NUT: a Tool for Understanding the Nutritional Content of What We Eat

CPSC 533C 2011 Project Proposal
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DESCRIPTION

The NUT (Nutritional Understanding Tool) application falls within the domain of nutritional information. The goal of NUT is to help users answer the question "What's in my food?" and to assist them in making healthy choices about what to eat. To achieve this goal, NUT will to support the exploration of the nutrient content of common foods through the visualization of a high-dimensional nutritional database.

Previous information visualization applications in this domain have typically focused on understanding foods by looking at one or two nutrients at a time. These types of applications only support users in exploring and making food choices on a nutrient-by-nutrient basis, for example, by looking for foods that have the most protein. In contrast, NUT will give the user a high-level understanding of the nutrient composition of the food as a whole, with the option to drill down to more detailed information if needed.

This project will make use of the abbreviated version of the USDA National Nutrient Database for Standard Reference (USDA NNDSR), which is the main source of food composition data for the United States. The most recent version, Release 24 [9], describes a collection of 7906 different foods with 51 dimensions, which includes the mean nutrient values for 47 different nutrients.

PERSONAL EXPERTISE

I do not have an academic background in nutrition, but I am very interested in food and healthy eating. A source of inspiration for this project comes from Michael Pollan's *In Defense of Food: An Eater's Manifesto* [7], which investigates how the 'nutrionalism' ideology (the term that Pollan has coined for the West's obsessive study of nutrients in isolation) and the resulting health fads such as 'eat less fat' or 'eat more protein', have led to poorer nutrition and health. Pollan argues that in order to make healthy choices we need to think about nutrients in combination and in the context of the whole food, rather than studying them in isolation.

My desire to create NUT stems from an interest in understanding how my choice of foods affects my overall nutrition. I am also interested in learning more about the overall nutrient profiles of food so that I can make smarter substitutions in my diet for foods such as milk or meat, which I try to avoid.

PROPOSED INFOVIS SOLUTION

My proposed solution will likely consist of multiple linked views centered around a high-dimensional overview of the foods and nutrient compositions in the USDA NNDSR (Figure 1). Throughout the visualization food items will be color-coded by food group, likely using a repeating color scheme of 10-12 colors. The additional views will likely included a searchable list view of all the foods (organized by food group) and a detail view containing the complete nutrient totals and portions sizes for each food.

The overview will likely use a modified version of the Circle Segments technique [1], with stacked lines rather than pixels (Figure 2). Each of the 47 segments will represent one nutrient, and within each segment individual food items will be encoded with an individual line, stacked from inside to outside the circle in the order of least to most amount of the nutrient. I am choosing a technique that shows all the

dimensions at once because this best supports my goal of helping users understand the whole food, and I believe this will make NUT more accessible to a wider audience than other less straightforward options. The ordering of the segments will be determined automatically using similarity metrics if time permits.

Interaction in the overview will include mouse-over labeling and brushing of food items between all segments (Figure 1), and linked selection of food items from the overview or list view to trigger the display of details in the detail view. In the overview, users will also be able to turn on a comparison mode to supporting brushing a second food in order to facilitate comparisons (Figure 3). More detailed examples of how these interactions work can be found in the scenarios of use in the next section.

One concern surrounding the overview design is that the visual clarity and the mouse precision will be poor given the density resulting from the number of data points. To improve the user interaction, I will likely explore step-by-step navigation using the keyboard. I also have a few ideas in mind for improving the visual clarity if necessary. These alternatives include implementing guaranteed visibility, or adding a segment view (inspired by the block view in MizBee [6]), which would allow the user to zoom in on a single nutrient (Figure 4). A third, less desirable alternative, would be to use a denser pixel display instead of lines to encode the individual food items.

Scenario of Use
A common scenario of use for NUT will be gaining a better understanding of the nutrient profile of a food, and to look for similarities or dissimilarities in the nutrient profiles of two foods. This includes searching for food replacements; for example, a lactose intolerant user looking for replacements for milk. In this scenario the user begins by selecting the food they wish to replace from the list view. The food is highlighted in the segments of the overview and the nutrient composition details are displayed in the detail view (Figure 1). The user then activates the comparison mode; the selected replacement food remains highlighted while the user brushes foods with the comparison highlighting (Figure 3). This allows the user to quickly look for foods where the highlighted lines are close together in a large number of segments, indicating similarities in the nutrient composition.

