PROJECT: HEALTH DASHBOARD

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PROJECT OVERVIEW

The Health Dashboard was my senior year capstone project for my major in Engineering Psychology at Tufts University.

The goal of this project, which was sponsored by Cambridge Consultants, was to explore the needs of elderly people living in assisted living facilities and their caregivers. In particular, there was an emphasis on developing an understanding of how these residents and their caregivers, such as their families and health-care providers, manage the day-to-day and long-term health of the resident.

This project was completed in collaboration with four other Tufts students: Andrea Dwyer, Leslie Johnston, Emily Maretsky, and Dale Chesney. We were advised by a project team from Cambridge Consultants and by Ryan Kilgore.

This project began in January 2010 and was completed in May 2010.

BACKGROUND RESEARCH

This project focused exclusively on the needs of the elderly and their health-care providers. As such, our first step in learning more about these users was to analyze existing information about health concerns and practices for the elderly, in addition to technology use by both health-care providers and patients.

Many long-term health issues can affect people later in life.

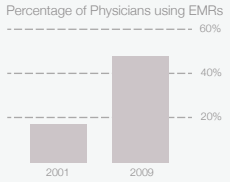
The leading causes of death for older persons are (in order) heart disease, cancer, stroke, chronic lower respiratory diseases, accidents, and diabetes.

Providing health-care to an elderly person often involves collaboration between a number of groups.

Both informal caregivers (families, friends, volunteers) and health-care professionals (physicians, nurses, health organizations) play a pivotal role in the health of an individual.

The use of electronic medical records systems is increasing at a rapid pace.

Data collected from physicians by the CDC indicates that, in the past ten years, usage of these systems has more than doubled. This data also suggests that adoption rates are going to continue to climb.



The use of electronic monitoring and record-keeping technologies is linked to positive health outcomes.

Use of these technologies has been shown to reduce hospitalizations, decrease the number of days spent in the hospital, and increase the quality of patient care.

EXISTING SYSTEMS

Our project sponsors were interested in learning more about how a health information system could be integrated with external, third-party sensors. These sensors could be used to collect health data, such as physical activity and heart rate, that could help physicians learn more about a patient's health history. Additionally, another benefit of these external sensors is that they could track a patient's compliance with crucial tasks including taking medicine and checking blood sugar levels.

Withings Wi-Fi Connected Scale

The Withings wireless scale measures weight, body fat, and body-mass index. After a user steps on the scale, it uses wifi to send this information to its servers. This device is relatively affordable ($159) and costs about two to three times more than a traditional scale.

Proteus Raisin Health Monitor

The Raisin Heart Monitor by Proteus is a cell phone sized device that sticks to the skin using an adhesive bandage. It measures heart rate, physical activity, and body position. It transmits information using BlueTooth and can communicate with BlueTooth enabled devices.

Polar Heart Rate Monitor Watch

The Polar Heart Rate Monitor is a watch that can be used to track heart rates and calories burned. Polar offers a wide range of watches with varying functionality. Data from their higher-end watches can be transferred from the watch to a computer.

FitBit Pedometer

The FitBit Pedometer is a battery-sized devices that can clip onto clothes or be carried in a pocket. It can track steps taken and calories burned during exercise. It costs less than $100 dollars.

FOCUS GROUPS

We held two focus groups, each with five residents at Brookhaven at Lexington, a retirement community in Lexington, Massachusetts. The participants in our focus groups were self-selected members of the technology group at Brookhaven. The goal of the focus groups was to collect information about the resident's health-related activities, medical concerns, and their experiences with computers and other technology.

INTERVIEWS WITH CAREGIVERS

We also conducted informal interviews with caregivers who work at Brookhaven in order to learn more about their experiences using health monitoring systems and electronic record systems.

During these interviews, the caregivers also shared their perspectives regarding technology adoption by elderly residents and the impact of technology on their lives.

FACILITIES

We were also able to take a guided tour of the Brookhaven facilities during our visit. During the tour, we saw some of the shared spaces at Brookhaven, including a library, dining rooms, exercise facilities, and the health center. This tour helped us learn more about resources available to residents and the types of activities participated in by residents.

