HyperFit: Hybrid Media in Personal Nutrition and Exercise Management

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Abstract—**HyperFit is an Internet service for personal management of nutrition and exercise. It provides tools for promoting healthy diet and physical activity. The principle of the service is to mimic the process of personal nutrition counseling. It includes self evaluation tools for testing and goal definition, food and exercise diaries, analysis tools, and feedback and encouragement given by a virtual trainer. Recommendations by the Finnish National Nutrition Council are used as the nutritional basis for the service. HyperFit uses a food database that contains the nutritional information for approximately 2,500 food products and categories, both product-specific and average.**

Hybrid media combining print and mobile technology are applied to improve the usability and arouse interest. The service is used both with a mobile phone and PC. A camera phone can be used to add food and exercise entries to the diaries by reading product barcodes.

HyperFit has been tested with potential individual users, weight management groups and nutritionists' counseling clients in several field trials. Participants of the trials have been content with the system. The trials suggest that a HyperFit type of service can be used to promote independent weight management and the use of hybrid media gives extra value to the service.

A patent application has been submitted for the system and the commercialization of the service is on the way.

Keywords-Pervasive healthcare; Nutritional information; Hybrid Media

I. INTRODUCTION

A. Nutrition and Exercise Management

Increasing overweight and lack of exercise are growing problems in most modern societies and create pressure on both citizens and national health care systems. Tools that promote and support independent weight management are important aids in tackling this issue in the future. To be effective, however, they need to be accepted by the users and fulfill users' expectations. The objective of the HyperFit project was to develop a prototype that would accomplish these demands.

Monitoring dietary and exercise habits combined with counseling and encouragement help individuals to set personal goals and make changes in their diet and exercise behavior that are likely to promote successful weight management [1]. Traditionally the monitoring has been carried out on paper-and-pencil diaries but several internet-based tools have emerged lately. Typically, these tools help users to monitor their eating and exercise behavior with diaries and provide suggestions on how to stay within the given goal range. The sites are maintained by various organizations (e.g. government agencies, professional, nutrition-education and consumer organizations, food industry, commercial organizations), both non commercial and commercial.

However, a survey of the internet sites done in the project [5] revealed that many of the existing tools have several defects. The accuracy and scientific validity of the services varies widely. The expertise behind the tools ranges from laypeople trained by the parent company to degree-trained professionals, and therefore the recommendations do not always comply with those currently accepted by professionals. The tools are complicated to use, no instructions for portion estimation are offered, and the focus is on calories rather than on advice on how to improve the overall diet.

Most of the Internet-based services only exploit a portal user interface. Some mobile phone applications, such as Wellness Diary [3] have been developed. No multi-channel (PC, mobile) based systems like HyperFit exist. The survey pointed out that new technology would presents interesting opportunities to support a health-promoting lifestyle. Interactive computer technology enables mimicking of the process of personal nutrition counseling to a certain extent. The ability to use the system with a mobile phone makes the counseling time and location independent. Hybrid media can be used to improve the usability of such systems.

B. Hybrid Media

The term hybrid media means the combination of printed and electronic media (www.hybridmedia.org). The best-known hybrid media application is barcode reading with a camera phone. For example, mobile phone readable QR-codes (Quick Response codes) are already being used widely in Japan. Reading two-dimensional (2D) barcodes (i.e. matrix codes) with a camera phone is becoming common in the Western world as well. Typically, a URL is encoded in the 2D barcode. After successfully de-coding the barcode, the barcode scanning software opens the web browser of the mobile phone with the given URL.

Barcode scanning requires a smart-phone with an integrated camera and a barcode scanning application. A smart-phone is a full-featured mobile phone with personal computer-like functionality. An important feature of most smart-phones is that applications for enhanced data processing and connectivity can be installed on the device. These applications may be

developed by the manufacturer of the device, by the operator or by any other third-party software developer.

VTT has been developing hybrid media technology since 1991 [4]. Many prototype systems have been developed and patent applications have been submitted. There is also a commercial product based on the technology that VTT has developed, i.e. UpCode. UpCode (http://www.upcode.fi/) is an application for reading 2D barcodes with a camera phone.

