Chapter 2.5
Interpreting Health and Wellness Information

Lena Mamykina
GVU Center, Georgia Institute of Technology, USA

Elizabeth D. Mynatt
GVU Center, Georgia Institute of Technology, USA

ABSTRACT

In the last decade, novel sensing technologies enabled development of applications that help individuals with chronic diseases monitor their health and activities. These applications can generate large volumes of data that need to be processed and analyzed. At the same time, many of these applications are designed for non-professional use by individuals of advanced age and low educational level. These users may find the data collected by the applications challenging and overwhelming, rather than helpful, and may require additional assistance in interpreting it. In this chapter, we discuss two different approaches to designing computing applications that not only collect the relevant health and wellness data but also find creative ways to engage individuals in the analysis and assist with interpretation of the data. These approaches include visualization of data using simple real world imagery and metaphors, and social scaffolding mechanisms that help novices learn by observing and imitating experts. We present example applications that utilize both of these approaches and discuss their relative strengths and limitations.

INTRODUCTION

Rapid developments in the sensing technologies lead to the introduction of sensors and object auto-identification in new areas of human life and activities. One such area that became a topic of extensive research is healthcare. In the healthcare domain, auto-identification takes a form of health and wellness monitoring and applies not only to objects, but also, and even more commonly, to activities, and to bio-indicators of individuals' health. For example, new sensing techniques attempt to determine individuals' diets by audio recording chewing sounds (Amft et al, 2006); individuals' interactions with RFID-tagged objects is used to infer the activities they engage in (Intille, 2003), and various sensors are designed to monitor new

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and traditional vital signs, such as heart rate, blood glucose, or gate.

Oftentimes, introduction of these new sensing techniques can lead to an exponential growth of the volumes of data available for interpreting. At the same time, many of the monitoring applications that utilize such sensors are designed in context of chronic disease management and are meant to be used by lay individuals and their non-clinical caregivers. As a result, the attention of researchers is starting to shift from sensing technologies to ways to incorporate these data into individuals' sensemaking and decision-making regarding their health and disease. After all, the richness of the captured data is of little value unless it can inform decisions and empower choices.

In this chapter we discuss two distinct approaches to enhancing the utility of auto-identification data for lay individuals, discuss recent research projects that utilize these approaches and compare and contrast their advantages and disadvantages. The two approaches we focus on are: 1) introduction of novel data presentation techniques that facilitate comprehension and analysis of the captured data and 2) incorporation of social scaffolding that helps individuals acquire skills necessary for data analysis by learning from experts.

We will begin our discussion by introducing three applications that utilize novel visualization techniques to represent health-related information captured by sensors. These applications include Digital Family Portrait (later referred to as DFP, Mynatt et at, 2000) designed by the Graphics, Visualization and Usability Center of the Georgia Institute of Technology, Fish 'n' Steps (Lin et at, 2006) designed by Siemens Corporate Research, Inc. and UbiFit Garden (Consolvo et at, 2007) designed by Intel Research, Inc. All of these applications use sensors to collect health or wellness data and rely on a particular approach to visualizing the resulting data set, namely they use metaphors of real world events or objects to assist in comprehension.

An alternative approach to facilitating analysis of health data captured by ubiquitous computing applications is by providing social scaffolding mechanisms. One example of such applications is Mobile Access to Health Information (MAHI, Mamykina et al, 2006) designed and developed by the Georgia Institute of Technology and Siemens Corporate Research, Inc. In contrast to DFP, Fish'n'Steps, or UbiFit Garden, MAHI uses relatively simple data presentation techniques. However, it includes a number of features that allow diabetes educators help individuals with diabetes acquire and develop skills necessary for reflective analysis of the captured data.

Evaluation studies of the applications we describe here showed that all of them were successful in reaching their respective design goals and led to positive changes in behaviors or attitudes of their users. While these studies did not specifically focus on data comprehension, such comprehension was the necessary first step in achieving these positive results. In addition, our own experiments comparing different types of visualizations showed that not all of them are equally effective. However, we believe that novel visualizations and social scaffolding have their unique advantages and disadvantages that need to be considered when making a choice as to which strategy to follow. In the rest of this chapter we describe the applications mentioned above in greater detail and talk about the results of their deployment studies. We then describe our attempts to evaluate the effectiveness of different types of data visualization. We conclude with the analysis of comparative advantages and limitations of the two approaches.

VISUALIZING HEALTH INFORMATION

As the world's elderly population increases in numbers, chronic diseases common to older adults stretch the capacity of traditional healthcare. As a