Another scenario involves understanding the range of nutrient compositions in a given food group because, for example, not all vegetables are created equal. In this scenario the user begins by looking for the vegetable food group in the overview, which is color-coded by a dark green (Figure 2). The user notices in many of the segments most of the dark green lines are close together, but in the calcium, beta-carotene and vitamin C segments, there are two very distinct dark green groups that are far apart. By brushing over the items in the two groups the user notices that while the inner groups consist of a wide variety of vegetables, the outer groups consist of mostly similar plants from the Brassica family.

Proposed implementation approach
 NUT will be implemented for web deployment. I am planning to use either Protovis [8] or d3.js [3]: I have quite a bit of previous experience in web development, and a solid understanding of Javascript, CSS, and DOM, so I think I will be comfortable learning either one.

MILESTONES
Week 1 (10/29 – 11/4)
  - exploration of Protovis and d3, and development of hello world projects; make final decision on which to use.
  - clean and format data
Week 2 (11/5 – 11/11)
  - implementation of overview based on sketches

- implement brushing and tooltips for overview

Week 3 (11/12 – 11/18)
- if required, implement segment view (or other overview alternatives)
- implement detail view
- implement food selection panel

Week 4 (11/19 – 25)
- finish linking together views
- implement highlighting based on selection panel interaction

Week 5 (11/26 – 12/2)
- implement similarity reordering for dimensions (time permitting)
- code freeze

Week 6 (12/3 – 12/10)
- work on final presentation/report

Week 7 (12/12 – 12/14)
- give final presentation
- complete and submit final report

RELATED WORK

A few other visualization have been developed using the USDA NNDSR, but none support high level exploration of food composition or facilitate the comparison of whole foods, and instead tend to focus on the properties of individual nutrients. Lonely datum's *Visualizing Nutrition* [4] allows the user to view a summary report for each nutrient in the data base, including visualization of the top 8 foods containing that nutrient and an ordered, size encoded view of all of the food groups and foods by nutrient type. A strength of this visualization, which NUT could potentially leverage in the future, is the integration of daily recommended intake values that gives users useful context for making food choices. An anonymous visualization on Many Eyes titled *Treemap of USDA National Nutrient Database* [5] visualizes the dataset in a tree map of food groups, where the user can specify a nutrient to be encoded by size, and a nutrient to be encoded by color. This is effective in visualizing all the foods at once, but only allows users to compare two nutrients at a time.

Inspiration for the overview design was drawn from Ankurst et. al's discussion of using similarity metrics for dimension ordering in a number of examples, including the circle-segments technique [[2]].