II. THE RESEARCH APPROACH

The idea of HyperFit was to combine internet, hybrid media and mobile technology with professional nutritional knowledge. The project group consisted of specialists from nutrition science, consumer research, information and media technology and usability testing. The development process was iterative; background studies were followed by software and technology development that were tested in usability and field trials. Based on the feedback the development was started again with the necessary background overviews.

The project started with a survey of existing counselling tools and food-related information in Internet [5]. The available counseling tools were evaluated, and, on this basis, the requirements for the HyperFit system were specified. Before the software implementation the consumer needs and expectations ware surveyed based on the mock ups of the main features of the system; 20 potential users were interviewed and they evaluated the planned service. Workshops and interviews for the ideas and expectations of different stakeholders were arranged. The representatives of food industry, health authorities, mobile device manufacturers, and software and service providers were interviewed.

The system development process consisted of three iterations. Special attention was paid to the usability and information visualization. After each iteration, the system was taken to field trials with potential users. Also the quality of the visual implementation, the usability of the service and the user experience were analyzed. During each iteration the system was enlarged with new features and usability improvements. Parallel with the prototype development, technology watch and business model development was run during the whole project.

III. RESULTS

A. HyperFit System

The main result of the project is the HyperFit system. It is an Internet service for personal management of nutrition and exercise. The service mimics the process of personal nutrition counseling. It starts with testing and goal definition, encourages the use of food and exercise diaries, and, finally, analyses the progress and gives feedback and encouragement.

Figure 1. Virtual trainer

The system is used under the guidance of a virtual trainer (fig 1). The trainer helps the user in goal definition and gives personal feedback and encouragement. The service can be used both with a mobile phone and PC. The mobile phone and PC applications are meant for slightly different purposes. The PC application is focused more on counseling, representing summary information and analysis. The mobile phone is primarily for quick and easy food and exercise diary data input. The service can be used also without a mobile phone.

Hybrid media is applied to product data search and feeding food and exercise diaries. The diaries can be filled out by scanning product barcodes with a camera phone. Exercise data can also be added from a heart rate monitor. A mobile phone product information service was adjusted with a speech interface for visually impaired people.

The service includes

- Tools for setting dietary and exercise targets. The official nutrition recommendations by the National Nutrition Council of Finland [6] form the base for the tools.

- Food and exercise diaries with several alternative data feeding methods: product browsing and search, favorite lists, barcode scanning etc. (fig. 2)

- Daily and weekly summaries and analyses of the nutrition and exercise balance and the nutritional quality of the diet (fig 3). The summaries compare the diet and physical activity to the goals and analyze the quality of the diet against the recommendations.

- Tools for following weight, waistline circumference, daily steps and perceived feelings.

- Self evaluation tools for testing weight management needs, eating and exercise habits. The tests are developed from the questionnaires by the Finnish Heart Association (www.sydanliitto.fi) and Finnish Diabetes Association (www.diabetes.fi).

- Product-specific information of existing products and average information on product categories, including the amounts of energy, protein, carbohydrates, fat and a number of other nutrients.

Figure 2. Barcode scanning

- Several calculators: a body mass index (BMI) calculator, an energy calculator for demonstrating the energy correspondence between exercise and food, and an exercise calculator for estimating the time and energy expended in a particular activity

- Food compiler: a tool for combining food items and composite dishes to count the values for energy and nutrients.

- Information about nutrition recommendations, energy and nutrients, weight management, food additives and exercise.

The HyperFit system food database was developed in the preceding TIVIK project [2]. It contains the nutritional information of for approximately 2,500 foods. The food database has both product-specific and average nutritional information. Product-specific information is taken directly from Finnish food producers (Fazer Bakeries, Raisio, Valio, Lännen tehtaat). The average nutritional information is from the Fineli® Finnish Food Composition Database (www.fineli.fi). Fineli uses the nutritional information based on the average recipes used in Finnish households. Users can also complement the data base with their own and compiled products.

Because the HyperFit database contains only a small fraction of the real products available in retail business, the missing products have been mapped to the average Fineli product categories using the EAN-code/FOODIS mapping of the Tuulia International (www.tuulia.fi) food database with tens of thousands of EAN-codes. This way the user reading barcodes with mobile phone gets the average nutritional information of the missing products.

