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Hybrid Media in Personal Management of Nutrition and Exercise

| Report on the HyperFit Project

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Report on the HyperFit Project

Edited by Paula Järvinen



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Keywords pervasive healthcare, nutritional information, hybrid media

Abstract

The purpose of the HyperFit project was to develop communicational tools for personal nutrition and exercise management.

The main result of the HyperFit project is the HyperFit application, 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 counselling. It includes self-evaluation tools for assessing eating and exercise habits and for defining personally set goals, food and exercise diaries, and analysis tools. The service also gives feedback and encouragement from 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 on approximately 2,500 foods, either product-specific or average. The products that are not included in the database are replaced with the average foods. However, HyperFit is able to use a more comprehensive product specific food database.

Hybrid media and mobile technology are applied to improve the usability and interest to use the system, especially among younger and technically-oriented people. The service can be used both with a mobile phone and a PC. A camera phone can be used to add food and exercise entries to the diaries by reading product barcodes. Exercise data can be inserted directly from a heart rate monitor to the system.

The usability and user experiences of the HyperFit service have been tested throughout the development process. Furthermore, HyperFit has been tested with

potential end users, weight management groups and professional nutritionists as part of their weight management efforts or professional counselling in several field trials. The participants in the trials have been content with the system and, on the whole, comments have been positive. 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 commercialisation of the product is on the way.

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Avainsanat pervasive healthcare, nutritional information, hybrid media

Tiivistelmä

HyperFit-projektin keskeisin tulos on HyperFit-järjestelmä: internet-palvelun prototyyppi ravitsemuksen ja liikunnan personoituun hallintaan. Se tarjoaa työkaluja terveellisen ruokavalion ja fyysisen aktiivisuuden edistämiseen Järjestelmän perusajatuksena on jäljitellä ravitsemusterapeutin ohjauksessa tapahtuvaa painonhallintaprosessia. Järjestelmä sisältää välineitä ruokailu- ja liikuntatottumusten itsearviointiin, painonhallinta- ja liikuntatavoitteiden asettamiseen, ruoka- ja liikuntapäiväkirjan sekä välineitä ruokavalion ja liikuntatottumusten analysointiin. Käyttäjä saa palautetta ja kannustusta virtuaalivalmentajalta. Järjestelmän ravitsemussuositukset perustuvat valtion ravitsemusneuvottelukunnan laatimiin suomalaisiin ravitsemussuosituksiin.

HyperFitissä on käytössä tuotetietopankki, joka sisältää ravitsemukselliset tiedot noin 25 000 ruoasta. Tiedot ovat joko tuotekohtaisia tai keskiarvotietoja. Keskiarvotietoja käytetään korvaamaan puuttuvia tuotetietoja. HyperFitin tietokanta on helposti korvattavissa kattavammalla tuotekohtaisella tietokannalla.

Toteutuksessa on sovellettu hybridimediaa ja mobiiliteknologiaa, joiden avulla käytettävyyttä voidaan edistää sekä lisätä nuorten ja tekniikkaorientoituneiden kiinnostusta Järjestelmää voi käyttää sekä matkapuhelimella että tietokoneella. Päiväkirjoihin voi lisäksi tallentaa tietoa syödyistä ruoista ja liikuntasuorituksista lukemalla tuotteen tai liikuntasuorituksen viivakoodin kamerapuhelimella. Tiedot liikuntasuorituksesta voi myös tallentaa suoraan sykemittarista.

Palvelun käytettävyyttä ja käyttökokemuksia on testattu kehitysprosessin eri vaiheissa. Lisäksi HyperFitia ovat koekäyttäneet yksittäiset käyttäjät, painonhallintaryhmät ja ravitsemusasiantuntijat työssään. Kokeisiin osallistujat ovat olleet tyytyväisiä järjestelmään, ja palaute on ollut pääosin myönteistä. Kokeiden perusteella voidaan päätellä, että HyperFitin kaltainen järjestelmä soveltuu painonhallinnan tukemiseen ja että hybridimedia tuottaa lisäarvoa palvelulle.

Järjestelmästä on tehty patenttihakemus ja kaupallistaminen on meneillään.

Preface

This publication contains the results of the project “Hybrid media in Personal Management of Nutrition and Exercise” (HyperFit). The two-year project was part of the FENIX Technology Programme (FENIX – Interactive Computing) run by the Finnish National Technology Agency (Tekes). The aim of the project was to develop communicational tools for personal nutrition and exercise management

The main findings of the project are compiled in this publication. The main result of the project is the HyperFit system, which is an Internet service for personal management of nutrition and exercise. It has been tried out in excessive user trials. A patent application has been submitted for the system and the commercialisation of the product is on the way.

Besides the main funders, Tekes and VTT, seven companies and associations financed the project and were represented in the project management group. By the end of the project the group comprised Pertti Hölttä (*Elisa*), Tor Jungman (*Finnish Hearth Association*), Harri Ojansuu (*Tekes*), Harri Sulku (*Beneway*), Juha Sylberg (*Finnish Federation of the Visually Impaired*), Marja Vakkuri (*Raisio*), Sami Vilvala (*Valio*), and Pertti Väisänen (*Tuulia International*). The group made a great effort on behalf of the project.

Experts associated with the project were Sven-Gustav Lindroos (*GSI Finland*), Merja Rastas (*National Public Health Institute*), Leena Nieminen (*The Association of Clinical and Public Health Nutritionists in Finland*), Annikka Marniemi (*The Finnish Consumers’ Association*) and Raija Kara (*National Nutrition Council of Finland*). They made an important contribution to the project.

VTT, the University of Kuopio and Helsinki School of Economics carried out the project. WICOL Ltd participated as a subcontractor to VTT. The project group members contributing to the publication were Caj Södergård (Section 1), Liisa Lähteenmäki (Sections 1, 2, 9, 11, 12), Seppo Juurikko (10), Anne-Mari Ottelin (3, 9), Nora Ohls (3, 9), Anne Arvola (9), Johanna Kuusi (9), Kari Kallinen (8), Paula Järvinen (2, 6, 11, 12), Timo Järvinen (5, 7), Timo Kinnunen (5.4, 6.6, 6.7), Pirjo Näkki (6.5, 7.4), Magnus Melin (7.3), Timo Siivonen (10)

and Sari Vainikainen (4). In addition to the authors, Christer Bäckström, Jouko Hyväkkä, Johanna Kuosmanen, Sonja Kangas, Hannu Kuukkanen, Kaisa Poutanen and Minna Suovirta have contributed to the project.

Hybrid media and mobile Internet present interesting opportunities to support health-promoting lifestyle and to promote lifestyle changes. Hopefully, this publication will provide new insights and inspiration in this field.

Espoo, 29. 9. 2007

Caj Södergård

Project leader

VTT

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1. Introduction

Increasing overweight and obesity are health problems that create escalating economic pressure on both private citizens and the national health care systems. Special attention has been paid to this problem among children and young people, but very few services providing tools to tackle this issue have been developed. Although sufficient information is available for making beneficial changes, it may not be sufficient to induce the desired changes.

The weak impact of knowledge on food choices can be attributed to several factors. First, the main reasons behind food choices are habits, sensory pleasure, price and convenience, and most of these factors are affect- or experience-based and therefore difficult to reach with factual information. Second, products marketed or recommended with health-related arguments have to be able to deliver that message effectively in the midst of all the other messages that are found in food products. The information on food is abundant, sometimes even contradictory, dispersed and difficult to interpret, which can make following nutritional recommendations difficult for ordinary consumers.

Consumers are becoming more and more fragmented in their need for information. Even when information is available it does not necessarily gain attention if the individual consumer does not find it personally relevant. Different people want and need the information in various forms, e.g. the middle-aged may want a fact-based form, whereas young people may be motivated by visual and interactive information. This variety of information is difficult to communicate through the traditional texts on packages.

Weight management requires coordination of several superficially simple everyday actions. The amount and energy content of ingested food and drink and physical activity has to be taken into account and processed into simple and understandable personally tailored advice.

In the preceding TIVIK project (www.vtt.fi/tivik), VTT, the University of Kuopio and the Helsinki School of Economics constructed and piloted a system for delivering personalised information about food products to the consumer [Järvinen, 2005]. The TIVIK system was used with both a PC's web browser

and a camera phone, which made an easy product information search possible by scanning the barcode of a food package. The feasibility of the TIVIK system was assessed in a field trial with 100 participants. Even if the product supply in TIVIK was limited to 700 products, the trial users were satisfied, especially appreciating the personalisation of information, the food diary and its associated physical exercise calculator. The preferred user device was the PC – partly because technical problems still hampered the use of mobile data at that time.

In the HyperFit project (www.vtt.fi/hyperfit) described here, the same research consortium addressed the observations made in TIVIK. We focused on tools for personal management of nutrition and physical activity. The target group was weight watchers. We expanded the food diary and added a module for monitoring physical exercise either by manual registering or in some cases by wiring to a sensory device. We also added a virtual trainer that “comments” on one’s success in maintaining the energy balance and progress in eating in the recommended way. By mapping the food products to a nutrient database containing average nutrition composition of products, the small product set of TIVIK was expanded to cover most of the food products on the Finnish market. The nutritional information can be searched in several ways in HyperFit; like in TIVIK by product name and by scanning the product barcode with the camera phone, but also from a list of purchased food products that is obtained electronically from the grocery shop. The usability of the mobile phone was improved by using fast 3G data connections and a more developed barcode reading function.

The ability to quickly find product information by reading barcodes on the food packages with a mobile phone is an important feature of HyperFit. This is *hybrid media*, the combination of printed and electronic communication (see www.hybridmedia.org). Food packages with barcodes and other information represent printed media; displaying detailed product information and other services in the web browser of the mobile phone represents electronic communication. Technological solutions other than optical codes exist for linking print to the mobile web, e.g. RFID (radio frequency identity). However, they do not require changes to the HyperFit system – only the triggering impulse is different.

The overall objective of this project was to develop and try out communication tools for personally tailored nutrition and physical activity management. The multi-channel (PC, mobile) system provides a new tool to monitor and promote the balance between eating and exercise. High and flexible usability is achieved by making it possible for the mobile phone user to access data by scanning the product barcodes.

2. Development Process

The HyperFit System was developed as an iterative process where surveys and studies, software development and testing alternated. The iterations started with background surveys and studies. The studies covered both user needs and technology. The outputs of the studies were analysed and converted to the technical requirements for the application. After that the software was designed, implemented and tested. Field tests and usability analyses finished each iteration circle, giving input to the next phase. A technology watch was done all along the process. Figure 1 outlines the development process.

The basis for HyperFit was the pilot system developed in the preceding TIVIK research project (a context-based personalised information system for delivering product information to the consumer) [Järvinen, 2005], which delivered personalised product-specific food information to consumers.

The development started with the following background studies:

- The surveys of existing counselling tools and food-related information (Chapter 3, Nutrition and Exercise Management Tools).
- A survey of consumer needs and expectations; 20 potential users were interviewed and they evaluated the usefulness of the future service based on the mockups of the main features of the system.
- Workshops and interviews for the ideas and expectations of the partners representing different stakeholders: the food industry, health authorities, mobile device manufacturers, and software and service providers.

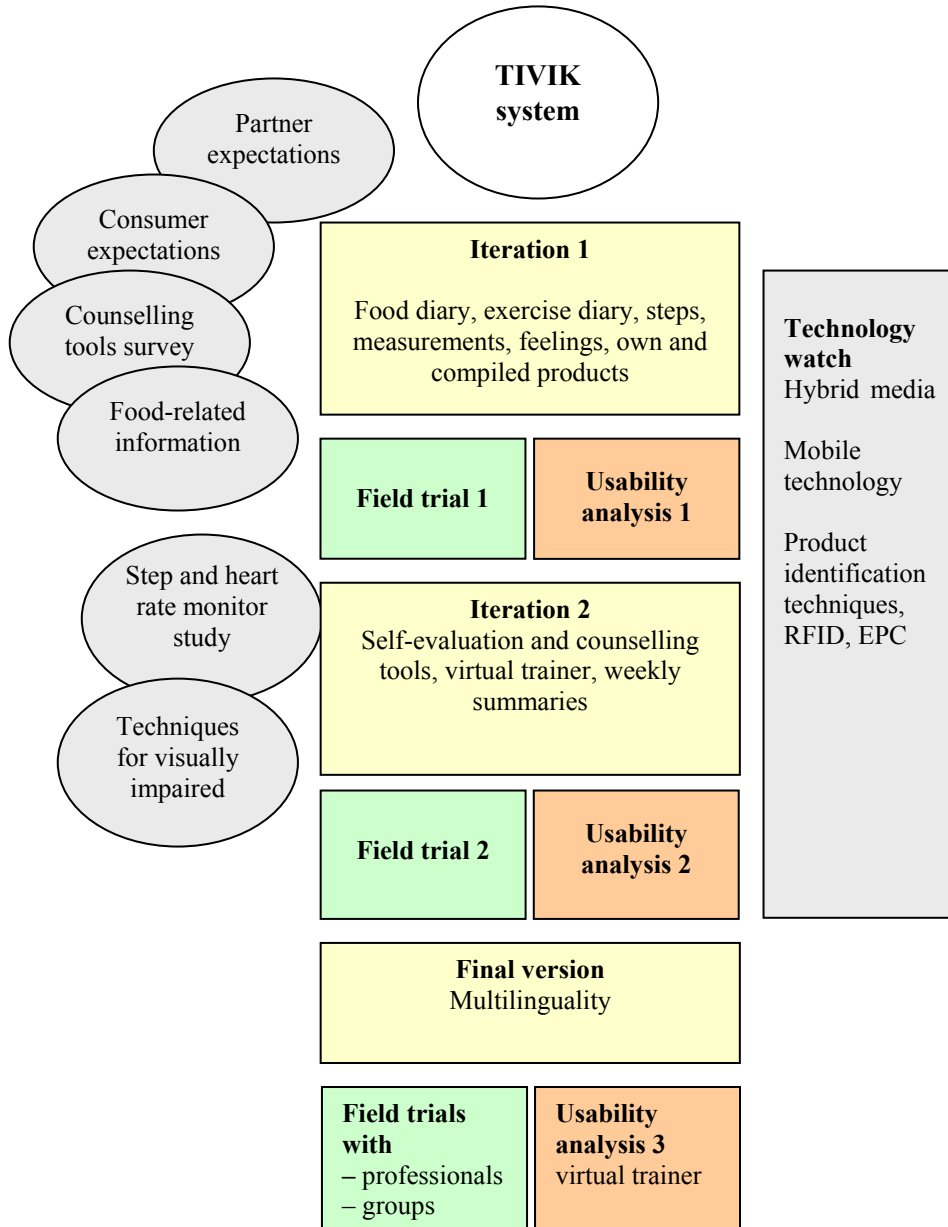


Figure 1. HyperFit development process.

