the design of contemporary (printed) labels.

We considered three form factors for Healthy Shelf: (1) a hand-held device such as PDA, (2) a device attached to a shopping cart, and (3) a kiosk attached to a supermarket shelf (Figure 1). We accounted for our survey results, the feedback from the low fidelity evaluation and team discussions and chose to prototype a kiosk attached to a supermarket shelf, because:

- Not everyone owns a PDA. Moreover, PDAs have small screens and are inconvenient to hold while shopping.
- Thieves steal carts and supermarkets may find it complicated to power devices attached to carts. Not everyone uses a cart while shopping.
- Labels on the shelf can be larger.

Prototype

We created a high fidelity prototype of Healthy Shelf with HTML and JavaScript, using the jQuery library. Nutritional data for products was contained in XML files.

The Healthy Shelf label initially presents a user with a "home" menu of products found on a nearby shelf. We imagined users would prefer menu selections, instead of scanning a barcode to select a product, because they may not wish to bring products to the labels or they may have their hands full. After the user selects a product, the label shows nutritional information in a format similar to nutritional labels on printed packaging (Figure 2). When the user clicks an icon adjacent to the serving size (F1), the label presents an icon to select a serving size and then calculates daily values of nutrients based on the new serving size. The user can collapse information for fats and carbohydrates (F3). When the user clicks the compare button at the top right corner (F2), the home menu is displayed again to select a second product for comparison. The label places nutritional details of both products side by side in a single label by recalculating daily values for a common serving size.

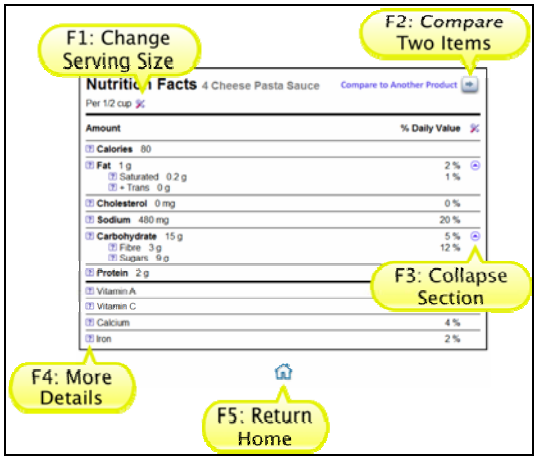

Figure 2. The interactive label for a product

User Evaluation

We compared the prototype of Healthy Shelf with reading contemporary nutritional labels to determine if people calculated the nutritional content of food products faster with Healthy Shelf, and if they preferred using Healthy Shelf.

We presented the prototype on an IBM ThinkPad X41 Tablet PC, with a screen size of 12.1 inches and a resolution of 1024 x 728 pixels. Users moved the computer mouse pointer and selected screen icons with a stylus.

We designed an experiment with nine participants to determine if the interactive labels could reduce the time taken and errors made when calculating daily values for different serving sizes and when making product comparisons. After a short session to familiarize the participants with the labels, each participant was asked to perform six tasks – three using Healthy Shelf and three by reading the contemporary label. The tasks required the participant to compare two food products and choose one product with the highest value of a certain nutrient. Some of the tasks required the participant to re-calculate the serving size for a certain nutrient. The participants were asked to read instructions for the task aloud and write their response on a slip of paper. We recorded the time from when they finished reading the instructions to when they began to write their response. We examined their response to determine if participants made the correct choice between the two products. After completing the six tasks, they completed a short questionnaire and answered interview questions about their preference for Healthy Shelf.

Since the tasks were not counter-balanced, we performed a between subjects mixed model ANOVA test of statistical significance that revealed no significant difference in the time to complete tasks by reading labels manually or using Healthy Shelf. We did not perform a single between participant mixed model for all six tasks because users did not complete all six tasks using a single method. Since we could not perform a within subjects evaluation of the time to complete the tasks, these results should be interpreted with caution.

The evaluation appears to reveal that fewer incorrect choices between two food products were made with Healthy Shelf (Table 1). The results show a higher error rate with Healthy Shelf for Task 6, but this may have been because one participant forgot to use the compare functionality. These results should also be interpreted with caution since the statistical significance of the errors has not been determined.

	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6
Manual	80%	100%	80%	40%	80%	80%
Healthy Shelf	100%	100%	100%	50%	100%	75%

Table 1: Percentage of correct choices between the two food products

The results of the questionnaire showed that most participants found it easier to adjust the serving size with Healthy Shelf, rather than with mental calculations. The lower error rates observed with Healthy Shelf support this. All participants felt that they would use Healthy Shelf when shopping for food.

Discussion

Our high fidelity prototype evaluation found that comparisons between food products are more accurate when using Healthy Shelf than when using conventional nutritional labels. The questionnaire results and interviews showed that users found serving size calculations easier with Healthy Shelf and would use these labels while shopping.

Future experiments that control for the time required to select products with interactive labels may show statistically significant advantages to comparing products with interactive nutritional labels.

With suggestions from participants and our observations, we developed design guidelines for interactive labels:

1. The "home" menu should have pictures of food products, instead of unrecognizable icons.
2. Interactive labels should be available on multiple modalities, such as kiosks, market carts, and PDAs.
3. The "home" menu should present virtual store aisles where users can find products by "walking" along the virtual shelves and selecting products.

Conclusion & Future Work

The Healthy Shelf project found that people liked using interactive labels to adjust serving sizes of nutritional information. We also found that these labels need to be at least as useful and convenient as reading the labels on the food packets. The next step for researchers is to define the vocabulary of interface elements for multi-platform labels, to explore techniques for interactive label association and release the wealth of digital information for real world items.

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