BIBLIOGRAPHY

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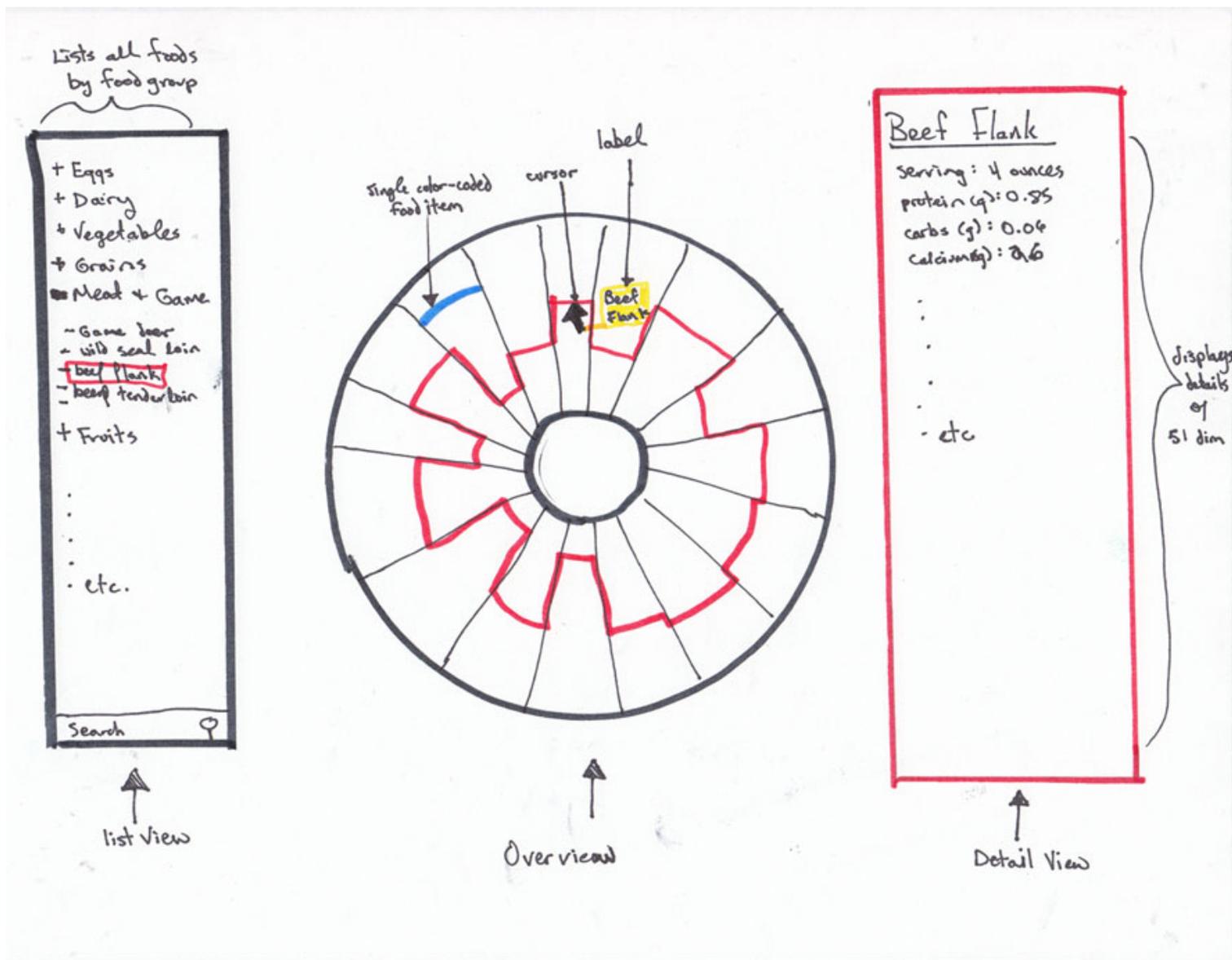
Figure 1: Sketch of NUT. Main components from left to right: list view, overview, detail view. Segments represent nutrients; Food items are shown as stacked lines within each segment. Only one food item is shown here as an example.
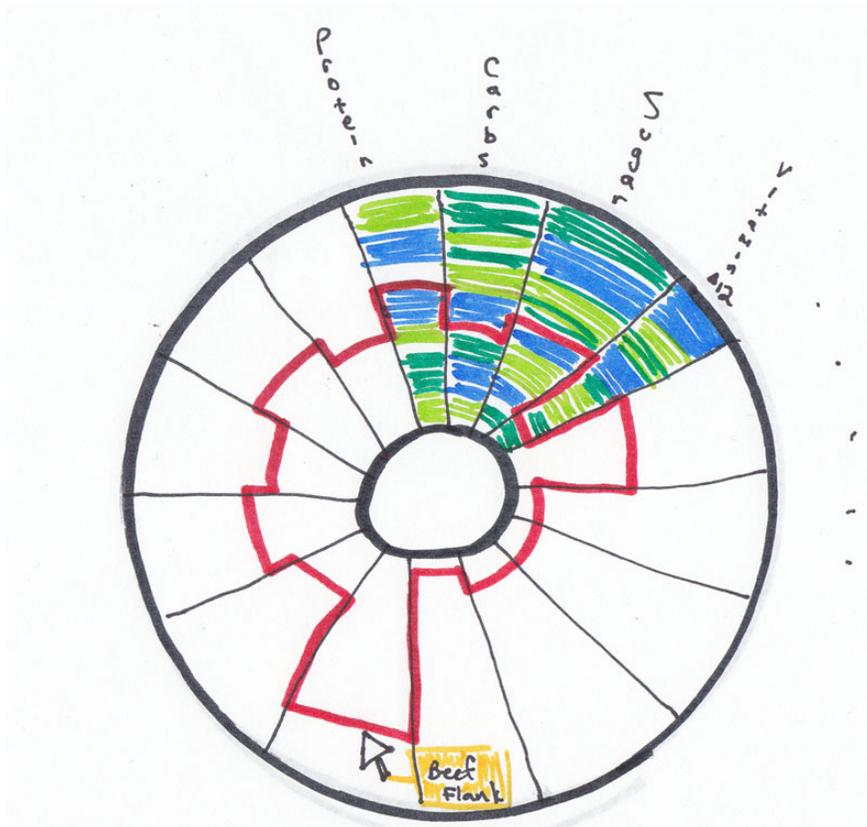
Figure 2: Overview panel. Shows stacked food items within 4 labeled