The development process consisted of two iterations and the final version implementation. In iteration 1 the preceding TIVIK system was enlarged with

food and exercise diaries, summary data and the food compiler tool. The food database and information content of the TIVIK system were also updated and several usability improvements were made. After iteration 1 the system was taken to field tests (Field trial 1, Chapter 9.3) where real users used the system for a while. The quality of the visual implementation of the service was also analysed (Chapter 8.2).

In iteration 2 the system was enlarged with self-evaluation and counselling tools, personal feedback by the virtual trainer and weekly summaries and analyses. Several usability improvements were made based on the findings of the first iteration tests. The heart rate monitor integration was implemented and the application for visually impaired people was made. After iteration 2, field tests were carried out with potential customers (Field trial 2, Chapter 9.3). The usability was tested by usability experts (Chapter 8.3).

Some minor improvements were made to the final version and a multilingual user interface was implemented. The final field tests with the final version were used as a tool for professional nutritionists (Chapter 9.4) and as support for group counselling (Chapter 9.5).

The project was divided into the following work packages:

- Gathering existing knowledge, expectations and needs through background studies of existing counselling tools and food-related information, survey of consumer needs and expectations, ideas and expectations of the partners representing different stakeholders (Chapters 3 and 4).
- Development of mobile technology components (optical code reading, step and heart rate monitor integration, voice output for visually impaired) (Chapter 5).
- Software development iterations, including requirement specifications, implementation, testing and field trials, and usability analysis (Chapters 6–9).
- Parallel with the tasks above, work packages for the technology watch and business model development were run during the whole project (Chapters 10 and 11).

3. Nutrition and Exercise Management Tool

Surveys of existing nutrition and exercise counselling tools and food-related information were carried out in the project. The surveys were done in order to specify the requirements for the HyperFit system and to evaluate the use of the external information as part of the system. Counselling tools are defined as giving an individual or a group of people means that will allow her/him to make the right choices and decisions concerning her/his action. Food-related information covers product information, recipes, and food knowledge and culture.

3.1 Counselling Tools

A search was performed using the Google search engine to identify the counselling tools available on the Internet. Search terms, such as healthy diet, physical activity, exercising, weight management, etc., were used to identify Internet websites containing tools (e.g. self-assessment tools, interactive tests and questionnaires, information material). Special attention was paid to Internet sites containing interactive calculators and monitoring mechanisms for diet and exercise that give users feedback on her/his own actions. In addition to the Internet search, other counselling tools for healthy eating, physical activity and weight management were searched from the literature and by asking the experts.

The interactive tools found on the Internet sites were usually employed to motivate behaviour change. Commonly featured components on the Internet sites were calculators, tests and questionnaires, nutrient analysis tools, feedback and online support systems, and tracking tools (Table 1). The latter were usually Internet-based food and exercise diaries replacing traditional paper diaries. These tools help users to monitor their own choices by entering the food consumed or exercise done, and, based on the information entered, suggestions for the user about how to stay within the goals are usually given.

Table 1. Examples of available interactive counselling tools.

Tool	Function	Example
Calculators		
BMI	Provides information on weight status.	Tohtori.fi (free Finnish health portal) www.tohtori.fi
Energy requirement	Estimates energy requirements based on basal metabolic rate and physical activity.	Finnish Heart Association www.sydanliitto.fi
Energy intake	Estimates the daily total calories consumed based on food item and portion size.	Me Naiset (a magazine for women) www.menaiset.fi
Energy expenditure	Estimates the energy expended in a particular activity.	Verkkoklinikka (free Finnish health portal) www.verkkoklinikka.fi
Tests and questionnaires		
Nutrition	Testing of own diet for various nutrients (fiber, fat, sodium, sugar, calcium, iron).	The Finnish Bread Information www.leipatiedotus.fi
Physical activity	Testing of own exercise habits.	Tohtori.fi (free Finnish health portal) www.tohtori.fi
Health risks	Testing of own risk for various diseases (type 2 diabetes, osteoporosis, cardiovascular diseases).	Finnish Diabetes Association www.diabetes.fi/testit/riskitesti/
Tracking tools		
For weight	Enables users to monitor their weight.	Tohtori.fi (free Finnish health portal) www.tohtori.fi
Calorie and physical activity tracking tools	Diaries that enable users to monitor their progress in dietary and exercise habits over a special time frame.	Keventäjät (MTV3 media organisation; chargeable service) keventajat.fi
Nutrient analysis		
Calculators	Allow users to combine several food items and composite dishes to generate daily values for energy and nutrients.	Finnish Fitness Plan ffp.uku.fi/clinic/energia1.htm
Meal planners	Allow users to combine several food items to make a meal and generate values for energy and nutrients.	Finnish Ministry of Education www.edu.fi/oppimateriaalit/terveellinenateria/
Feedback and online support systems		
Discussion boards	Online bulletin boards where users can leave and expect to see responses to healthy lifestyle-related messages they have left.	Terhi.net (private home page) www.terhi.net
Shared tips, “success stories”, comments, questions, etc.	Online advice for users to support ongoing behaviour change efforts.	Weight Watchers www.painonvartijat.fi

The search for other than Internet-based tools found only a few tools to support healthy living. Some self-assessment tools, like tables for food and exercise diaries, and questionnaires related to diet and exercise, were found as printed material. Brochures made by nutrition-education and consumer organisations contained self-evaluation tests and questionnaires concerning their topic of interest (e.g. fat intake test by Finnish Heart Association and calcium intake test by Dairy Nutrition Council). However, the same tests were often found as interactive versions on the Internet sites of these organisations

The most interesting Internet sites containing counselling tools or services related to nutrition, exercise and weight management were reported. The sites are maintained by various organisations (e.g. government agencies, professional, nutrition-education and consumer organisations, food industry, and commercial organisations) and they can be divided into non-commercial and commercial services.

3.1.1 Free Internet Counselling Tools

Many government agencies, professional, nutrition-education and consumer organisations are providing information about healthful eating habits and weight management strategies on their Internet sites. Just general information is offered on most sites and the sites have a professional appearance, but some counselling tools are available for free as well. Registration is sometimes needed. Free services and tools for healthy living are mostly provided by nutrition-education and consumer organisations, often as part of larger health campaigns (e.g. www.kotimaisetkasvikset.fi/konekuntoon, www.pienipaatospaivassa.fi). These services include tools like body mass index calculators, calculators for estimating energy requirements based on basal metabolic rate and physical activity, counters and tests for self-assessment of health risks, diet and physical activity level (Table 2).

In addition to non-commercial organisations, the food industry and food retailers are offering free Internet services and counselling tools related to healthy living and weight management. The nutrition information provided is usually emphasised towards the production sector of the company (e.g. the bakery industry provides information about dietary fibre, the dairy industry about calcium, etc.), and the tools offered by the industry promote the interests of

manufacturers as well. An essential part of the Internet sites hosted by the industry is naturally the information on company products and services. A great number of these Internet sites provide a search engine to help customers find a suitable product for a special diet from the company's selection (www.atria.fi, www.saarioinen.fi). Special services for exercising and healthy diet hosted by a bakery company (www.vaasan.com) and for weight management hosted by a dairy company (www.valio.fi) are also available.

In Finland the food retailers are not very active in providing nutrition information, whereas Central Europe retailers have been showing significant interest in nutrition services. For example, Tesco, Britain's largest retailer, runs Britain's largest online dieting and healthy eating service Tescodiets.com (www.tescodiets.com/).

Table 2. Examples of free Internet services and counselling tools for healthy living and weight management.

Service	Access	Administrator	Components
EnergyNet	ffp.uku.fi/cgi-bin/energynet03/index.pl?language_id=2	University of Kuopio	Online dietary and fitness assessment tools that provide an estimation of the daily energy requirement, estimation of energy content of daily food, counters for total energy expenditure and energy cost in different physical activity.
Tohtori.fi	www.tohtori.fi/?page=8294240	Coronaria Media Oy	Commercial, free for users health portal that includes self-assessment tools (hip/waist-ratio calculator, BMI calculator, tests for healthy diet and physical activity), articles about weight management, nutrition and physical activity. Weight curve, food and exercise diaries require log-in.
Valio	www.valio.fi/profeel/	Valio Oy	Weight management service by Finnish dairy company. Contains information on weight control, meal plans for 5 weeks, nutrient analysis program, energy calculator, tests for healthy diet and BMI counter.
Margarini-tiedotus	www.margariniitiedotus.fi	Margariniitiedotus, Raisio Oyj, Unilever Finland Oy	Web service by information centre of margarine industry that contains, e.g., information on margarine for both consumers and health specialists, videos, music, a game and ask-an-expert service.
Pieni päätös päivässä	www.pienipaatospaivassa.net/	Finnish Heart Association, Finnish Diabetes Association, Association for Healthy Lifestyles, Finnish Institute of Occupational Health and Kunnossa kaiken ikää -program	A campaign by consumer organisations. Web pages contain information on healthy lifestyle, diet and physical activity. Contains links for self-assessment tests, food recipes, FAQ, and counter for small diet changes.

3.1.2 Commercial Internet Counselling Tools

Several fee-based commercial Internet services containing counselling tools for healthy eating and weight loss are offered to the public (Table 3). These Internet-based services are used online, in some cases with email or mobile phone SMS text messages as well. Commercial services mimic the process of personal counselling to the extent that the membership often provides a virtual visit to a dietician. The information offered is usually tailored to the personal characteristics of the user and the users are provided with a personalised nutrition plan based on their own goals. Some services include recommendations for physical activity as well. Tools for monitoring own choices are widely provided. All commercial services include at least food, and in most cases an exercise diary is also included. Feedback for users is usually provided as charts and reports; sometimes the feedback is given through mobile phone (www.weightbalance.fi) or personal sessions (www.verkkoklinikka.fi/kuntoverkko). Food recipes containing energy and nutrition values are in most cases an essential part of the service. Customised grocery lists to assist users in purchasing appropriate foods are offered as well.

Staff qualifications and prices in commercial services vary a lot. About one-third of the services report that the service is designed and operated by a qualified health professional, like an authorised nutritionist, doctor, exercise leader or behavioural scientist. Other reported qualifications of service staff are, e.g., laypeople trained by the company, food specialists and former clients. However, some of the services completely lack information about staff experience and training. Prices are related to the extent of the service: simple services are low in costs and those services including personal counselling are the most expensive ones. The least expensive service detected in the survey cost 1.90 €/month, whereas the most expensive was 985 € with personal counselling.

Table 3. Examples of commercial Internet services and counselling tools for healthy living and weight management.

Service / Access	Administrator	Components	Charge
Weight Balance / www.weight balance.fi	Teleca Finland Oy	Food diary, weight curve which can be created by sms messages, discussion forum, free weight management program	Less than 5 kg: 49 € 5–10 kg: 59 € more than 10 kg: 69 €
Miljoonan kilon keikka / www.miljoonan kilonkeikka.fi	Miljoonan Kilon Keikka Oy, The Finnish Red Cross, National Public Health Institute	Calorie and exercise counter, food diary, weight curve, recipes, discussion forum, exercise plan	29 €/4 months
Keventäjät / www.keventajat.fi	MTV 3	Calorie and exercise counter, food analysis tool, weight curve, discussion forum, contact with experts, exercise plan, tailored food recipes	29 €/3 months 49 €/6 months 79 €/12 months
Kiloklubi www.kiloklubi.fi	Sanoma Magazines Finland Oy	Calorie and exercise counter, food analysis tool, weight curve, discussion forum, contact with experts, tailored food recipes	29 €/3 months 49 €/6 months 89 €/12 months
Nutris www.nutris.fi	Healthmakers Oy	Calorie and exercise counter, food analysis tool, weight curve, discussion forum, contact with experts, tailored meal suggestions	Depending on version: 28–88 €/month 40–140 €/12 months 69–238 €/24 months cd version 49–149 €

3.1.3 Evaluation of Counselling Tools

New technology-based services present interesting opportunities for delivering and disseminating tools to support a health-promoting lifestyle and to promote lifestyle changes. Interactive computer technology enables mimicking the process of personal nutrition counselling to a certain extent; similar to personal counselling, people are surveyed and the results are used to develop individualised feedback and advice. For this purpose, tools for record keeping, personalised feedback and accountability are needed to provide support in the balancing of diet and exercise, and through this the adoption of a healthy lifestyle. The available counselling tools found in the survey were evaluated,

and, on this basis, the likely requirements for the dietary and exercise counselling tools needed for the HyperFit system were specified. Special attention was paid to the usability of the existing tools since the aim of HyperFit was to develop tools that would be accessible and thus support the achievement of lifestyle goals.

No tools specifically geared just to the target group of HyperFit (youngsters, young adults, 18 to 30-year-old men) were found in the search, although the Internet might be the most natural and appealing tool to deliver information to this group.

The evaluation of the content quality of Internet-based tools showed that the accuracy and scientific value of the subject matter varied widely. The source behind the tools varied from laypeople trained by the parent company to degree-trained professionals, and this resulted in the recommendations given not always being consistent with the recommendations currently accepted by dietetic professionals. The official nutrition recommendations in Finland are made by the National Nutrition Council [2005] and they are suitable for the whole population. The recommendations promote exercise along with healthy dietary habits as well. These recommendations were chosen as the basis for the counselling tools developed in the HyperFit project.

Internet-based lifestyle counselling should contain the same elements as traditional counselling. As a first step in a lifestyle change it is important to make people aware of their energy intake levels and the level of physical activity. In the survey, self-evaluation tools developed for this purpose were found both as printed material and on the Internet and concerned various nutrition-related topics. However, no extensive test measuring the overall healthiness of diet was found, and such a test was developed for the HyperFit system based on the questionnaire by the Finnish Heart Association and Finnish Diabetes Association. A test for self-evaluation of the level of physical activity was developed in collaboration with the same organisations.

Monitoring progress in dietary and exercise habits can help individuals to focus on central issues and take action to improve their health. Traditionally, the monitoring has been carried out in paper diaries but several Internet-based tools that allow users to track their progress were found in the search. However, many existing tracking tools and diaries are complicated to use, no instructions for

portion estimation are offered, the selection in the food and activity databases is limited or the focus is only on calories rather than in advice on how to improve the quality of overall diet is given. These faults were chosen as targets for the development of the food and exercise diaries for HyperFit.

The search also revealed that the strength of HyperFit diaries compared to existing ones is the extensive database that also contains product-specific information. Average nutrition information is normally used in the food databases and no other diaries could be used with a mobile phone, which makes the data transmission system in HyperFit system unique.

