NutriStat: Tracking Young Child Nutrition

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Abstract
Our childhood eating patterns strongly affect our lifelong health. Recently, type II diabetes emerged as a national health crisis in America that can be prevented almost entirely by improving the quality of child nutrition. In this paper, we describe the scenario-based design process used to build NutriStat, a system for tracking young child nutrition for children with multiple caregivers. NutriStat empowers parents to collaboratively monitor a young child's diet and consequently provide more well-rounded nutrition.

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Introduction – The Problem Context
Poor nutrition is an international crisis. Health problems such as obesity, anemia, and type II diabetes can result from months, years, or entire lifetimes of poor diet. In January 2006, The New York Times featured a four-part article on the diabetes epidemic, citing that nearly 21 million Americans are believed to be diabetic [5]. Most dietary scientists agree that the eating patterns we learn as children dictate the eating patterns we manifest as adults. For this reason, the topic of young child nutrition should be central to any discussion of world health.

A "young child" is a between ages three and five. This is an important time in a person's life because it is when the majority of humans learn to feed themselves. Unfortunately, most young children do not think about the ramifications of their food choices. John Piaget's model of child development and learning asserts that young children are still working towards abstract and concrete thinking [1], a skill that is necessary for considering the future effects of one's eating.

The problem of poor nutrition is compounded when we consider parental involvement. 67% of U.S. mothers with children under five also work full-time [4]. This statistic informally implies that most children are fed by busy adults. Unfortunately, it is too easy for good nutritional choices to compromised by time constraints and budgetary concerns.

It seems as if the impetus lies on parents of young children to provide a healthy food environment and actively reinforce good dietary patterns. This can be difficult when we consider the problem of "multiple food providers." This is to say, many adults collaborate to feed one young child. In a normal day, a child might be fed breakfast by one parent, lunch by a day-care provider, and dinner by yet another parent. Ideally, each adult is aware of the others' choices, but often this is not the case. Surely, it is difficult for a young child to receive a well-rounded set of meals without active collaboration among these adults.

A system needs to be devised that allows parents and caregivers of young children to collaboratively track their child's diet. The solution should be extensible to different settings, such as preschool, home, and day-care. Furthermore, the solution interface should seamlessly integrate into the context of use.

One might argue that parents can determine what their child ate simply by asking the child. This is certainly true, but verbal communication alone does not allow for longitudinal analysis. Many diseases, such as type II diabetes, result from long-term dietary patterns that are best understood with long-range record keeping.

Scenario-Based Design

As students in Prof. Anthony Hornof's user interface class (University of Oregon CIS 543), we employed a scenario-based design pattern (SBD) [3] to explore the problem of health and nutrition. Our goal was to identify important health and nutrition problems that might be ameliorated with technology. We interviewed food-bank administrators, parents of young children, a pediatric nutritionist, and an expert on the topic of fast-food media. After digesting these conversations, we decided to focus our attention on the problem of young-child nutrition.

Field Studies

As part of the SBD process, we observed mealtime routines for three families. In all three studies, parental work schedules forced the children to be fed by different adults at different times during the day. In two of the field-studies, the children lunched at daycare, which introduced yet another caregiver. Our field studies were not comprehensive, but they were revealing. Most importantly, we learned that the distributed nature of nutritional decision-making can be a large source of frustration for many parents. Space limitations prevent a more detailed discussion of our results. However, it is interesting to note that each caregiver in our study said that they make an honest attempt to serve "healthy" food, but their decisions are usually impromptu and not necessarily part of a larger nutritional scheme.

From our field studies, we created several scenarios surrounding the task of feeding a young child. These scenarios identify hypothetical stakeholders (parents, children, or other caregivers), the settings (homes, daycare centers), and the artifacts (grocery lists, kitchen supplies, pantries, etc). The scenarios reveal that a caregiver often answers two questions before feeding a child:

1. What did this child already eat?
2. What should I feed this child next?

It is a reasonable assumption that most parents are well-equipped to answer the second question, but often cannot answer the first.

The System Tasks

In response to the problem of collaborative child nutrition, we decided that our system should support the following tasks: Record the food that a child consumes, retrieve "quick" data (high-level nutrition summaries), and retrieve detailed data (in-depth nutritional histories)

We debated a variety of social and context issues, such as what technology is usually available when these tasks are underway. Our previously developed scenarios emphasize the importance of completing the system tasks in a timely manner and with minimal interruption of normal routine.

Information Design

Before we designed any tangible part of our system, we enumerated the types of information that would be necessary to support our system's tasks. The activities that we want to support dictate the types of information that the system requires. This step is important because it bounds the scope of our project and is a necessary prerequisite to designing an interactive system.

Our interviews with stakeholders suggested that the system should allow for multiple children and for multiple caregivers. For each child, the system should maintain a history of consumed foods. Each record should contain food-type, quantity, who served the food, and when the food was consumed.

Initial Designs

Next, we were ready to consider the interactive elements of the system. The most important consideration at this stage was to develop a system that fits into the context of use: the busy lives of busy parents. Our field study participants said that any system we design should be easy-to-use. They also mentioned that an ideal nutrition-tracking system should not severely interrupt their daily routine.

At this point, the design process presented several questions: What types of technology will the system use? How will the system visually display information? How will the system provide for user input?

In response to these questions, we devised a surplus of ideas. Some schemes involved portable digital assistants (PDAs), voice-activated wrist-watches, and cellphone wireless area protocol (WAP) technology. Although some ideas were imaginative beyond reality, these brainstorms are not without merit. Many wild ideas have a kernel of quality that can be extracted into other more feasible ideas.

