Promoting a Healthy Lifestyle Through a Virtual Specialist Solution

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CHI 2006, April 22–27, 2006, Montréal, Québec, Canada.
ACM 1-59593-298-4/06/0004.

Abstract
As reported by the World Health Organization (WHO), malnutrition is a health problem faced by many nations around the world. In Mexico around 50% of adult population is obese; this in turn situates people on risk of contracting other diseases such as diabetes, and hypertension. To address this problem, one of the main institutes of health in Mexico has implemented a program for preventing diseases related to bad feeding and physical activity habits. In our aim to provide a technological solution to help people with such problems, we conducted a field study around this program to envision and inform our design. We propose a Virtual Specialist (VS) that stays with the patient and advice him at all times on issues related to keeping diet and exercise programs. We argue that patients that use this solution would feel more motivated to keep working on their programs, since they get a feeling of being personally attended.

Keywords
Diet and exercise habits, obesity, healthcare systems, human computer interaction

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

As reported by the World Health Organization (WHO), malnutrition is a health problem faced by many nations around the world. WHO affirms that the key causes are increased consumption of energy-dense foods high in saturated fats and sugars, and reduced physical activity [1]. The Organization for Economic Co-operation and Development (OECD) reports in the last study that The United States of America, Mexico and United Kingdom are the top countries with this problem [2]. In accordance with the Mexican Institute of Health, around 50% of adult population is obese. Nowadays diabetes type 2, hypertension and obesity are a public health problem in México, and great part of the health spending is focused in these diseases and its complications [3]. The Instituto Mexicano del Seguro Social (IMSS) is the main public health organization in Mexico, attending more than 50 millions of affiliated people. The IMSS recently implemented PREVENIMSS, a national program for education and prevention of diseases caused by malnutrition and obesity. PREVENIMSS works by organizing informational sessions about the risks of keeping sedentary life and bad feeding habits. Over these sessions a group of health specialists (nutritionist, exercise trainer and psychologist) assesses the patient's health in order to design a personalized diet and exercise plan. After the fourth and final session, patients are encouraged to maintain with the plan and assist to a weekly appointment with the specialists [4].

Our work aims to provide a design of a technological solution focused on supporting the interaction and communication between the specialists and patients as proposed by the PREVENIMSS program, in order to help the patients in the process to maintain good nutrition and physical activity habits. To achieve this goal, we have conducted a field study within the PREVENIMSS program. The central concept of our design is a Virtual Specialist (VS) that stays with the patient and advice him at all times on issues related to keeping the diet and exercise programs. The VS is software that accompanies the user everywhere and provides him with the means to keep in constant communication with the specialists. We argue that patients that use this solution would feel more motivated to keep working on their programs, since they get a feeling of being personally attended.

Background and related research

My Food Phone is a mobile application that helps users to keep track of the food that he/she ingests every day by taking pictures of food ingested and getting reviews from the nutritionist [5]. Polar Watches enable users to keep track of their exercise routines, allowing them to monitor their heart rate and get a report of the number of calories burned [6]. Wilson [7] states that constant communication between health care providers and their patients increases the patients' satisfaction. He also discusses some of the characteristics that the future medical care systems should have, making emphasis on client ubiquity, simple operation, and enhanced communication channels. Raghupathi and Tan [8] state that among health care information technologies, the Internet plays a crucial role in bridging the gap between health care providers and consumers.

Understanding how people tracks exercise and diet lifestyle

We conducted a field study to understand the way that patients track a diet and an exercise program assisted by PREVENIMSS staff. We focused on four main

aspects: (1) users' diet and exercise habits, (2) PREVENIMSS role and environment influence in users' lifestyle habits, (3) essential information to create a diet and exercise program and (4) exercising and nutrition effects in users.

Methods

The study started with passive observations of four PREVENIMSS sessions. Our observation helped us become involved the group and to identify our target informants. In addition, we conducted eight semi-structured interviews: three with the PREVENIMSS staff and five with the patients. These interviews lasted approximately one hour. Each informant was introduced to the characteristics of the study and was asked to participate voluntarily. We interviewed the nutritionist, psychologist and exercise trainer from the PREVENIMSS staff. The patients interviewed were under an age of 20-59 years old. All our informants have overweight problems and expressed disposition to improve their lifestyle habits.