In addition to self-evaluation tools, motivating tools are essential for promoting lifestyle changes. The available evidence indicates that with intensive monitoring, counselling and encouragement, individuals can change their diet and exercise behaviour. The existing monitoring tools usually provided the feedback for the user as charts and reports. Visualising the progress may increase the motivation per se, but, on the other hand, charts and reports may be hard to interpret for the average user not familiar with the field of nutrition or exercise. In the HyperFit project the motivation of the user was therefore in the foreground when designing the feedback for users.

3.2 Food-related Information

In order to maintain interest and motivation to use a web service, the information should be as diverse as possible and easily obtainable. A survey was performed to determine what food-related information is already available online. The level of interest in this information from the consumer's perspective was also evaluated, as well as the possible additional information and instructions that they provide to the consumer about products and their use. The available information and the form in which it is presented were studied.

At the moment, food-related information is scattered on the Internet in several places and in different forms, making the information hard to use. A service that could integrate customised external information would enable more efficient tailoring of the service to the specific needs and interests of the consumer. These external sources could be product information and food preparation instructions in various different forms.

A Google search was performed to investigate the functional tools available on the Internet. Search terms such as weight management, food instructions, food news, etc., were used. With these terms, a large number of links were found, but their substance varied greatly. For example, the term “weight management” found a total of 231,000 links, the term “food instructions” a total of 178,000 links, the term “recipes” 723,000 and the term “food news” 78 links. The links were all to Internet sites that had the terms mentioned in it. The search resulted in a large number of links but their relevance to the topic was to some extent weaker than expected. Therefore, material was also searched using the link list on the Finnish Food and Drink Industries’ Federation (ETL) website.

A great number of food-related sites were found and the most relevant sites were reported. Mostly domestic sites were focused on. However, the audiovisual material on these sites was scarce and foreign sites were also used.

The material was divided into four groups: product information, recipes, food information and food culture, as well as audiovisual material. A list of all websites used is in appendix A.

3.2.1 Product Information

Food product information can be found on the Internet in many different places and in many different forms. In addition to food product manufacturers’ websites, information was found on the websites of associations, restaurants and food stores. The content and form of the information available varied according to the website. Product information is regarded as all information regarding the nutritional content, product description, ingredients and purpose of use.

Food Producers

Nutritional information, product descriptions and lists of ingredients can be found on most producers’ websites. The nutritional information that was provided always consisted of energy content (kcal and kJ) as well as amount of protein, carbohydrates and fat per 100 g of the product. In some cases the carbohydrate amount was further divided into sugar and lactose, depending on the product. In addition, the amount of saturated fat was also provided by some.

In addition to the macronutrient contents provided (energy, carbohydrate, protein and fat), some of the vitamin and mineral contents were available, depending on the product. The most frequently reported contents were those of calcium, vitamin D, vitamin C, fibre and sodium.

Many websites also provided other nutritional information, i.e. what special diet a product is suitable for. Other product attributes were also emphasised, i.e. low salt content, high fibre content, no cholesterol, no additives, etc. The most specific websites also provided the country of origin of the various ingredients used.

In general, all of the product information was found as a separate part of the website and worked using a general search field or through product categories. Many websites also provided more general health-related information, i.e. fibre information, vegetable information. The information provided by food producers varied from a limited supply of just ingredients and macronutrient contents (i.e. www.ingman.fi), to a very wide selection of information and services (i.e. www.valio.fi, www.atria.fi, www.fazergroup.fi) where the consumer is provided with general information about health and nutrition.

Associations

A number of domestic associations provide consumers with product or product category information. The information varied, according to the website, from general information about product use to very specific product information. The largest providers of information were Finfood Suomen Ruokatieto ry (www.finfood.fi) and its subsites (www.finfood.fi/kananmuna, www.finfood.fi/liha and www.finfood.fi/luomu) as well as Kotimaiset Kasvikset ry (Finnish Horticultural Products Society, (www.kotimaisetkasvikset.fi)). The websites contained a range of different information concerning Finnish food and horticultural products.

The Finfood main page contained general information about Finnish food as well as statistical and nutritional information. The website also contained a learning package with different food-related information for different aged people. The subsites contained varying information about ingredients, preparation, use, compositional and nutritional information, suitability for special diets and the role of the product in the diet. The Kotimaiset Kasvikset website contained a consumer-oriented part with information about vegetables, vegetarian dishes, the

storage and preservation of vegetables, nutritional contents, “vegetable of the year”, consumption of vegetables and more specific information, i.e. the colour components of vegetables.

Restaurants and Other Mass-Catering Services

Numerous fast-food restaurants and chains provide online information about their products. For example, all of the following restaurants’ websites provided the nutritional content and suitability for special diets: www.mcdonalds.fi, www.hesburger.fi, www.picnic.fi, www.subway.fi, www.kotipizza.fi. McDonald’s, for example, provides information for all products as well as allergy-related information and a nutritional calculator that calculates the nutritional content of all products selected.

Other mass-catering services, i.e. lunch and student cafeterias as well as other restaurants, provided weekly menus on their websites but did not mention the nutritional content of their meals (www.fazeramica.fi, www.sodexho.fi, and www.katriantell.fi). The only information provided on the menus was the suitability for special diets (i.e. low lactose, lactose-free, gluten-free, vegetarian, and milk-free).

Retail Stores’ Services

The websites of retail stores contained information concerning the products they sell. The products could be found through a search field and contained nutritional information as well as product information. The nutritional information provided was generally the macronutrient content as well as the ingredients and additives used in the product. Some products also contained more specific information about the type of fat and amounts of sodium and fibre. In addition, they specify the producer, country where the product is produced and the origin of the ingredients. The websites also present seasonal and new products (www.pirkka.fi, www.plussa.com, www.yhteishyva.net/ruokamaailma).

3.2.2 Recipes

An abundance of recipes were available on the Internet. Recipes were provided by most of the food producers', associations' and retail stores' websites. In addition to these, recipes were also found on other websites, i.e. the websites of food-related television programmes and magazines.

The amount of recipes available varied between websites. The Valio website provided the most recipes. The website hosts Finland's most diverse Internet cookbook with over 2,500 tested recipes. The website offers very diverse information concerning cooking, nutrition and Valio's products. The cookbook, nutrition and wellbeing information, product information and test kitchen presentation can be accessed free of charge. By registering as an active user, the personal recipe folder, party guide, food-related entertainment (links, quizzes, games, art, food horoscope) and tips become available. In addition, the active users can access Valio's Internet-TV with videos of food and meal preparation.

Food producers' recipes are mainly ones that use their products as ingredients. There were, however, some websites that offered recipes that were not based on their products but completed the recipe collection. For example, Atria, specialising in meat products, also offered recipes for various desserts in addition to their meat-based recipes. The search possibilities for these services ranged from a simple alphabetically ordered list to a much more complex search criteria.

Recipes for different purposes, i.e. parties, students, seasonal dishes, were also available on other websites. Depending on the number of recipes available, they were presented in either a list form under an appropriate heading, available through a search service or through a mechanism which utilised both. Recipes were found on www.ruokala.tv/Public/Etusivu, www.anna.fi, www.kotijakeittio.fi, www.mainio.net, www.soneraplaza.fi/ellit/ideakeittio/haku. The Soneraplaza website also offers illustrated recipes in addition to traditional recipes. In the illustrated recipes each step of the process is shown with a picture of the process.

3.2.3 Food Knowledge and Culture

Elisa telecommunications offers a diverse service to make cooking easier. The food and wine web pages contain information about trends, an extensive

cookbook, wine tips and food news. The service is available free of charge but requires registration in order to access the whole service (elisa.net/ruokajaviini/).

The Helsingin Sanomat online newspaper has a special food and drink section every Thursday. It offers information on different foods and trends with a weekly theme. However, this also requires registration and ordering of the online newspaper (www.hs.fi/uutiset/verkko-hesari).

3.2.4 Audiovisual Material

Audiovisual material on the Internet is mainly in the form of recipes. Some recipes were illustrated with photographs (www.soneraplaza.fi/ellit/ideakeittio) and others were videos (www.maku.fi/makuaskeleet, www.uktvfood.co.uk, www.foodnetwork.com/food/video_guide, www.valio.fi).

The quality of the content of the videos varied from simple to very advanced. Video services in Finnish chose simple recipes and demonstrations, i.e. preparing mayonnaise, using gelatine and making meringue. Valio has launched an Internet video service that contains some recipes and product information in video form. The service provides a couple of recipes at a time that change a couple of times a month. The recipes are divided into 4 categories: tricks and tips, easy and fast, rewarding weekdays, weekend. The service is available free of charge but requires registration.

The UKTV Food website offers a wider range of material. Videos from popular television shows are available where one dish or meal is prepared at a time. The website also offers a service from which videos and recipes can be ordered to a mobile phone for a small cost. The videos provided by the website are of good quality and offer an interesting form of entertainment.

3.2.5 Feedback Systems

All websites were equipped with a possibility to give feedback. In general, there were two possibilities to give feedback: an electronic feedback form or a phone number for consumer use. The feedback forms varied in length from one open

question to numerous detailed questions. Usually, both the phone number and form options were provided.

3.2.6 Evaluation of Information

If the available product information could be linked to a personal database in a service, it would personalise the service and enable its use according to individual interests. The consumer could easily access the information on new products, or unknown products, and receive information regarding their ingredients, country of origin, and suitability for different allergies or special diets. Comparison of different products would also be easier and faster. In addition to benefiting the consumers, this linking of product information to the service would also serve the food industry (producers, retail stores and mass-catering services). It would provide them with an effective marketing channel directly to the interested consumers. Linking recipes to the service would make the use of different products at home easier and faster, and the energy content of a portion size could be calculated directly from the recipes. Recipes could also be collected into an online cookbook where they could be found easily. Food news, food cultural information and audiovisual material would provide an efficient way to get acquainted with food-related topics, improve cooking skills and make the service more entertaining.

The ability to access the external information would also further promote the role of the mobile phone in the service. A mobile phone is easily transported, regardless of time and place, and would be easy to take into the kitchen. Hence food preparation demonstrations could be utilised everywhere. This would add to the usability of the service and attract consumers that are interested in technology, i.e. men and young adults that are less interested in cooking.

With the diversification of the service, its use in everyday life would be easier. It would enable the service to be tailored to the needs of the individual consumer, supporting them regardless of interest in food and technical skills. The consumer could decide on how he/she uses the service and the vast amount of material available.

4. Food Databases

Food composition databases provide detailed information on the nutritional composition of foods and they are used for many different purposes. Food composition databases can be classified based on the origin of food information (product specific or average information), who has developed the databases (research or governmental institutes, food industry or service developers) and the purpose of use (e.g. dietary surveys, health services, product development and food labeling). Utilisation of different food composition databases varies depending on whether they are aimed at public or professional use. Different uses of food composition databases are analysed in the report on the EuroFIR-project (www.eurofir.net/temp/2ndspsynthesisspreport.pdf).

Most of the developed services gather food composition information from different sources because common and comprehensive food composition databases are not available.

There are several international collaborative projects and networks, the aim of which is to unify the collection, availability and trustworthiness of food composition databases. EuroFIR (European Food Information Resource Network, www.eurofir.net/) is an EU project (2005–2009), the goal of which is to establish the first comprehensive pan-European food information resource for food and health research. The National Nutrient Databank Conference (NNDC) is organised annually in the USA to increase collaboration between experts and developers of food composition databases. In 2004 they published the International Nutrient Databank Directory (www.medicine.uiowa.edu/gerc/NNDC/NDB%20survey%20final%20version%202011-04.pdf), which collects information on several different databases and their characteristics. The International Network of Food Data Systems (INFOODS, www.fao.org/infoods/index_en.stm) maintains an international directory of the data available on the nutrient composition of foods. Other collaboration projects for unifying nutritional information have been NORFOODS (www.foodcomp.dk/norfoods/nordic_food_data_webs.html) and COST Action 99, which published the report “Eurofoods recommendations for food composition database management and data interchange” (www.eurofir.org/COSTAction99/Download/EurofoodsRecommendations.pdf).

The EuroFIR project aims to improve collaboration and data transfer between national food composition databases and the food industry by creating unified solutions and recommendations for data transfer. Getting information from the food industry is often problematic because automatic data transfer from the industry to national databases is not available. The experiences and problems of data transfer (e.g. different formats of data, checking and handling the data, reminding of food industry) in the pilot cases (Belgium, Finland, Italy and the Netherlands) are described in “Pilot cases on data transfer from food industry to European national food composition databases” (www.eurofir.net/temp/Pilotspcasessspnsdpdatasprtransfer.pdf).

4.1 National Food Composition Databases

Research institutes and national public health institutes in different countries maintain national food composition databases like Fineli®, the Finnish Food Composition Database (www.finel.fi). The Fineli database contains information on the nutrient content of foods used in Finland. The information in national food composition databases contains mostly average nutritional information based on research results and literature, but they also contain some accurate information on food products. These databases are often used as a starting point when developing services. Based on the requirements of the service, the databases can be enhanced by information on the food industry or restaurants (e.g. fast food).

Outside Europe, important food composition databases that are often used by developers are the USDA National Nutrient Database for Standard Reference Release 18 (www.ars.usda.gov/main/site_main.htm?modecode=12354500) in the USA and the Canadian nutrient file (CNF, www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index_e.html) in Canada. Examples of co-operation between different countries are CEECFOODS (Central and Eastern European Countries Food Database System, www.florafood.com/dcs/home/index.html) and The WorldFood Dietary Assessment System (www.fao.org/infoods/software_worldfood_en.stm).

4.2 Industrial Food Composition Databases

Product databases have been developed between food manufacturers and retailers. The databases include product information, such as sizes of packages for delivery, storage requirements, food manufacturers, product identity, and nutritional contents and properties. The information is mainly used for logistical requirements between the food industry and retailers, and the focus is different than in health services for consumers.

The Sinfos (www.sinfos.com/) data pool is used in several European countries as a product databank. The Sinfos (www.sinfos.fi/) Finnish data pool is part of the international Sinfos database and all Finnish retailers receive suppliers' product information via the Sinfos data pool. Other databanks specialising in data transfer between the food industry and retailers are 1Sync (www.1sync.org/), which is used by big chain stores like Wal-Mart. The implementations are mostly in-company solutions for a certain chain of store and not between different store chains. There are also national solutions like EAN (www.eanreg.no/) in Norway and UDEX (www.udex.com/) in England.

Many food manufacturers have a lot of product and nutrient information on their web pages. Food manufacturers also co-operate with each other. Examples of services where information is combined from different suppliers are the allergen databank ALBA (www.allergenendatabank.nl) in the Netherlands, Spanish co-operation between manufacturers of candies (FEAD, www.fead.es) and the GPI databank (www.gpidatabank.nl/index.html) in the Netherlands, which combines product information on food manufacturers, restaurants and canteens.