FINDINGS AND REQUIREMENTS ANALYSIS

The information collected as a part the focus groups, interviews, and tour were then analyzed and used to develop a set of guidelines for the development of the Health Dashboard.

Elderly Users

The system should:

- accommodate different stages of life.
- be straight-forward to navigate.
- assist with urgent health concerns.
- not require the use of an electronic device in public.
- allow users to control access to information.
- present users' medical information both at a single point in time and as a trend.

Caregivers

The system should:

- allow sharing of information with both formal and informal caregivers.
- give caregivers a quick overview of a person's health status.
- allow caregivers to receive urgent information, including emergency information.
- help caregivers track difficult metrics.

Functional Requirements

The system should:

- have the ability to interact with wired and wireless sensors.
- serve as a reference for health concerns.
- not serve as a diagnostic tool for residents.
- allow for users to enter information quickly.
- present a clear navigation structure.
- streamline the communication of information between residents and caregivers.

Physical Requirements

The system should:

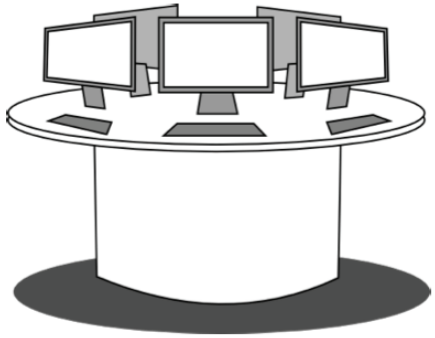
- be easy to hold and carry.
- have an adjustable screen angle.
- include physical controls (not just soft buttons).
- not look like a computer.
- have a large screen.
- fit in a pocket or purse.
- be easy to use while standing.

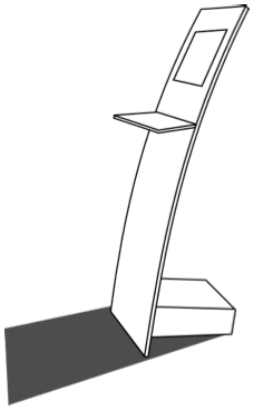
DESIGN CONCEPTS

Based on the information provided during the focus groups and interviews, we developed four initial concepts.

The Kiosk

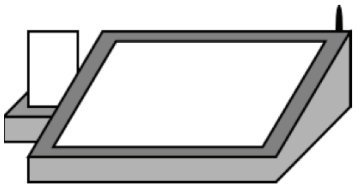
The kiosk is a communal health dashboard system located in a central area of a hospital or residential facility. Kiosk users could access their health data and also use sensors, such as blood pressure monitors, that are located with the kiosk. The kiosk is a cost effective system, as the cost for both the kiosk and any additional sensors could be shared by a number of users.





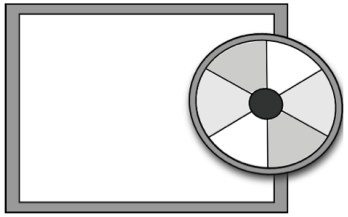
The Dock

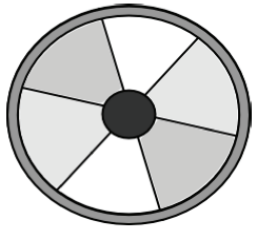
The dock is a tabletop device that allows users to view and update their health information. The dock is accompanied by a small handheld device that can be used for access on-the-go. A strength of this design is that it could be customized for individual users, who could buy sensors to track health information relevant to their medical concerns.