nutrient segments; other segments removed for clarity. Brushing over an item in one segment highlights that food in the other segments
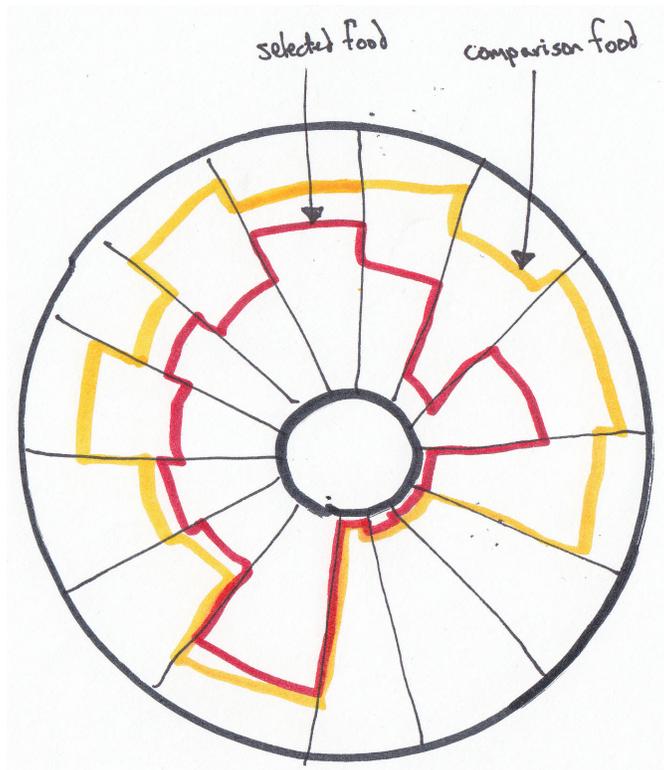

Figure 3: Overview panel, showing selected food highlighting (red) and comparison food highlighting (yellow). Food items removed for clarity.
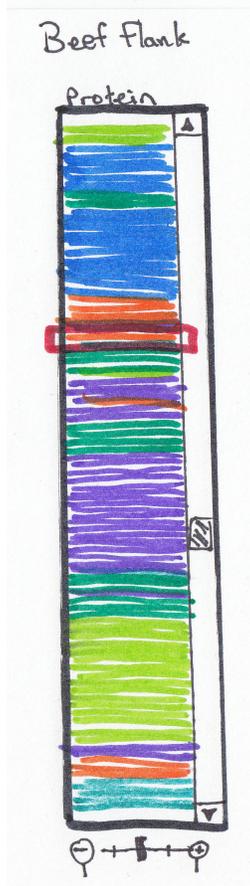
Figure 4: A zoomable segment view would allow users to zoom in on the details of a nutrient.