4.3 The Databases of Service Developers

The databases of service developers usually combine information from several sources and they are mostly developed to meet the requirements of a certain service. An example of a service developer that also sells food composition database information to other developers is ESHA research (www.esha.com/). The information in the ESHA data food composition database is composed of USDA and Canadian Nutrient databases as well as information from food manufacturers, fast food chains and literature. The foods have been classified into different categories and parts of the food pyramid.

4.4 Conclusions

There are many different developers of food composition databases and they are used for several purposes. Comprehensive product information, reliability and accuracy play an important role when developing services.

Many countries have national food composition databases that include information on eating habits and food products of the area. International co-operation between national food composition databases is going on and the goal is to develop common practices for data transfer between different parties. The maintainers of national databases are increasing the amount of exact product information in addition to average information. In order to accomplish the comprehensive national food composition database, co-operation between maintainers of industrial databases and food composition databases is required.

Product databases that have information from several suppliers are used between the food industry and retailers. There are expectations of widening and opening them to so that they could be utilised in consumer applications and services as well.

To get reliable and accurate food composition database is already challenging on the national level and will take some time on the international level. Hopefully, co-operation projects in this area will be successful and speed up the process by creating common recommendations for data formats and transfer.

5. Technology

5.1 Hybrid Media

According to the definition by the Hybrid Media Community (www.hybridmedia.org/), the term hybrid media means the combination of printed and electronic media. 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 in Japan. Reading two-dimensional (2D) barcodes (i.e. matrix codes) with a camera phone is becoming common in the Western world as well. However, the most popular 2D barcode format in Western countries will probably not be QR-code, but Data Matrix. 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.

HyperFit utilises barcode reading with camera phones and uses the conventional one-dimensional (1D) barcodes printed on food package. In this case, a complete URL is not encoded in the code. Instead, an EAN (European Article Numbering) number is encoded. After reading the barcode with a camera phone, the HyperFit barcode reading software opens the web browser of the mobile phone. Then, the web browser retrieves the product information page from the server. This product information page contains personalised nutritional information on the product and additional services, such as a button for adding the product to the food diary (Chapter 6.4). The barcode reading software was developed in the TIVIK project that preceded HyperFi [Järvinen, 2005].

VTT has been developing hybrid media technology since 1991. Many prototype systems have been developed and some patent applications have been submitted. There is also a commercial product based on the technology that VTT has developed, i.e. UpCode. UpCode (www.upcode.fi/) is an application for reading 2D barcodes with a camera phone. The Finnish financial newspaper Kauppalehti, the free distribution newspaper Uutislehti 100, the catalogue printer Eniro and Soprano's magazines Uusi Toimisto and Kampanja use the Upcode product.

5.2 Mobile Technology

Mobile technologies have developed exponentially during recent decades, and the rapid progress is still taking place. In addition to making telephone calls and sending SMS messages with a mobile phone, it is possible to browse the web, take photographs, listen to MP3 music, watch TV, play games, and so on. Barcode scanning requires a smartphone with an integrated camera and a barcode scanning application.

According to the definition by Wikipedia, a smartphone is a full-featured mobile phone with personal computer-like functionality. An important feature of most smartphones 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. The HyperFit barcode reader application is an example of this kind of application. Symbian is the most popular operating system in the smart mobile devices. The market analysis provider Canalys estimates that in 2006 Symbian had a 67% share worldwide, Microsoft had a 14% share, RIM (Research In Motion) had a 7% share, Linux had a 6% share and the Garnet OS had a 5% share. Canalys expects that Linux will become more popular in the future.

The existing smartphones with integrated cameras work very well when reading 2D barcodes using applications such as UpCode, Kaywa (reader.kaywa.com/) or Glass (www.activeprint.org/). This is not the case, however, when reading 1D barcodes. Today, the resolutions of integrated cameras are typically 1.3 megapixels or higher, which is enough for 1D barcode scanning applications. However, the lense of the camera phone is an issue in 1D barcode scanning. The focus distance of a typical camera phone lense is too far, starting from 30 centimeters. Hence the 1D barcode scanning applications need a special add-on macro lens that must be attached to the camera phone. It is needed to shorten the focus distance to five centimetres. This requirement prevents the 1D barcode scanning applications getting into the mass market because the average consumer does not want to buy any accessories for his or her mobile phone. It is difficult to know if this problem will ever be solved since there is not enough space for a good quality lense in a camera phone device that should be small in size and, at the same time, have plenty of features. However, the limitations of barcode scanning will be forgotten as soon as barcodes are replaced by RFID tags.

5.3 RFID and EPC

Radio-frequency identification (RFID) is an automatic identification method that relies on storing and remotely retrieving data using devices called RFID tags or transponders. An RFID tag is an object that can be attached to or incorporated into a product for the purpose of identification using radio waves. The RFID tag can automatically be read from several meters away and does not have to be in the line of sight of the reader. Nowadays, RFID technology is used in many applications. In Helsinki, for example, RFID tags are embedded in travel cards that can be used as tickets on all public transportation, such as buses, local trains and metro. The EPC (Electronic Product Code) standard will utilise RFID technology as well. In the future, EPC will be used in logistics applications.

An EPC contains the EAN number and other data related to the food product. It is attached to the food casing. In the future there might be a gate in every supermarket that automatically reads all the EPCs attached to the groceries in the shopping cart. The price of the purchase will be calculated instantly and there will be no longer a need for cash desks. Additionally, EPC will bring many other benefits to the retail sector. For example, it will make it easier to trace any individual product in the logistics chain. The global EPC system will be finished in a few years. However, barcodes will be used in parallel with EPCs for many years; it will take 10–15 years before even the premium daily consumer goods have item-level RFID tags.

There are currently three mobile phone models with integrated RFID or NFC (Near Field Communication) readers on the market. All are manufactured by Nokia: Nokia 3220, 5140 and 6131. None of them are smartphones. The NFC technology enables users to read small amounts of data from compatible tags, as well as to communicate with other devices, with a simple touch. NFC technology has evolved from a combination of RFID, contactless identification and interconnection technologies. According to some estimates, there will be an NFC reader in every second mobile phone by 2010.

5.4 Pedometers and Heart Rate Monitors

A market survey of pedometers was carried out. It revealed that several pedometers exist but none of them are capable of communicating with a PC. For example, one widely used and low cost pedometer is Omron Walking Style II, which calculates steps, aerobic steps, travelled distance and energy consumption during the exercise. But, for the purposes of the HyperFit project, where all manual data input should be avoided, there was no way to transfer the exercise information from the device to the HyperFit system automatically.

Another survey was done to examine HRM (Heart Rate Monitor) devices. Two of the most popular HRM manufacturers come from Finland – Polar and Suunto. The HRM device usually contains three components: 1) a transmitter belt, 2) a wrist unit and 3) a foot pod (or a bike pod). Three possible candidates for the HyperFit project were found. The results are shown in Table 4.

Table 4. Three possible HRM device candidates for HyperFit system.

Device	Communications, PC software	Communications, Mobile phone	Features
Polar S625X	Polar Precision Performance, IR wireless	Nokia 5140, 5140i, IR wireless, MobileLink software	heart rate, altitude, speed, distance
Suunto X6HR	Suunto Activity Manager, serial communications cable	--	heart rate, altimeter, compass, watch, barometer
Suunto t6	Suunto Training Manager, USB cable	--	heart rate, altimeter, EPOC, speed, distance, watch, barometer

All HRM devices listed in Table 4 are in the 400 to 500 euro price range when a foot pod (or bike pod) is included. Our choice for the HyperFit project was Polar S625X, as we could then use the Polar SDK (Software Development Kit) to develop our own easy-to-use application for transferring the exercise data to the HyperFit system.

6. Pilot System

6.1 System Overview

HyperFit is an Internet service for personal management of nutrition and exercise. It provides tools for promoting healthy diet and physical activity. The idea of the service is to mimic the process of personal nutrition counselling. It starts with testing and goal definition with the help of a virtual counsellor, encourages the use of food and exercise diaries, and, finally, analyses the progress and gives feedback and encouragement. Recommendations by the Finnish National Nutrition Council are used as the nutritional basis for the counselling tools.

The service can be used with both a mobile phone and a PC. The mobile phone and PC applications are meant for slightly different purposes. The mobile phone is primarily for quick and easy food and exercise diary data input. One way to add products to the food diary is to read barcodes with a camera phone. The PC application is focused more on counselling, representing summary information and analysis. Most of the guidance and feedback is given by a virtual trainer.

HyperFit can be used without a mobile phone, but the mobile application offers time and location independence and quick data entry mechanisms.

The system includes

- Self-evaluation tools for testing weight management needs, and eating and exercise habits.
- Tools for setting dietary and exercise targets.
- Food and exercise diaries with several alternative data feeding methods: product browsing and search, favourite lists, reading bar codes from food packages with a camera phone, etc.
- Tools for following weight, waistline circumference, daily steps and perceived feelings.

- Calculators: a body mass index (BMI) calculator, an energy calculator for demonstrating the correspondence between energy, 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.
- Daily and weekly summaries and analyses of the nutrition and exercise situation based on food and exercise diaries.
- Personal feedback and encouragement given by a virtual trainer.
- Product-specific information on existing products and average information on product categories, including the amounts of energy, protein, carbohydrates and other various nutrients.
- Information about nutrition recommendations, energy and nutrients, vitamins and minerals, weight management, food additives and exercise.

The user can choose between two trainers, a male or a female. The feedback differs depending on the trainer. There are other variations depending on the time of the day, the day of the week and some other parameters. The virtual trainer is shown during the registration process and the daily and weekly summaries. The user can change the virtual trainer. Figures 2 and 3 show some guidance and feedback examples given by the virtual trainers.

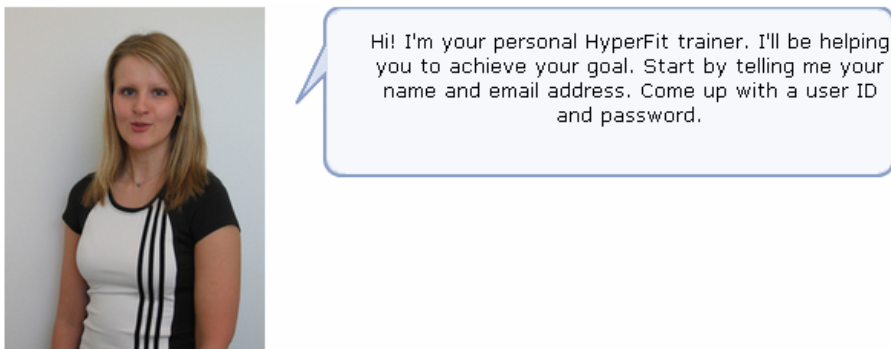


Figure 2. Guidance from Kaisa.



Oh dear. Your energy profile could use some work...

Your carbohydrate intake is too low. Carbohydrates are your body's most important source of energy, so you'll need them if you want to keep going. Recommended sources of carbohydrates are high-fibre cereal products, vegetables, fruits and berries.

Your protein intake is slightly higher than recommended. This is, however, not a problem for your health. For people trying to lose weight an ample protein intake can even be beneficial thanks to the feeling of fullness it gives.

Figure 3. Feedback from Veli-Matti.

The system is integrated with the Nutritioncode system by Tuulia International Oy (www.tuulia.fi), where the consumer can follow the nutritional quality of his/her food basket in relation to nutritional recommendations. Through the integration HyperFit users get lists of purchased foods to be added to the food diary.

A “Quick barcode” system was built in order to lower the threshold to add food and exercise data to the diaries. With the system users can print lists of barcodes containing favourite foods, exercise activities, common meals and snacks, and then insert them into the diaries with the camera phone.

A heart rate monitor is integrated with the system. With a simple interface exercise information can be sent from the heart rate monitor direct to the HyperFit exercise diary.

In the project the mobile phone product information service was adjusted for visually impaired people. A beeping sound was added to the barcode reader to give an indication of the reading process. After recognition the product information from the HyperFit web pages was converted to speech in the mobile phone.

6.2 Food Database

The HyperFit system uses the food database that was developed in the preceding TIVIK project [Järvinen, 2005]. It contains the nutritional information of for approximately 2,500 foods. The food database has both product-specific and average nutritional information on Finnish foodstuffs. Product-specific food information is taken directly from the 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.

The HyperFit database only contains a fraction of the real products available in retail business. To be able to get the average nutritional information on the missing products, they have been mapped to the average Fineli products using the EAN-code/FOODID mapping of Tuulia International food database with tens of thousands of products. The system tells the user the source of the information and whether the information is product-specific or average.

6.2.1 Product Information

The HyperFit database contains the following product and nutritive information:

Identification and classification information

- Supplier name
- Product GTIN (EAN number)
- Product name
- Country of origin
- Country of manufacture
- Food category

Nutritional contents

- Energy kcal
- Protein g
- Carbohydrates g
- Carbohydrates, of which sugar g

- Carbohydrates, of which lactose g
- Fat g
- Fat, of which saturated
- Fat, of which unsaturated
- Nutritional fibres

Nutritional composition

- Alcohol content %
- Salt content %
- Fat content %
- Sugar content %

Vitamins and minerals

- Vitamin C, Vitamin D, thiamine and folate
- Minerals Calcium, Iron and Magnesium

Ingredients

The data format for product information in the HyperFit database is based on the product information form by the Finnish Grocery Trade Association (www.pty.fi). The form must be completed for each product offered for wholesale trade in Finland.

6.2.2 Food Taxonomy

A food taxonomy was created in the HyperFit project to support easy and natural browsing of product data. The Finnish Grocery Trade Association has a taxonomy for product information but it is developed for storage and logistics purposes and does not fit very well with consumer applications.

The created taxonomy has three levels. The lowest level is taken from the Finnish Grocery Trade food taxonomy as the information is already in the product information forms. The two upper levels were created in the project. Figure 4 shows the top level of the taxonomy. Figure 5 shows the subclasses of baked goods and some products of the lowest subclass.

Product browsing



- + [Baked goods](#)
- + [Cereal preparations](#)
- + [Dietary fats, mayonnaises and sauces](#)
- + [Drinks and drink powders](#)
- + [Eggs and egg foods](#)
- + [Fish, fish foods, shellfish](#)
- + [Fruit and berries](#)
- + [Ice cream and desserts](#)
- + [Meat](#)
- + [Meat and processed foods, meat foods](#)
- + [Milk preparations and foods](#)
- + [Miscellaneous foods and ingredients](#)
- + [Potatoes and potato foods](#)
- + [Salads and salad dressings](#)
- + [Sugar, sweeteners, sugar confectionery](#)
- + [Vegetables and vegetable foods](#)
- + [Alcoholic beverages](#)

Figure 4. Food taxonomy.