The Dial

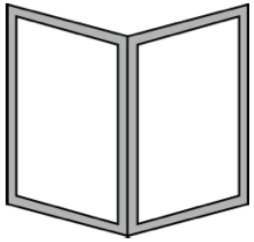
The dial is a circular handheld device. This design concept is larger than a clam shell phone but small enough to fit into a purse or pocket. At the center of the dial is a physical rotary control, which may be more familiar to elderly users than a touch screen control. The shape of the dial limits the amount of information that can be displayed and would be best paired with a larger device, such as the dock

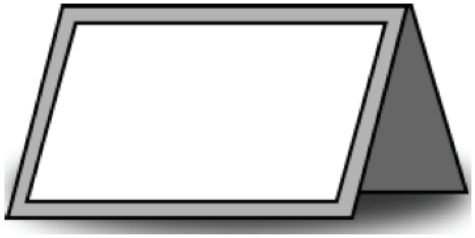




The Folio

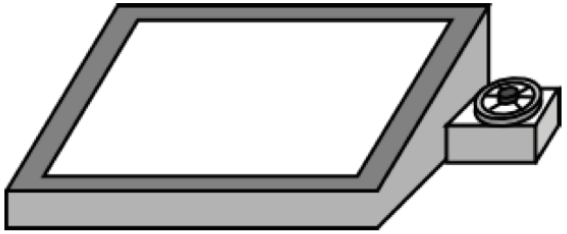
The folio is a foldable, book-sized device. It is comprised of two screens, connected by a hinge. Depending on the information being displayed, the interfaces images could expand to fill both screens. The screens could also display other information, such as family pictures, when not in use.





CONCEPT SELECTION

For this project, we chose to move forward with a system that combined the hand-held dial and the dock. Both the dial and dock looked significantly different than a traditional computer, a quality that was emphasized by the elderly residents in our focus groups. This design gives individuals the opportunity to decide whether to share the dock with others, each of whom would have their own hand-held. In this way, users could make their own judgements about security and cost. Additionally, this design provides users with the ability to access and input information both on the go and while at home.

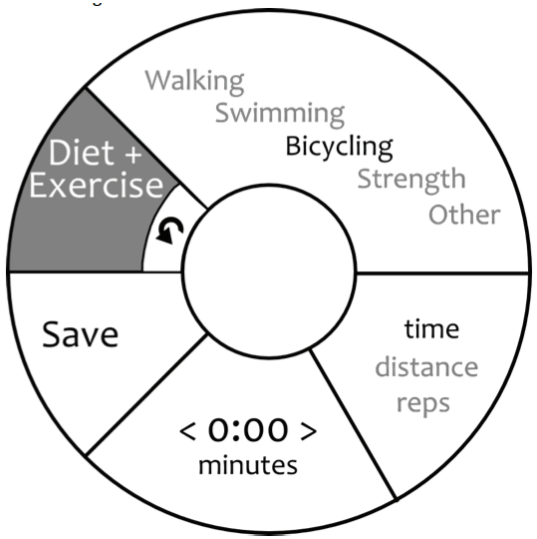


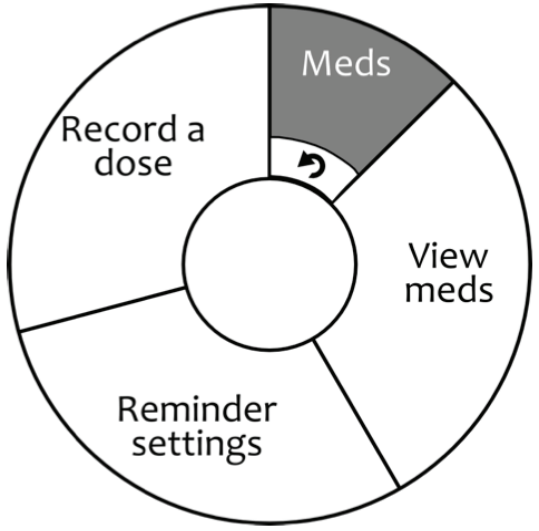
PHYSICAL PROTOTYPING

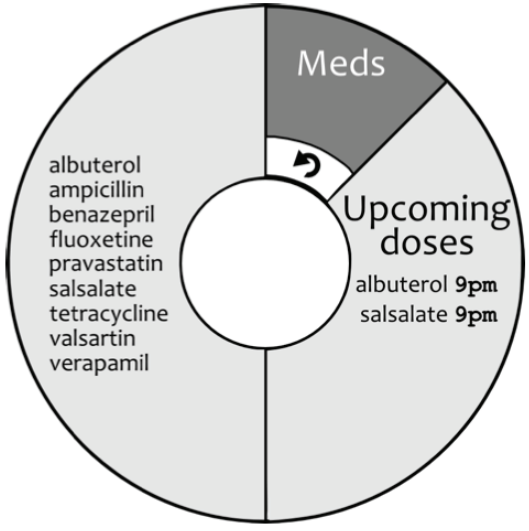
We developed a low-fidelity prototype of this system using cardboard and poster stock.