A "Quick barcode" system was built to lower the threshold of adding food and exercise data to the diaries. The users can print lists of barcodes containing their favorite foods, exercises, common meals and snacks and insert them to the diaries with the camera phone.
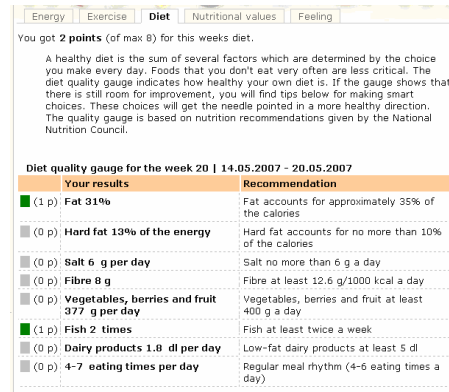

Figure 3. Weekly summary

B. Field Trials

HyperFit service was tested in several field trials during the project. The purpose of the trials was to estimate the future success of the system and give feedback to the system development. User expectations, experiences, interest in different parts of the service and willingness to pay for the service were measured. Special attention was paid on the use of hybrid media and mobile phone. The first two trials involved potential individual end users interested in weight management; the third studied the service as a supportive tool for weight management groups and the fourth the use of the service in professional nutritional counseling.   A total of 97 individual users, nine nutritionists and five groups with instructors and 39 group members participated in the field trials.

The individual users were allowed to try out the system as part of their everyday practices for two weeks. They either had both mobile and PC applications or only the PC application. The results with the end users were overall positive. The wide and detailed information represented in an easy format was appreciated. The most useful features were the food and exercise diaries with the summaries and analyses and product information. Feedback from the virtual trainer was considered positive. The mobile application gave extra value to the service (Fig. 4). It was considered an appropriate and useful tool, and reading the barcodes with the camera phone was seen as an easy way to enter foods.

The willingness to pay of the service was higher in the group that used also the mobile application. There seemed to two types of users: those who were interested in nutrition and found the service informative and useful, and those who wanted something that could be less precise but more effortless to use. An easy-to-use version that applied average values was developed to these less precise users.

The professional nutritionists used the HyperFit PC application three weeks either themselves or with their patients. The impression of the system positive and it was regarded as a useful tool in nutritional counseling. It was considered clear, easy to use and comprehensive. The most used feature was the food diary. Also the tests concerning food and exercise habits were frequently used. The professional content and clear graphics were especially appreciated.
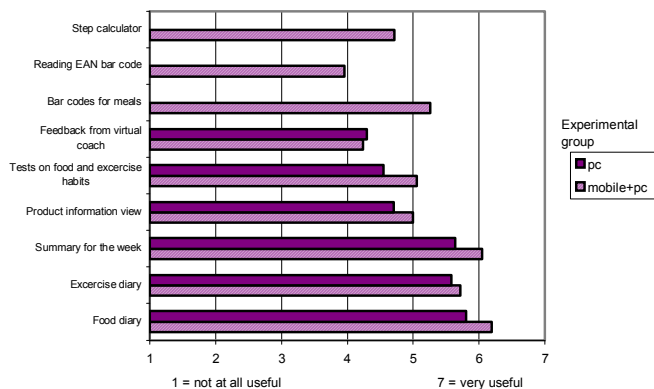
Figure 4. Usefulness of the different service functions by the mobile+PC and PC-groups in the second trial.

In group counseling the group members were given tasks that involved keeping food and exercise diaries for 2-3 days and the tasks were processed in group meetings. The impression of the HyperFit system for both group members and the instructors was positive and it was regarded as an interesting and beneficial system. HyperFit was considered a useful tool both in group meetings and outside the meetings to motivate the group members.

IV. DISCUSSION

The objective of the HyperFit project was to develop communication tools based on hybrid media and mobile internet technologies for personal nutrition and exercise management. HyperFit was built as an extensive service that contains a large variety of tools and functions. Therefore the service covers well also the professional requirements for nutrition and exercise management tools.

Although being more extensive than the existing services, whether meant for professionals or lay people [5] the HyperFit service has been built in a way that using it does not require any special training. Furthermore the service permits data sharing between lay people and professionals allowing the collection of eating and exercise-related behaviors regardless of the time and place, especially when using the mobile interface. This solution produces a tool that can be used both as a self-aid kit and part of personal counseling. The positive feedback from the extensive user trials with individual users, nutritionists and weight management groups indicates that the target of making the service easily accessible to lay people and at the same time providing accurate information to the professionals was achieved and the service was well received.