Search results



• > [Baked goods](#) > [Rusks and bagels](#) > coffee bagels

Search results 1-6 / 6

- **Kilorinkeli 500 g** (Fazer Leipomot)
Energy amount: 320 kcal/100 g, 112 kcal/portion (portion size: 1 pc, 35 g)
- **Leserinkeli 300 g** (Fazer Leipomot)
Energy amount: 340 kcal/100 g, 119 kcal/portion (portion size: 1 pc, 35 g)
- **Sugar ring with low-fat milk** [Fineli]
Energy amount: 354 kcal/100 g, 124 kcal/portion (portion size: 1 pc, 35 g)
- **Vaniljarinkeli 500 g** (Fazer Leipomot)
Energy amount: 310 kcal/100 g, 109 kcal/portion (portion size: 1 pc, 35 g)
- **Pretzel/savory baked rings** [Fineli]
Energy amount: 355 kcal/100 g, 124 kcal/portion (portion size: 1 pc, 35 g)

Figure 5. Baked goods.

Another purpose of the classification was to connect portion sizes to products. The portion size is an easy way for users to approximate the amount of food eaten instead of calculating grams and calories. Three portion sizes were usually specified for each category of the lowest level of the taxonomy. All products that belong to some category have the same portion sizes. For instance, for bread, there are portions of small slice (20 g), medium slice (30 g) and large slice (40 g) (Figure 6).

Portion		
Description	Amount	Weight
<div style="border: 1px solid gray; padding: 2px;"> slice (30 g) ▼ </div> <div style="border: 1px solid gray; padding: 2px; margin-top: 2px;"> small slice (20 g) </div> <div style="border: 1px solid gray; padding: 2px; margin-top: 2px; background-color: #007bff; color: white;"> slice (30 g) </div> <div style="border: 1px solid gray; padding: 2px; margin-top: 2px;"> large slice (40 g) </div>	1.0 no. of items	30.0 g

Figure 6. Portions.

6.3 PC Application

6.3.1 Self-evaluation with Tests and Calculators

Using the HyperFit system starts with self-evaluation. The weight management needs, food and exercise habits are tested and goals are set for weight management and exercise. The self-evaluation includes the following phases:

- Background information registration: age, weight, waistline and physical activity. The Body Mass Index (BMI) is calculated and the user gets feedback based on the BMI and waistline.
- Eating habits testing with a questionnaire and feedback. This contains 20 questions concerning the use of fat, salt, meat, fish, milk products, fruit and vegetables, snacks, drinking habits and eating frequency. The questionnaire is based on the Finnish Heart Association and Finnish Diabetes association self-evaluation tests.
- Exercise habits testing with a questionnaire and feedback. The test contains 8 questions concerning daily routine exercise and fitness training. This questionnaire is also based on the Finnish Heart Association and Finnish Diabetes Association self-evaluation tests.
- Setting the goals for weight management, daily and weekly exercise, and daily steps with the help of the recommendations given by the virtual trainer.

At the end of the registration the user gets a summary of the weight management and exercise targets, test results and feedback. The food and exercise habit tests are available for re-evaluation at any time. In addition, users can test their eating habits with a questionnaire. The eating habits questionnaire is developed from the Finnish Heart Association and Finnish Diabetes Association self-evaluation tests.

The Exercise Calculator either calculates the energy amount consumed during a given exercise period or the time period needed to exercise a selected sport to consume a given amount of energy.

The HyperFit Energy Calculator shows how long an exercise period should be in order to consume a given amount of energy or how much food should be eaten to get the energy (Figure 7).

Energy calculator



Energy amount: kcal

Energy amount (150 kcal) as exercise

 25 min	 51 min	 38 min
 38 min	 25 min	 11 min

- all exercises -

Energy amount (150 kcal) as food

Shrove bun with jam and almond paste (1 pc)	0.8 pcs
Cucumber (slice)	312.4 pcs
Minced meat burger	0.5 pcs
Organic skimmed milk 0% fat, without added vitamin d (glass)	2.6 pcs
Berry and fruit yoghurt fat-free (jar)	1.1 pcs
Cheese emmental , 27-30 g fat, blue-label (slice)	4.0 pcs
Egg without shell (1 pc)	1.8 pcs
Potato crisps fatty, potato snack (1 dl)	3.6 pcs
Muesli crunchy high fat (portion)	1.3 pcs
Mandarin, average, with peel (1 pc)	6.9 pcs

Figure 7. Energy Calculator.

6.3.2 Food Diary

The food diary is the core of the HyperFit system. Users type in entries on the food they have eaten. Food can be inserted from a favourite list, searching by name or by browsing the food categories. Users register the product, the amount they have eaten and the time of the day. Alternatively, users can just enter the energy amount, but then the feedback is more limited.

Filling in the diary is the most arduous task in HyperFit. Much attention has been paid to ease of use. At minimum, the user only needs to select the product and save it. To help to estimate the portion size of the food, the system gives alternative portion sizes with verbal explanations (one spoon/one cup, etc, see Chapter 6.2.2 Food Taxonomy) for each product. Also, because people eat quite similarly each day, a previous diary can be entered and modified for the current day. Figure 8 shows a snapshot of the food diary.

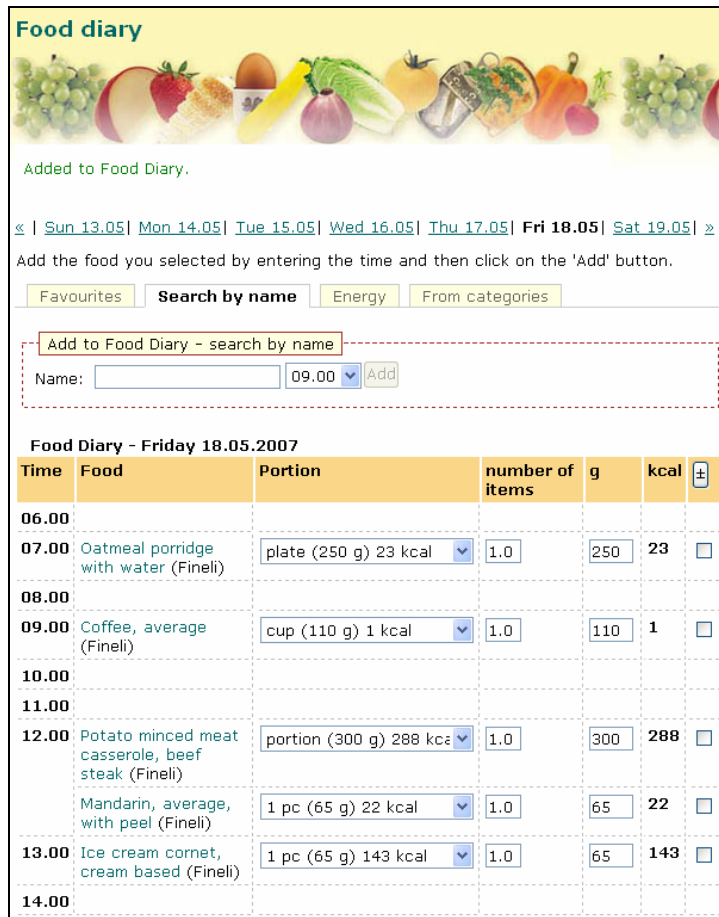


Figure 8. Food diary.

The diary shows also summary information based on the data entries (Figure 9). It shows the daily total nutritional values compared to the recommendations, the energy profile and the caloric intake from food and drinks. The nutritional values include energy, carbohydrates, protein, fat (hard and soft), fibre, sugar, salt, vitamins D, C, thiamine and folate, and minerals calcium, iron and magnesium. The energy profile shows the proportional amounts of energy derived from carbohydrates, protein and fat.

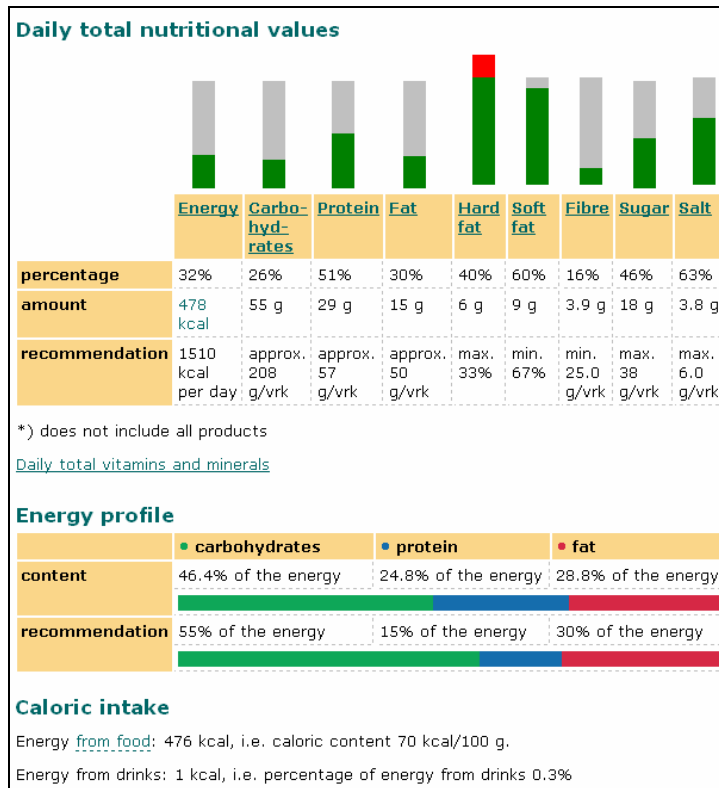


Figure 9. Food diary summary.

6.3.3 Exercise Diary

Users insert both the fitness activities and daily routines into the exercise diary, for example gardening, cleaning and playing with children. They also insert the exercise type, duration and the time of day of the exercise. The system automatically counts the consumed energy. Users can also insert the measured consumption, strain and heart rate. The information can also be read automatically from a heart rate counter (see 6.7 Heart Rate Monitor Information). Figure 10 shows a snapshot of the HyperFit exercise diary.

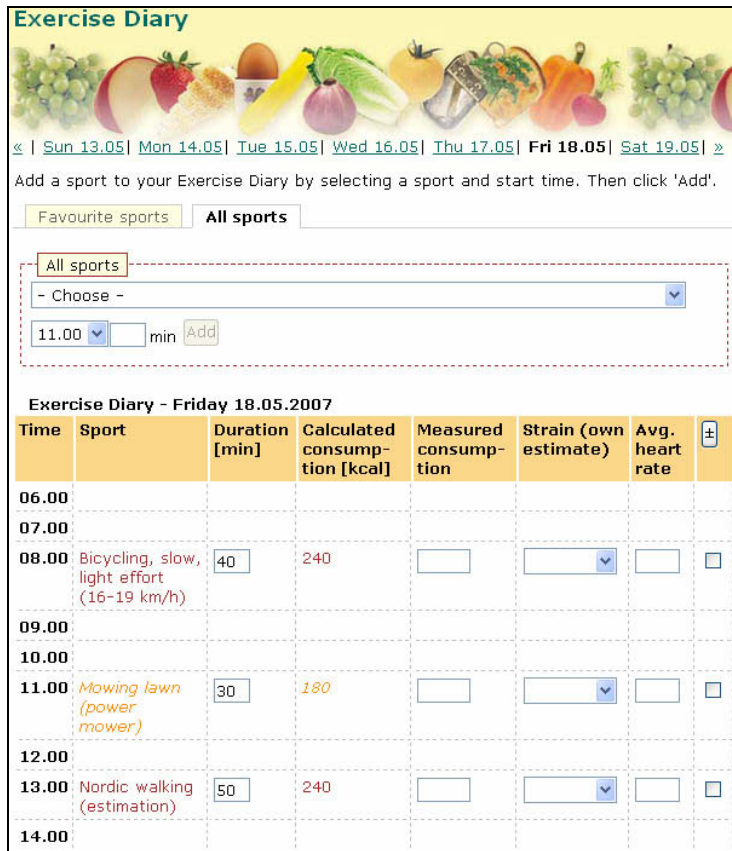


Figure 10. Exercise diary.

The diary summarises the status of achieving the exercise goals (Figure 11), both from the weekly fitness and daily routine goals.

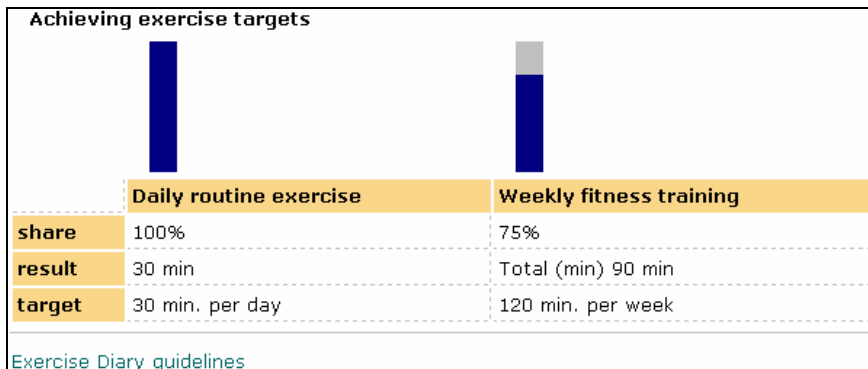


Figure 11. Exercise diary summary.

6.3.4 Steps, Measurements and Feelings

Users can save the number of the daily steps, weight, waistline and the feeling of the day. The information is used to monitor the trends and achieving the goals. Figure 12 shows the weight curve based on the weight information.

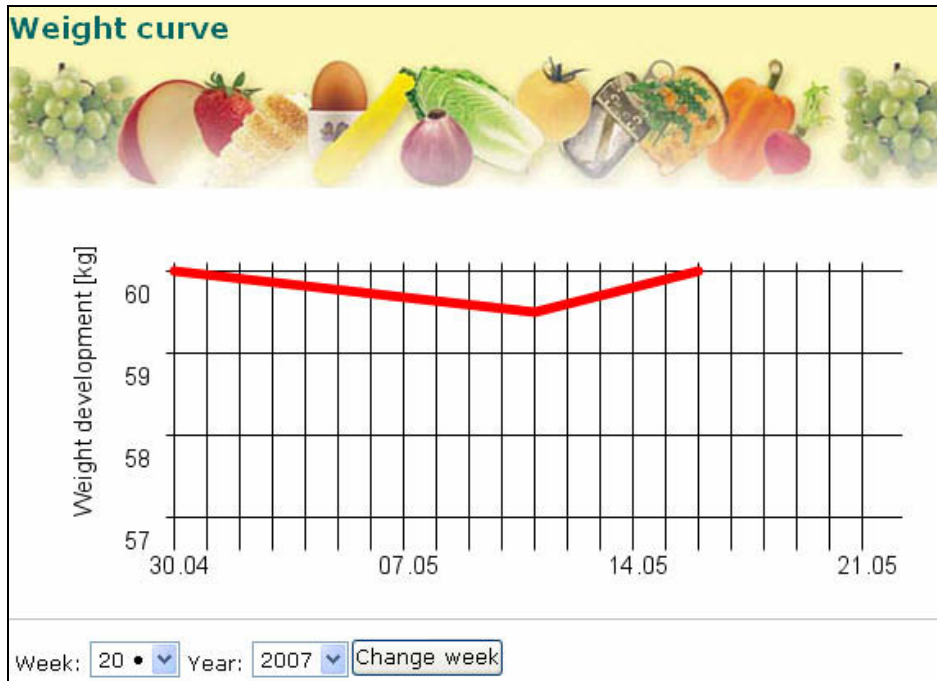


Figure 12. Weight curve.