DIAL WIREFRAMES

Clockwise from the top left, these are wireframes of: the main menu, the interface for recording physical activity, the medication menu, and a medication information screen.

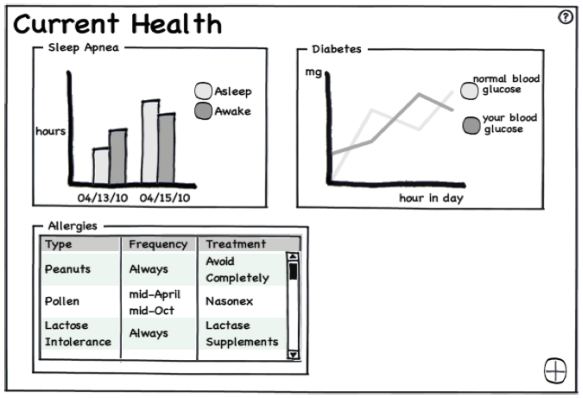


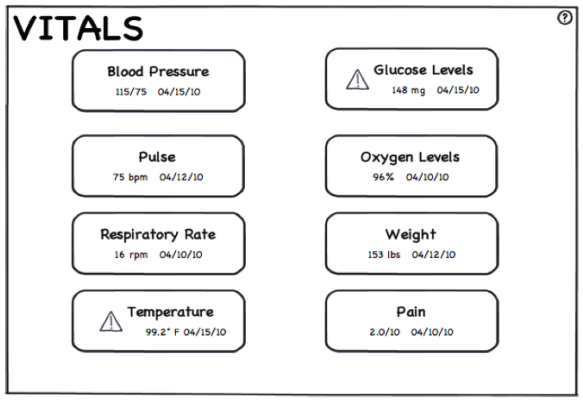


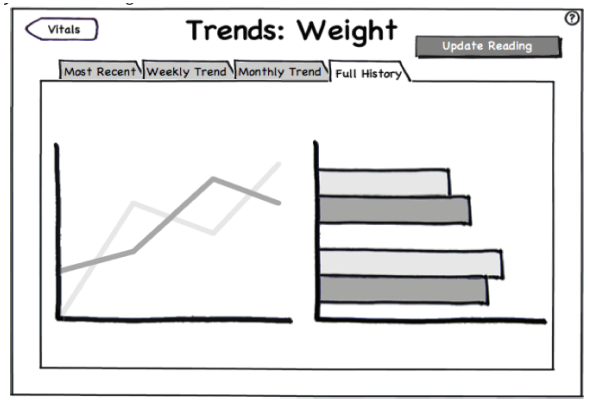


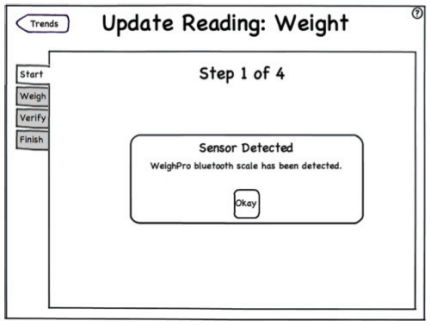
DOCK WIREFRAMES

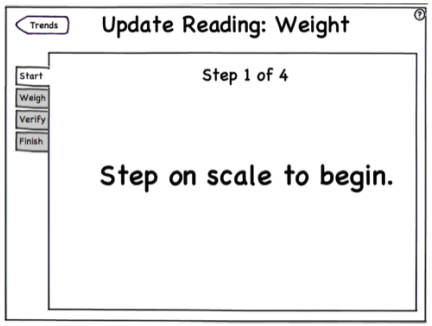
These wireframes are representative of what users would see when using the dock. The top row contains wireframes that are related to the visualizations and information that users could see using the dock, such as an overall assessment of a user's health, notifications about abnormal conditions, and trends over time. The second row illustrates the process of using a third party sensor (in this case, a wireless scale) with the device. Using external sensors can be difficult and, in order to minimize confusion, the system provides a simple set of instructions and feedback to users as they complete this process.