Results

The interviews were analyzed using a comparative verification of evidence which resulted on the identification of major themes for each topic of inquiry. We found that the most relevant aspect to motivate users is to maintain communication with specialists through control appointments. These control appointments are weekly programmed and our informants expressed that is hard for them to attend every week. An informant made the following comment during an interview: "*Sometimes I can't keep my appointments because I live far from the hospital and when I missed them I tend to gain weight".* Another interesting finding is related to how the users decide which food to buy and eat considering their diet program. All of our users expressed that they normally keep their diet program in a place near to where they eat and prepare their meals in order to be aware of which food will be the best selection. Related to this, an informant stated: *"I used to place my diet program in the fridge because in this case I can be aware of what food I can consume while I'm preparing my meal".* In addition, some of our informants expressed that they found it difficult to keep up the diet when they eat away from home. Our results also point that the PREVENIMSS staff needs to monitor the diet and exercise habits of the users. The nutritionist made the following comment: *"I encourage my patients to keep a 24 hours diet diary informing what portions of food they consumed and when they ingested them. This diary helps me to asses their progress and based on it plan the new diet program".* The trainer also expressed the importance of a diary to track users' progress. Finally, we found that the informants show disposition to use technology devices that help them to track their progress. Some of them even bought devices such as a blood pressure and heart rate monitors to measure their improvements and keep motivated to continue with their programs.

Desirable system's features

We envision that to help users maintain their diet and exercise programs monitored by PREVENIMSS staff our system should support the following aspects:

Enable users and PREVENIMSS staff to maintain close contact through a human alike interface. We propose a virtual specialist unit that acts as a presence of the specialists in the users' home, monitoring the user's progress and advising him trough audio messages.

Enable PREVENIMSS staff to monitor users' lifestyle and create personalized programs. We propose a specialist assistant that collects and organize information for the specialist.

*Enable users to keep up with their programs based on contextual recommendations and remainders. W*e propose a mobile virtual specialist that acts as a user's companion helping them to be aware of their diet and exercise programs wherever they are.

Enable the user to easily maintain a diary. To reduce the users' effort in creating a diary we propose the use of ubiquitous devices that capture the users' behavior.

To clarify how these features are addressed by our system, we elaborated several scenarios of use to illustrate the system's functionality [9].

Scenario 1: Collaborating with PREVENIMSS staff
Juan is a 38 years old man; in recent years he has gained some weight and a couple weeks ago the physician found out that he has a high blood pressure and transferred him to the PREVENIMSS Program. Juan is evaluated by a nutritionist and an exercise trainer. These specialists design a personalized diet and exercise program for him. The specialists enter plan information to a computer system that will allow them to keep track of Juan's progress. The specialist will use the system's control panel to monitor Juan's activities, modify future plans, and send him audio messages explaining any changes on the program.

Scenario 2: Using the Virtual Specialist unit at home
At morning, Juan walks to the Virtual Specialist (VS) unit (Figure 1a) and stands on the weighing scale, the VS greets Juan and asks him to introduce his wrist trough a blood pressure monitor that also measures Juan's heart rate. The VS compares this new data to previous records and congratulates Juan in case he has made some progress. Then a diet and exercise plan (DEP) gets printed in digital paper. Finally, the VS replays any new audio messages from the specialists. On the unit's panel there are 2 devices: a digital pen he uses to mark on the DEP which food he ingests along the day, and a digital watch that is programmed by the VS with the exercise plan. For exercising, Juan activates the watch, and it starts measuring time and Juan's heart rate. If Juan goes either below or above the pre-programmed heart rate boundaries, an alarm alerts Juan of the situation so he can always exert properly. When Juan is about to have breakfast, he check out the DEP attached to his fridge. He reviews the food groups he is allowed to eat and decides what to eat. Then, he quickly marks in the DEP the kind of food and number of portions ingested along with the time of the day. At night Juan writes on the DEP some comments for the specialists. Finally he places all devices on their cradles on the VS unit, and all data collected is sent to the server for the context diary.

Scenario 3: Using the mobile virtual specialist
When Juan walks into a restaurant, the Mobile Virtual Specialist (MVS) on Juan's cell phone requests the electronic version of the menu. When Juan reviews it, he finds a variety of dishes and he is not quite sure which ones he is allowed to eat, so he uses his cell phone camera to scan the barcode printed next to a dish that interests him. Next, the MVS displays a bar chart (Figure 1b) used to inform Juan about the degree to which that dish is recommendable. Using these recommendations Juan can make an informed decision

over what to have and then press a button so the MVS adds the last scanned dish to the food. In case the restaurant does not have an access point with this service, he may still take a picture which would be attached to the diary by the MVS. In case the user decides to ignore the recommendations, the MVS will advice him later to take corrective actions.