6.3.5 Daily Status

In the HyperFit application the user's main page shows the energy and exercise summary for the day. The virtual trainer gives feedback and encouragement based on the situation. The energy summary (Figure 13) shows the energy intake from food, the energy consumption from exercise and how much energy should be still taken or consumed during the day to keep up with the weight management goals.

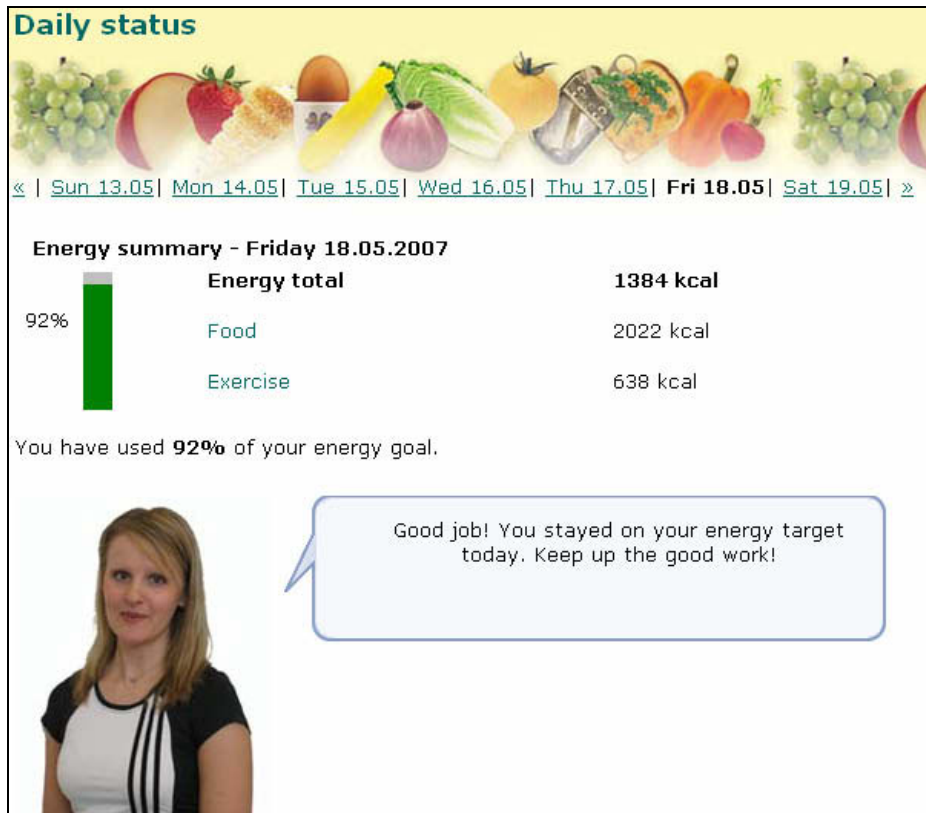


Figure 13. Energy summary.

The exercise summary (Figure 14) shows the accumulated amount of routine exercise and steps during the day, and the weekly fitness training, and compares them with the targets.

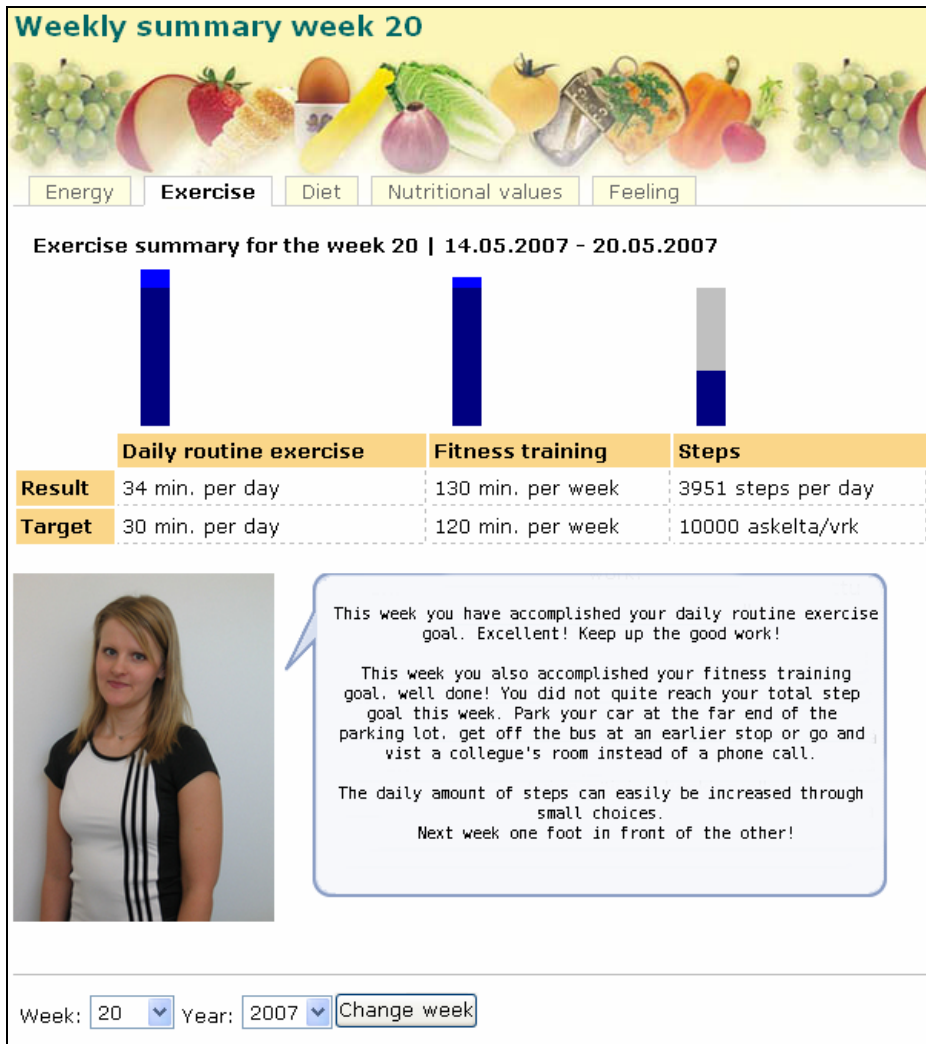


Figure 14. Exercise summary.

6.3.6 Weekly Summary

The weekly summary consists of several summary and analysis pages with feedback from the virtual trainer.

- Energy summary (Figure 15) shows the average energy total for the week, the daily energy total, food intake, exercise consumption for each day and a weight prediction.

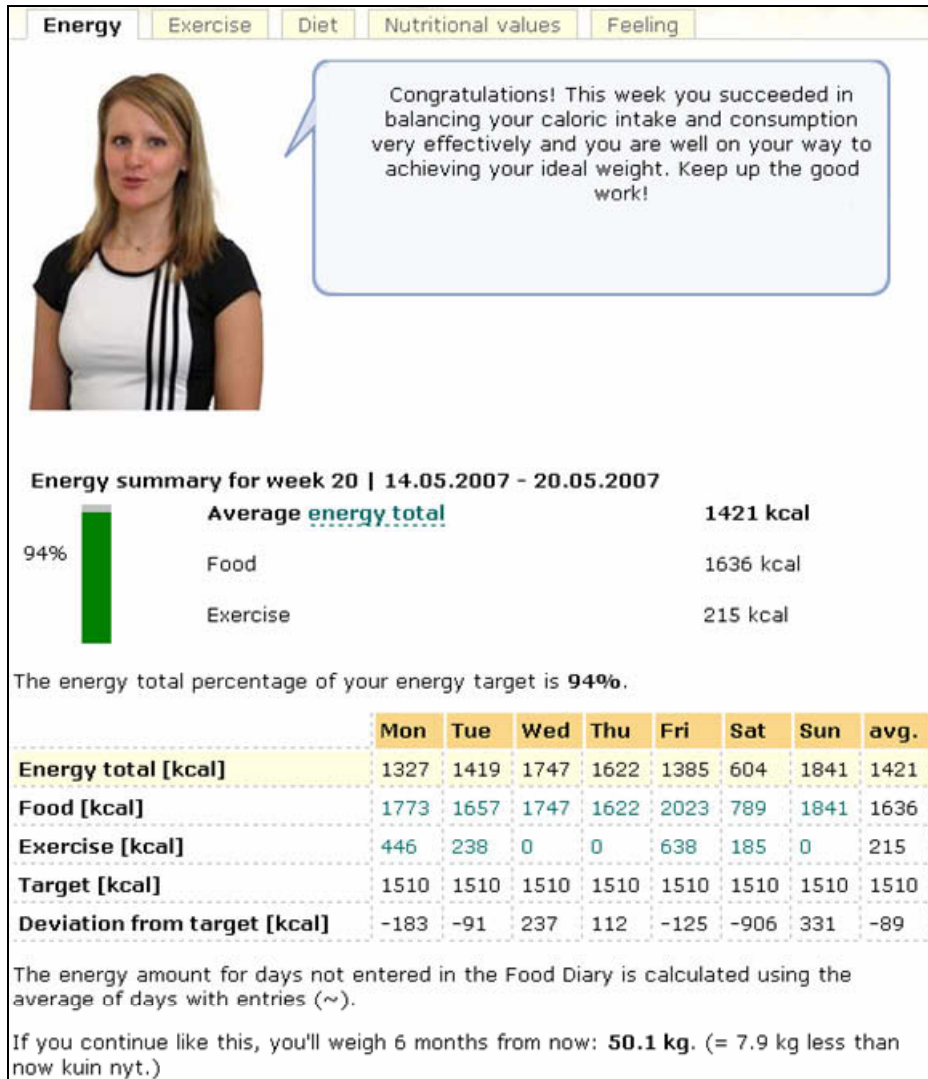


Figure 15. Energy summary.

- Diet summary (Figure 16). The contents of the food diary for the week are analysed. The user gets scores from 0 to 8 based on the quality of the diet, and feedback. The amounts of fat, hard fat, salt, fibre, vegetables,

fruit and berries, fish, and low fat dairy products are calculated and the user gets a score if the amount conforms to the recommendations of the Finnish National Nutrition Council. The regular meal rhythm is also evaluated. The analysis method is developed in the HyperFit project.



Figure 16. Diet summary.

- Nutritional values (Figure 17). The total weekly nutritional intake is compared to the recommendations and to the energy profile in a similar manner to the food diary page, with feedback from the virtual trainer. The nutritional values include energy, carbohydrates, protein, fat (hard

and soft), fibre, sugar, salt, vitamin D, Vitamin C, thiamine and folate, and minerals calcium, iron and magnesium. The energy profile shows the proportional amounts of energy received from carbohydrates, protein and fat.

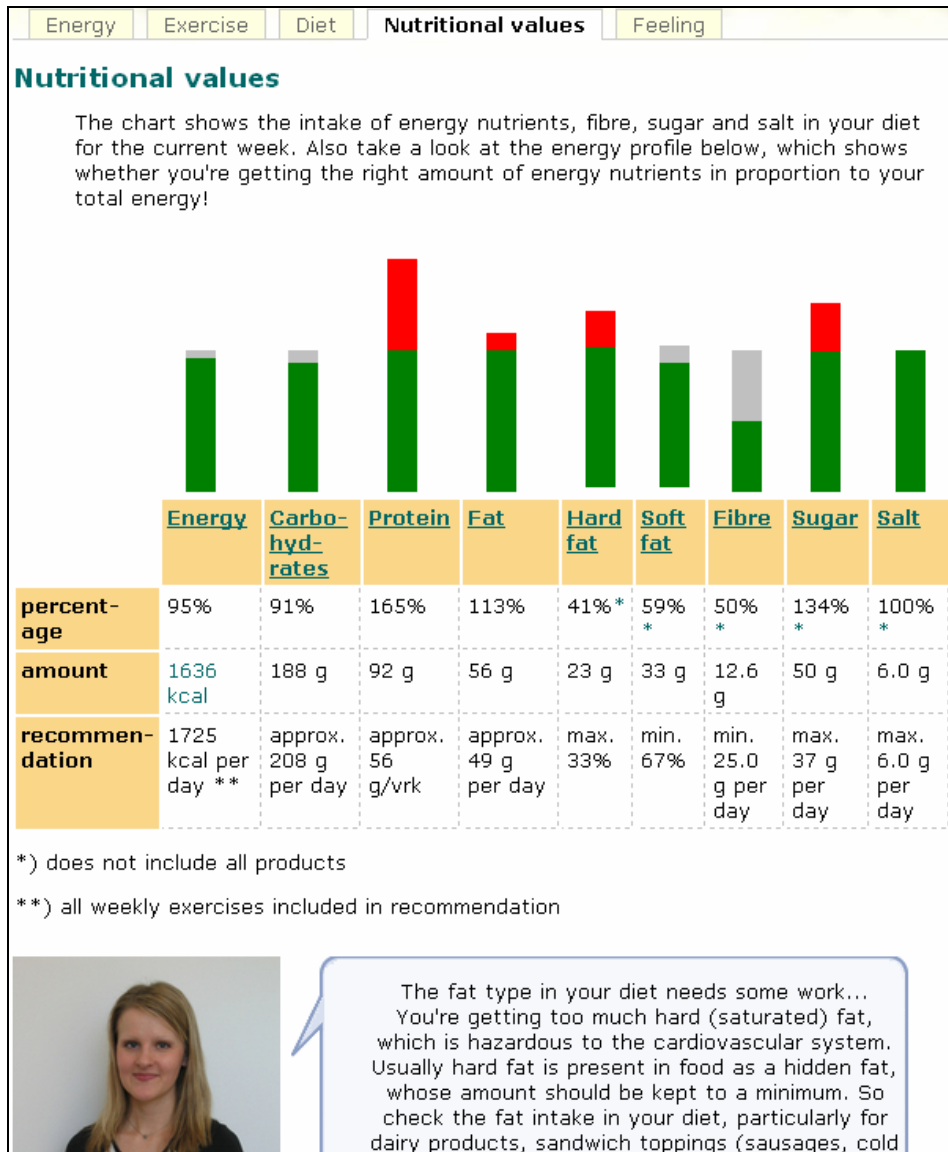


Figure 17. Nutritional values.