Many of our system ideas contained a reoccurring design element, which we call the "food-pyramid analysis." This tool provided quick information about a child's recent dietary consumption. The pyramid analysis is based on the official food pyramid, published by the United States Department of Agriculture (the USDA). The food pyramid recommends daily serving limits for the six food groups. The NutriStat pyramid displays a child's current nutritional status in terms of the USDA food pyramid. This tool also serves to remind and reinforce well-rounded nutrition habits. An obvious question from the user's perspective is, "what is a serving size?" The USDA food pyramid outlines portion size, and we consider this to be part of the knowledge required to use the pyramid with or without NutriStat.

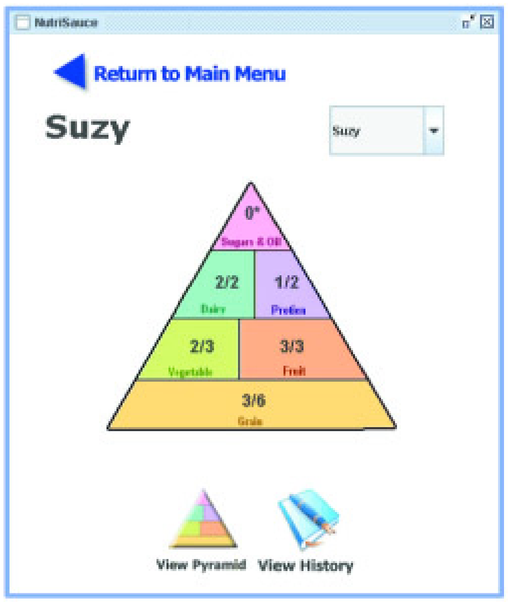

Figure 1: One of our re-occuring design ideas was the "food pyramid analysis," which displays serving consumption in the form of the USDA's food pyramid. In this example, Suzy ate two of her three recommended vegetable servings.

Paper-Based Prototypes

We distilled our ideas into two system concepts: a cellphone-based application that uses WAP and a Java-based application that can be deployed on a variety of hardware. We developed paper-based prototypes for both of these systems. Figure 2 shows the paper-based cellphone prototype. Paper-based prototypes consist of a series of pre-fabricated cutouts that represent various states that occur during system use. Although paper-based prototypes require some imagination from users, they are a good tool for quickly and inexpensively obtaining design feedback.

Evaluation of the Paper-Based Prototypes

We assembled four participants to test our paper-based prototypes. Our goal was to discover the strengths of both systems, in hopes of developing a single working prototype. Each participant was asked to use the prototypes to accomplish a battery of tasks, such as:

"Imagine that a child in your care, named Alice, just ate one cup of applesauce. Please enter this information into the system."

Or,

"Please determine what Judy ate for lunch yesterday."

Figure 2: We developed paper-based prototypes for our initial system designs. Pictured here are the paper cutouts for the cellphone-based system.

We followed Apple's "Ten Steps for Conducting a User Observation" [2] and asked our participants to "think aloud" about what comes to their mind as they worked with our prototypes. The results were surprising and useful. All the participants resisted the cellphone-based system because the impoverished interface made for difficult data-entry. Specifically, text-input usually requires finessed thumb gymnastics and the small screen-space limits the amount of information that can be displayed at any given moment. Although our particular cellphone-based implementation was not a success, it should be noted that mobile phones have many merits. Possibly, a future version of NutriStat will include a more feasible cellphone implementation. Our pyramid-analysis tool was well received, but several of the participants suggested that our food pyramid should be interactive.

The Working Prototype

We incorporated the user feedback from the first prototype evaluation, we deferred the cellphone-based system for future exploration, and we developed a working Java-based prototype. We chose the Java Virtual Machine because it offers a good compromise between portability and ease-of-deployment. In many ways, building a Java-based prototype is similar to building a paper-based prototype. Both versions present design decisions in an imperfect, but usable fashion. We refer to our Java prototype as a "working prototype" because it offers a level of interface fidelity that can closely approximate the experience of using a final product.

Evaluation

We evaluated the working NutriStat prototype with four "novice" participants. That is, they had no prior experience with the NutriStat system. All the participants were parents or caregivers of children. The test setup was similar to the earlier paper-based evaluation: We asked participants to complete a short battery of system tasks and to think out-loud while doing so. We videotaped the sessions, which allowed for detailed post-evaluation analysis.

The results of our evaluation are mixed. Although NutriStat supports the system tasks surrounding collaborative monitoring of young child nutrition, it does so rudimentarily. Our decision to use Java allowed us to quickly develop a prototype. However, what we developed was just that: *a prototype*.

Our biggest concern is that NutriStat, in its current state, is difficult to deploy in a real-world context. An ideal version of NutriStat requires a hardware infrastructure beyond the financial means of our project. Such a system might be web-based with a user interface through wireless PDAs. However, our scenario-based design work leads the way for future iterations of NutriStat.

Figure 3: In our working prototype, users (parents) can view a detailed nutritional history for their child.

Conclusion

NutriStat was designed using the scenario-based design pattern. With SBD, much time and effort is invested in the early development stages to better understand how the users will interact with the system. The design focus is shifted away from the internal details of the system and onto task-oriented system usability. SBD emphasizes building systems that support *users accomplishing tasks*.

The problem of young child nutrition is foundational to any discussion on national health and well-being. Type II diabetes is one such crisis that can be improved with better pediatric dietary patterns. Although NutriStat is not entirely deployable, there exists a need for systems that address child nutrition. NutriStat is a good first step to attacking one aspect of the problem: parent accountability for dietary decisions.

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