The virtual specialist unit

The Virtual Specialist (VS) unit is a fiberglass body which contains several devices connected to a host computer where the software that senses these devices is executed (Figure 1a). On the base there is a CPU. The motherboard has audio capabilities and there is a loudspeaker facing the user. The weighting scale, blood pressure monitor, printer and cradles for the pen and watch are attached to the body of the unit and internally connected to the CPU trough several RS232, USB and LPT ports. Finally the unit has a modem which should be connected to the phone jack at the user's home.

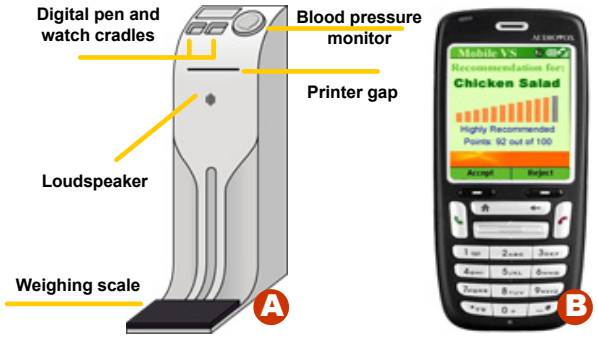

Figure 1. (a) The Virtual Specialist Unit and (b) The Mobile Virtual Specialist

System's architecture

Figure 2 shows the agent based architecture of the system. We next describe the agents of the architecture.

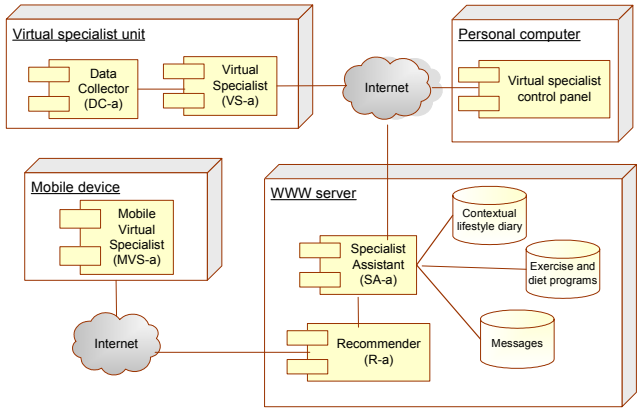

Figure 2. The multi-agent system's architecture

Data collector: This agent is responsible for sensing incoming signals from different devices passing the data collected to the virtual specialist.

Virtual specialist: This agent receives information related to the current condition of the patient and sends it to the specialist assistant, so it can be organized in the databases. This agent also requests to the specialist assistant all new messages, to replay them for the user.

Specialist Assistant: This agent serves requests from specialists for information related to the patient's messages, plans and the context diary. These requests can be either to store or retrieve data from the databases.

Recommender: This agent attends request from the mobile virtual specialist, receiving a restaurant dish description and returning a recommendation based on the patients specifics needs assigning a score based on the context diary information.

Virtual Specialist Control Panel: This interface is used by exercise trainer and nutritionist to monitor the patient's progress and enter information about diet and exercise plans. It is organized on tabs where specialists keep updated the plans for the user, access the history of the patient's behavior, reviews audio and text messages and watches alert messages about any regressions in the patient's progress.

Mobile Virtual Specialist: This agent is responsible for giving recommendations to the user. It sends information about the dish description to the recommender agent as read from barcodes. When the score for the requested product arrives, it generates a bar chart for the recommendation (Figure 1b). The agent also identifies the user's selection and sends it to the specialist assistant so it can be stored in the contextual diary database. It also, stays current about the user's behavior during the day, and reminds him when he hasn't complied with the program.

Conclusions and future work

We conducted a field study to understand the diet and exercise habits of the patients that attend to the PREVENIMSS program. We realized that patients need to be in constant communication with health specialists which keep them motivated. Based on our findings we designed a Virtual Health Specialist solution that represents the real specialist, allowing users to feel personally attended. As part of our future work we plan to conduct a concept evaluation of the Virtual Health Specialist solution. Progress in this project will be presented during the Student Competition session in CHI 2006.

Acknowledgments

We thank the personnel of PREVENIMSS, to our interviewees, to Professors Jesus Favela, Victor M. Gonzalez and Cuauhtémoc Rivera who provided helpful comments on this work and to Edgardo Aviles for helping us with the graphics design.

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