- The summary of feeling ratings (Figure 18) shows the average mood of the week and the daily ratings of feelings.








Figure 18. Feelings summary.

6.3.7 Product Information

Users can query information on products stored into the HyperFit database. Products can be searched by product name, EAN code or by browsing food categories. The product information contains

- General product information (manufacture, country of origin, country of manufacture)
- The ingredients
- The nutritional information, including energy, fat, protein, carbohydrates, sugar, lactose, fibre
- Vitamin D, Vitamin C, thiamine and folate, and minerals (calcium, iron, magnesium).

The program shows how much a pre-defined portion of each nutrient is for the daily recommendations of the user. The user can change the portion size. The user can also select two products and compare the nutritional content of the products. Figure 19 shows an example of product information.

Wilhelmiina 185 g	
General	
Manufacturer	Fazer Leipomot
Country of origin	Suomi
Country of manufacture	Suomi
Ingredients	<p>Vehnäjauho</p> <p>kasvimargariini [kasviöljyä, kasvirasvaa, vettä, emulgointiaineita (E471, E472c), suolaa, happamuudensäätöainetta (E330), aromeja, väriä (E160a)]</p> <p>sokeri</p> <p>nostatusaineet (E500, E336)</p> <p>suola</p> <p>aromi (vanilliinia)</p>
Energy	
Energy content	56 kcal per portion
Percentage of total energy	 <p>4% of the daily goal target: 1480 kcal per day</p>
Energy profile	<ul style="list-style-type: none"> carbohydrates: 45 E % protein: 4 E % fat: 51 E % 
Fat	
Fat content	31%
Fat amount	 <p>3 g per portion 6% of the recommendation recommendation: approx. 49 g per day</p>
Fat type	<ul style="list-style-type: none"> soft: 52% hard: 48% <p>recommendation: at least 67% soft fats</p> 
Protein	
	 <p>1 g per portion 1% of the recommendation recommendation: approx. 56 g per day</p>




Carbohydrates		
	 <p>6 g per portion 3% of the recommendation recommendation: approx. 204 g per day</p>	
Sugar		
	 <p>3 g per portion 7% of the recommendation recommendation: max. 37 g per day</p>	
Lactose		
	Lactose-free, lactose alle 0.01 g per portion	
Salt		
Salt content	0%	
Salt (NaCl) amount	-	
Fibre		
	 <p>less than 1 g per portion 1% of the recommendation recommendation: min. 25 g per day</p>	
Vitamins		
	Amount / portion	Percentage of daily recommended allowance
vitamin D	0.0 µg	0.1%
vitamin C	0.0 mg	0.0%
Thiamine (B1)	0.0 mg	0.4%
Folate	1.0 mg	0.3%
Minerals		
	Min. amount / portion	Percentage of daily recommended allowance
Calcium (Ca)	1.7 mg	0.2%
Iron (Fe)	0.1 mg	0.6%
Magnesium (Mg)	1.5 mg	0.5%
Information per portion Information per 100 g Go to Exercise Calculator		

Figure 19. Product information.

6.3.8 Own and Compiled Products

Users can add their own products, compiled foods and meals to the system. The complemented products are only available to the user who added the product. In the future this could be a way to accumulate real products in the database. Figure 20 shows the form for adding own products and Figure 21 a compiled food.

Add own product

Required information

Name:

Class:

Portion: g

Portion description:

Energy/100 g: kcal

Additional information

Protein/100 g: g

Carbohydrates/100 g: g

Carbohydrates (sugars)/100 g: g

Fat/100 g: g

Saturated fatty acids/100 g: g

Fibre/100 g: g

Salt/100 g: g

Calcium/100 g: mg

Figure 20. Own product.

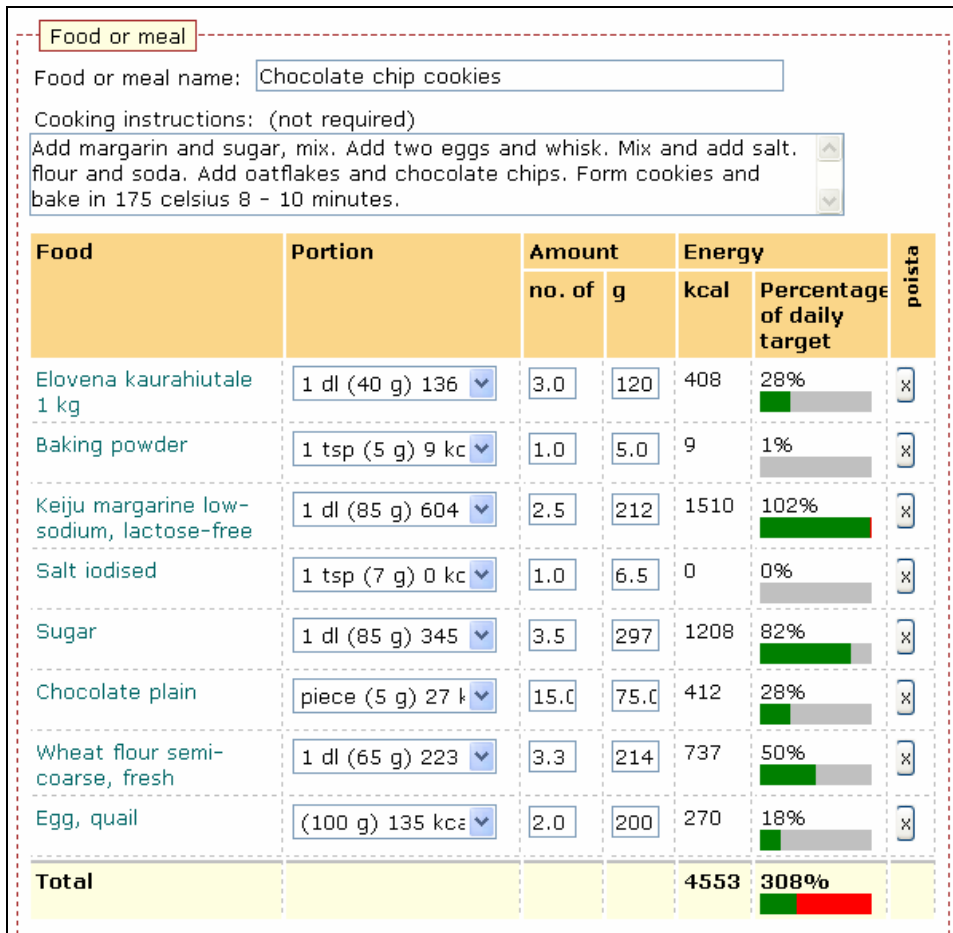


Figure 21. Compiled food.

6.3.9 Favourites

HyperFit keeps a list of the user's favourite products. All products inserted in the food diary are automatically added to the favourites list. Users can also add products from the HyperFit database to the favourites list. The list is shown in a priority order based on use frequencies. Figure 22 shows an example of a favourites list. The orange and grey balls visualise the energy content of the product. The more orange balls are shown, the more the product contains energy per 100 g. Users can also print the barcodes of the favourite products (see Chapter 6.5 Quick Barcodes).

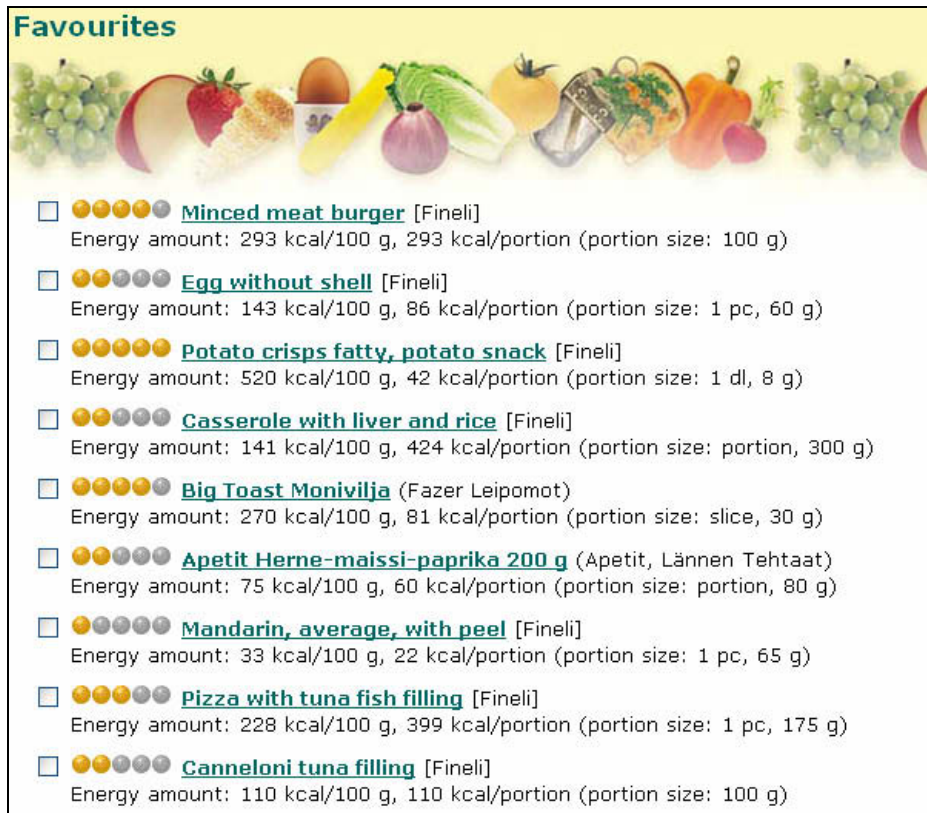


Figure 22. Favourites list.

6.4 Mobile Application

The mobile application is developed for location-independent, quick and easy use of the system. With a mobile device users can browse and enter data into the food and exercise diaries, enter steps, measurements and feelings, search product data and use the energy calculator.

One distinctive and appealing feature in the mobile phone is the ability to identify products by reading barcodes with the phone's camera. Users can browse the product data on the recognised product and add it to the food diary.

From the mobile application users can see the total energy for the day and the energy, exercise and step summaries in the diaries. Figure 23 shows the main page of the mobile service.

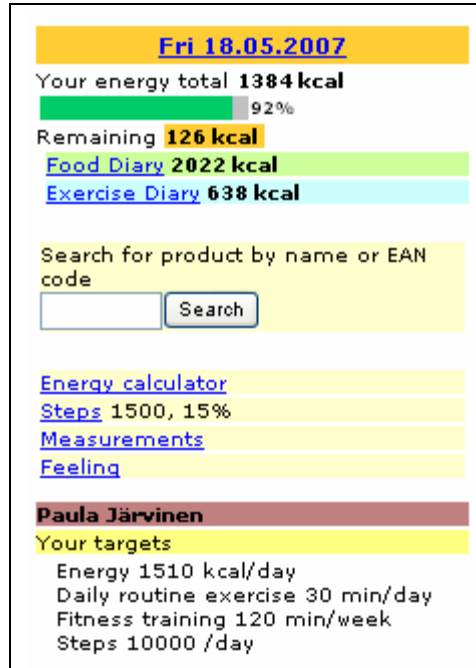


Figure 23. Mobile application main page.

6.4.1 Food and Exercise Diaries

Figure 24 shows the food diary of the mobile application. Users can add products to the food diary by adding products from the favourites list, by using the search functions or by reading product barcodes with the camera phone. The favourites list shows the same products in the mobile and PC applications.

Food Diary Sat 19.05.2007	
Total 789 kcal	
Add favourite food	
Search by product name or EAN code	
	Search
Add energy amount	
Time: 07:00	
<input type="checkbox"/> Oatmeal porridge with water 23 kcal	
<input type="checkbox"/> Berry and fruit yoghurt fat-free 142 kcal	
Time: 09:00	
<input type="checkbox"/> Coffee, average 1 kcal	
<input type="checkbox"/> Shrove bun with jam and almond paste 195 kcal	
Time: 12:00	
<input type="checkbox"/> Potato minced meat casserole, beef steak 288 kcal	
<input type="checkbox"/> Mandarin, average, with peel 22 kcal	
Time: 15:00	
<input type="checkbox"/> Big Toast Monivilja 81 kcal	
<input type="checkbox"/> Cheese emmental, 27-30 g fat, blue-label 38 kcal	
Copy to next day	

Figure 24. Food diary.

Figure 25 shows the exercise diary. Activities can be added to the exercise diary from the favourites list, from all exercise choices or by reading barcodes of exercises from a paper list (see Chapter 6.5 Quick barcodes).

Exercise Diary
Sat 19.05.2007

Total consumption 185 kcal

- Select sport -
 Duration min
 day
 Time:

Time: 09:00
 [Nordic walking \(estimation\)](#)
 40 min 185 kcal

Daily routine exercise: -, your target 30 min/day
 Fitness training per day: 130 min,
 108% your target (120 min/day)

> [Home](#)

Figure 25. Exercise diary.

Both diaries are shared with the PC application. Every food and activity added to either diary is shown in real time in both applications.

6.4.2 Steps, Measurements and Feelings

Users can store the daily steps, weight, waistline circumference and feeling ratings of the day in HyperFit with the mobile phone. Figure 26 shows the weight and waistline insertion page.

The screenshot shows a mobile application interface. At the top, there is a blue link labeled "> Home". Below this is a yellow header bar containing the text "Measurements" and "Sat 19.05.2007" in blue. The main content area has a white background. It features two labels: "Weight:" and "Waistline:". Next to "Weight:" is a small white input box followed by the text "kg". Next to "Waistline:" is a similar white input box followed by the text "cm". Below these input fields is a blue button with the text "Save". At the bottom of the screen, there is another blue link labeled "> Home".

Figure 26. Weight and waistline insertion.

6.4.3 Product Information

Product information is also available on the mobile phone. It can be shown as a result of the search function, from links from the food diary or by reading the product barcode with a camera phone. The product information contains the same information as the PC applications: the basic information, nutrition information and the recommendations. Figure 27 shows an example of the product information on the mobile phone.

The HyperFit database only contains a fraction of the real products with barcodes. To be able to get the average nutritional information on the missing products, their barcodes have been mapped to the average Fineli products. In this way the user reading barcodes from packages with a mobile phone always gets some information on the product. The system tells the user whether the information is product-specific or average.