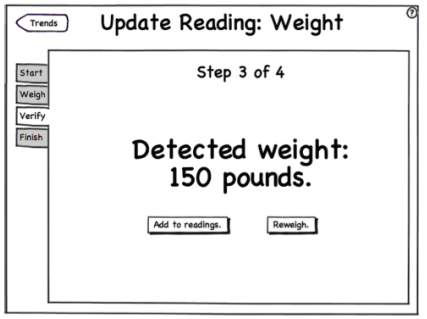






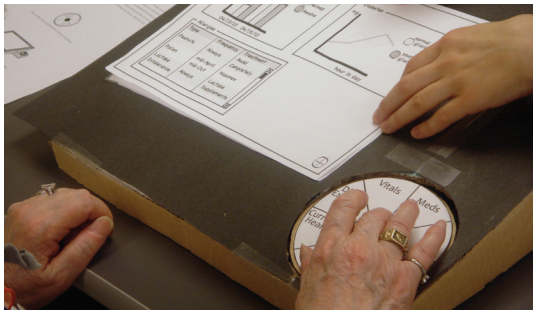


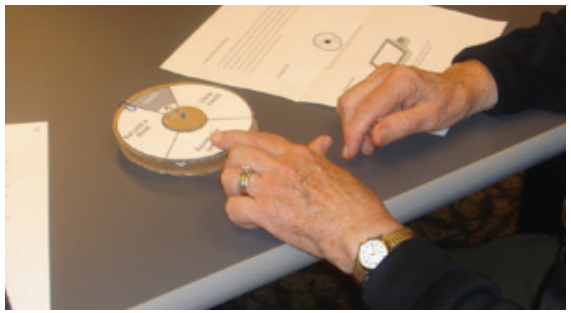




USER EVALUATION

Using the physical prototype we developed, we again visited the Brookhaven site to work with a group of elderly residents. These residents were asked to complete four tasks using our prototype, (1) to retrieve their list of current medications, (2) to record having completed a 20 minute run, (3) to record their weight using a wireless scale, and (4) to answer questions about their sleeping habits. While doing so, users were asked to talk aloud and provide feedback.





GUIDELINES FOR FUTURE WORK

We then analyzed the written and verbal feedback provided by the residents, in addition to our own observations. We used this information to create a set of actionable design recommendations for future versions of the system.

Allow for customization.

Both caregivers and residents stressed the importance of being able to customize the content available in the system and its interface to reflect individual physical limitations and health concerns.

Avoid ambiguity.

The residents were uncomfortable using interface elements that did not have a clear outcome. Menu items and icons should convey information about what lies beneath.

Adapt to existing lifestyles.

The system should reflect the habits and routines that play a pivotal role in the care of adults with health issues or who are living in senior communities.

Track appropriate metrics.

Health conditions can vary greatly from person to person and it is important to provide both patients and caregivers with the appropriate information and tools to collect that information.

Encourage continued use.

In order for the system to have value to both caregivers and patients, it is important that both parties are active users.

CONTINUED WORK

After providing our final report to Cambridge Consultants, they have continued to develop the Health Dashboard. The pictures below show work they've done since we completed the project.

PUBLICITY

These links provide additional information about the project and future work in this domain by Cambridge Consultants.

Putting the patient first: students work with elderly to define the next stage of the connected health revolution.
http://www.cambridgeconsultants.com/news_pr278.html

Creating user friendly medical technology
http://www.governing.com/topics/health-human-services/creating-user-friendly-medical-technology.html