The system has been considered easy to use, clear and understandable, although somewhat effort-demanding. The system provides a huge amount of information for those who are ready to put on the effort of keeping their diet and exercise records with care. The feedback from one's own behavior and the wide range of information derived from the service has been appreciated as rewarding. The limitation of this kind of service is that many people are not willing to make the required

effort. The lack of effort can be caused by various reasons: there is no motivation to monitor and change one's own behavior or the system is too demanding compared to the mental and practical resources the user has in her or his exposure. For those individuals who wished to have an effortless service a simplified data recording system was developed.

The idea to mimic the process of personal nutrition counseling by a virtual trainer was well accepted. In health-related behaviors, whether weight loss or management or increasing physical activity, the self-efficacy has been found as a major predictor of success [8]. Self-efficacy refers to individuals' ability to achieve a desired outcome and it influences choosing as well as maintaining activities [7]. Self efficacy is domain specific and success within a behaviour domain promotes self efficacy. The virtual trainer in the service gives personalized feedback from successful changes in the diet and exercise practices and thereby is likely to improve user's self efficacy. The trainer also suggests further improvements when choices and physical activity has not been sufficient. This creates a positive cycle where virtual trainers' comments strengthen individuals' self-efficacy and thereby give them better chances to make further improvements in their behaviors. Therefore it is not surprising that trial users found this advice and encouragement given by the virtual trainer positive. The usability tests [5] showed that the virtual trainer elicited perceived media richness and the users were more willing to use the system with the virtual trainer than without.

The visualizations and summaries provided by the Hyperfit service were developed by interviewing both the lay users and professional nutritionists who counsel their clients. The graphs and tables used provided easily accessible feedback from one's own behavior which further supports the use of this kind of service as an independent support tool in efforts to balance food intake and exercise activities. In supporting low-fat product choices, making the health-related messages more relevant for individuals together with better tools to monitor one's own dietary practices is likely to support the desired changes [9].

The possible barrier for the use of the system is in the effort required to keep the food and exercise diaries. The future challenge is to further ease the mechanisms of keeping the records, so that achieving the personal feedback will become more effortless. According to the users, the most natural way of using the service would be during a short one to two week periods at certain intervals. This would enable to follow how diet and physical activity have changed over a time, when deliberate changes have been made

The field trials suggest that hybrid media and mobile technology can be used to promote independent weight management and this gives extra value to the HyperFit service and differentiates it from previously existing services. Those who could enter the service with both mobile and PC interfaces were more positive about the service at the end of the trials. This suggests that, although people liked to use the PC interface more and rated it easier to use, the mobile link provided a new, location independent and therefore an exciting way to enter data to the system, especially when using the bar

code reading facility with the camera. The internet-based service was especially accepted by the young and technology oriented people, but after getting familiar with the techniques, the use was rather uncomplicated also among other groups. The challenge for getting the middle-age and elderly people to use these kind of services is to encourage them to take the initiative and thereby cross the threshold of using mobile phones for other purposes than purely making voice calls.

The project pointed out problems in the development of this kind of systems. There were difficulties in the utilization of the still immature technology, especially in barcode reading with camera phones. A hybrid media application needs a smart-phone with a camera and a special add-on macro lens that must be attached to the camera phone. This requirement prevents the 1D barcode scanning applications getting into the mass market, because the average consumer does not want to buy any accessories to his or her mobile phone. However, the limitations of the barcode scanning will be forgotten as soon as barcodes are replaced with by RFID tags

Another problem area is the availability of nutritional information. Usable product information exists, but commercial and political reasons prohibit the use of it. The database used in HyperFit contained product information complemented with average nutritional information. It was sufficient for weight management purposes. However, a comprehensive food data base would give added value to the service.

The business partners of the project have considered the theme of the project important and interesting. It widened the knowledge in the areas of healthy eating and exercise habits, hybrid media, mobile and communication. The final indication of the success of the project is that it generated one patent application and the commercialization of the HyperFit system is on the way.

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