Oatmeal porridge with water
 Fineli average information

Energy 9 kcal/100 g
 Portion: plate (250 g) 1.0 items
 Energy 23 kcal per portion
 2% of day's target

Portion size:

Number of items:

Sat 07.00

[Energy calculator](#)

<div style="background-color: #FFA500; padding: 2px;">Nutritional values</div> <p>Fat less than 1 g per portion 1% of the recommendation approx. 49 g per day</p> <p>Hard fat 10% Recommendation max. 33%</p> <p>Soft fat 90% Recommendation min. 67%</p> <p>Protein 1 g per portion 2% of the recommendation approx. 56 g per day</p> <p>Carbohydrates 4 g per portion 2% of the recommendation approx. 204 g per day</p> <p>Fibre 1 g per portion 3% of the recommendation min. 25 g per day</p> <p>Salt 1 g per portion 21% of the recommendation max. 6 g per day</p> <p>Sugar less than 1 g per portion 0% of the recommendation max. 37 g per day</p> <p>Lactose less than 0.01 g per portion Lactose-free</p>	<div style="background-color: #FFA500; padding: 2px;">Vitamins</div> <p>vitamin D 0.0 µg 0% of the recommendation</p> <p>vitamin C 0.0 mg 0% of the recommendation</p> <p>Thiamine (B1) 0.1 mg 1% of the recommendation</p> <p>Folate 2.1 µg 1% of the recommendation</p> <div style="background-color: #FFA500; padding: 2px;">Minerals</div> <p>Calcium (Ca) 12.8 mg 2% of the recommendation</p> <p>Iron (Fe) 0.4 mg 3% of the recommendation</p> <p>Magnesium (Mg) 9.1 mg 3% of the recommendation</p> <div style="background-color: #FFA500; padding: 2px;">Ingredients</div> <p>vesi ka., vesijohdovesi; kaurahiutale; ruokasuola jodioitu</p> <div style="background-color: #FFA500; padding: 2px;">Manufacturing</div> <p>Country of origin - Country of manufacture - > Home > Food Diary</p>
--	---

Figure 27. Product information.

6.5 Quick Barcodes

Barcodes do not exist for all kind of products, such as meals at restaurants or home. Therefore, the HyperFit system provides quick energy barcodes for the most commonly eaten meals and snacks in order to lower the threshold to use the service, even though the information only gives a rough estimate of the true energy content.

Quick energy barcodes contain information on the calory content of each meal. The user can print the barcodes and add meals to his/her food diary by scanning the codes with a camera phone. In this case only the caloric content is saved in the food diary. Two examples of quick energy barcodes can be seen in Figure 28.

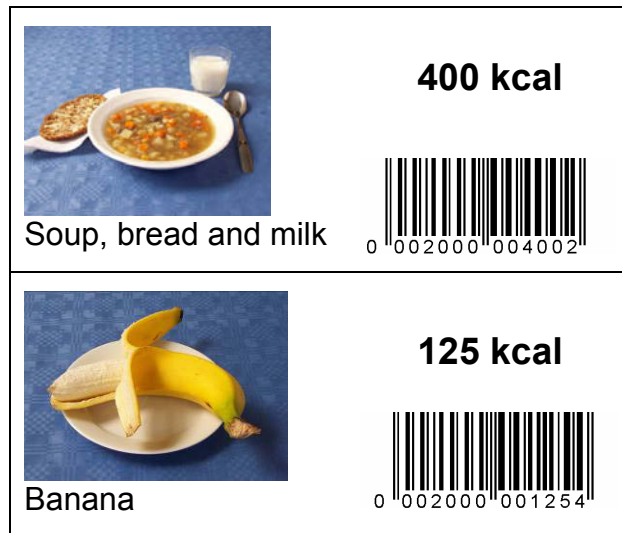


Figure 28. Examples of quick energy barcodes.

Additionally, users may create their own quick barcode lists for their favourite products. In that case the user selects the desired foods from her/his favourites and the HyperFit system generates barcodes for the selected products, own foods and/or compilations. When a barcode is being scanned with a camera phone the browser shows a product information page for the scanned food. If the default portion is correct, the food can be directly added into the food diary.

In the same way, easy access to the exercise diary is also provided with quick exercise barcodes. Users can print a list of barcodes for their favourite sports that they have selected in the profile page (Figure 29). When scanning an exercise barcode with mobile phone the browser is directed to the exercise diary page with the sports and time selected. Users only have to give the duration of the exercise to make an exercise diary entry.



Figure 29. Examples of exercise barcodes.

6.6 Application for Visually Impaired People

The possibility of reading product barcodes and linking the barcode with web-based information within a smartphone browser has been a subject of interest for many years. In the HyperFit project a beeping sound was added to the EAN-13 barcode reader software to give indication and feedback for visually impaired people. When there are high-frequency components in the camera picture (like a barcode) the beeping sound is higher, whereas normal package printing areas give lower frequency sounds. The most problematic issues are related to the camera distance and picture focus.

Another essential subject is the screen reader software enabling visually impaired people to hear what information was linked to the barcode. Nuance, which was previously known as Scansoft, is a leading supplier of speech recognition, imaging, PDF and OCR solutions. Nuance TALKS™ converts the display text of a cellular handset into highly intelligible speech, making the device completely accessible for blind and visually impaired people. Nuance TALKS runs on Symbian-powered mobile phones to speech-enable contact names, callerID, text messages, help files and other screen content.

The Finnish Federation of the Visually Impaired (FFVI) translated Nuance TALKS into Finnish during the spring of 2004. In the HyperFit project the Finnish version of TALKS was tested in a Nokia 6630 phone to see how well it reads HyperFit XHTML pages in the phone browser. TALKS version 2.51.4 (10.2.2006) was used. Figure 30 gives one example of what the phone display looks like and what the reader says when an EAN-13 barcode is read from an Elovena package.

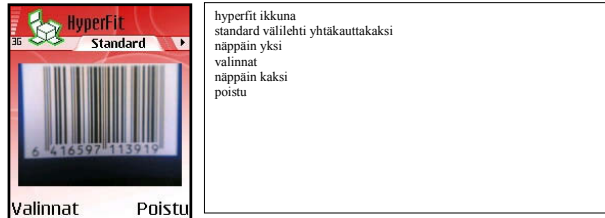


Figure 30. Phone display.

When the HyperFit barcode reader application successfully decodes an EAN-13 barcode it automatically opens the phone browser application with the product URL as a start-up parameter. If there is a hyperlink at the beginning of the XHTML page, TALKS just reads the hyperlink text, nothing else. Reading continues when the user presses the “down arrow” key. When the browser connects to the server and downloads the XHTML page, the product information (Figure 31) is displayed (separate textboxes represent “down arrow” key presses).

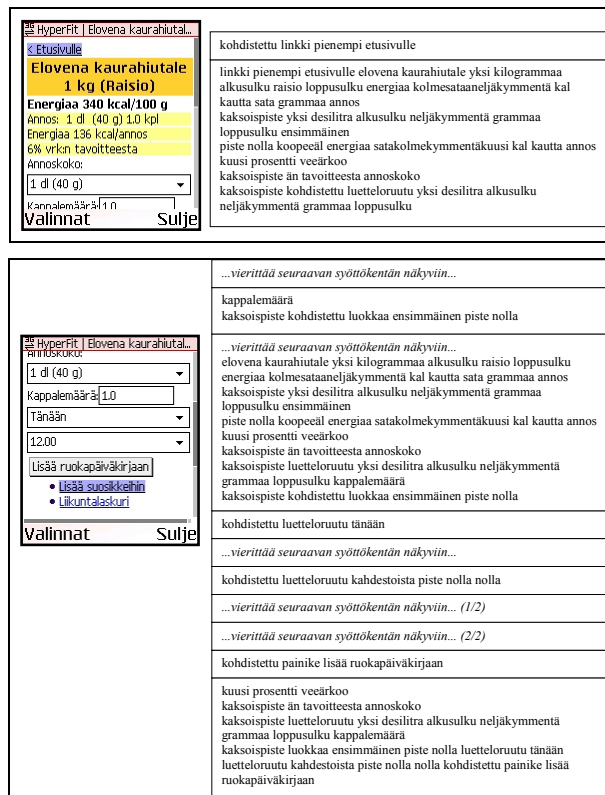


Figure 31. Product information with “down arrow” key pressed.

It was clear at this point that TALKS operates very well when simple applications are used (like “Messages” or “Address Book”), but when a browser application is used and the displayed XHTML page contains lots of information, maybe even input fields and buttons, the operation is not so simple anymore. Here is a summary of the test:

- TALKS can read all product information to visually impaired users.
- TALKS can read additional information, like what type the focused input field has, how many items there are in a list box, or which is the currently selected item.
- The scrolling of XHTML pages is problematic; TALKS often reads the whole display again, repeating something just read.
- XHTML pages with lots of input fields make navigation more difficult.
- The visual groupings of the user interface elements are not handled by the reader, so they are ignored. Additionally, TALKS sometimes pauses reading in strange places (e.g. there is always a pause before a colon).

As a result, a dynamic generation for a separate set of XHTML pages was implemented, optimised for TALKS and visually impaired users. Optimisation was done so that only product information was displayed and a new grouping of information without scrolling was constructed. Figure 32 shows screen displays as an example of optimised pages for one product.

<p>HyperFit Tuotetiedot</p> <p>Valio täysmaito 1 l HYLÄ UHT.</p> <p>Valmistajan tiedot Vallo.</p> <p>Energiaa 64 kilokaloria/100 g. Annos lasillinen (170 g) 1 kpl. Energiaa 128 kilokaloria/annos. 5 prosenttia vuorokauden tavoitteesta.</p> <p>Lisätiedot</p>	<p>HyperFit Tuotetiedot</p> <p>Lisätiedot.</p> <p>Ainesosat</p> <p>Valmistustiedot</p> <p>Ravintoarvot</p> <p>Vitaminit</p> <p>Kivennäisaineet</p>	<p>HyperFit Tuotetiedot</p> <p>Ainesosat.</p> <p>Hedelmälliha, vesi.</p>	<p>HyperFit Tuotetiedot</p> <p>Valmistustiedot.</p> <p>Alkuperämaa Suomi. Valmistusmaa Suomi.</p>
Valinnat Sulje	Valinnat Takaisin	Valinnat Takaisin	Valinnat Takaisin
<p>HyperFit Tuotetiedot</p> <p>Ravintoarvot.</p> <p>Rasvaa 1 g/annos. Kovaa rasvaa 35 prosenttia. Pehmeää rasvaa 65 prosenttia. Proteiinia 2 g/annos. Hiilihydraatteja 2 g/annos. Kuitua 1 g/annos. Suolaa 1 g/annos. Sokeria 1 g/annos. Laktoosia alle 0.01 g/annos. Laktoositon.</p>	<p>HyperFit Tuotetiedot</p> <p>Vitaminit.</p> <p>D-vitamiini 0.1 mikrogrammaa. C-vitamiini 0.7 mg. Tiamini(B1) 0.0 mg. Folaatti 3.0 mg.</p>	<p>HyperFit Tuotetiedot</p> <p>Kivennäisaineet.</p> <p>Kalsium (Ca) 10.4 mg. Rauta (Fe) 0.3 mg. Magnesium (Mg).</p>	
Valinnat Takaisin	Valinnat Takaisin	Valinnat Takaisin	

Figure 32. Optimised pages.

6.7 Heart Rate Monitor Integration

Exercise information can be sent from the Polar S625X HRM (Heart Rate Monitor) to the HyperFit database with “PolarApp.exe”, a small dedicated application that runs on PCs with Microsoft Windows. The user interface of the application is simple and very easy to use, and contains only two phases:

- 1) Read the exercise information from the wrist unit (Figure 33).
- 2) Send the summary of the selected data to the HyperFit database (Figure 34).

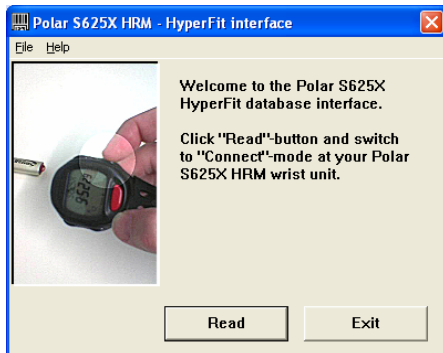


Figure 33. The Read function.

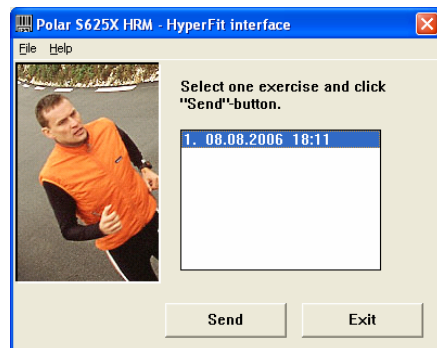


Figure 34. The Send function.

When the user presses the “Read” button and sets the S625X wrist unit to infrared communications “Connect” mode (by pressing one button), the application automatically reads all physical activity stored in the wrist unit. The sequence number, date of exercise and start time are shown to the user in a list box. The latest exercise is shown at the top of the list. When the user presses the “Send” button the application opens up a browser using the HyperFit HRM page as the start-up page. The exercise parameters are fed into an HTML form (Figure 35) by URL parameters.

HyperFit | Sykemittari - Microsoft Internet Explorer

Address <http://tivilk.vtt.fi/hyperfit2/web/sykemittari.do?duration=30&averageHeartRate=160&averageSpeed=10&distance=5069&date=08.08.2006&time=18.11>

Etisivu Suosikit Tuotehaku Testit ja laskurit Omat tiedot Ravitsemus ja liikunta Ohje

Hyperfit

Päivän tilanne
Ruokapäiväkirja
Liikuntapäiväkirja
Askeleet
Mitat
Fiilis
Viikkoyhteenveto
Painokäyrä
Mitä jos...

Sykemittari

Yleistä

Liikuntalaji: - valitse -
Rasitusaste: (oma arvio, vapaaehtoinen kenttä)

Sykemittarin arvot

Arvot on ajalta 08.08.2006 klo 18.11.

Kesto: 30 min
Keskisyke: 160 bpm
Keskinopeus: 10 km/h
Matkan pituus: 5069 m

Tallenna liikuntapäiväkirjaan

Local intranet

Figure 35. Exercise data is entered into the HyperFit form automatically.

7. System Implementation

7.1 System Architecture

The HyperFit system has a three-tier software architecture (Figure 36). The PC and the mobile phone display the user interfaces on their web browsers as HTML and XHTML pages. JSP (Java Server Pages) and Java Servlet technologies were used to create dynamic HTML and XHTML pages. The JSP pages and Java servlets use a database API (Application Program Interface) written in Java to connect to the database. A relational database is used to store the application data.

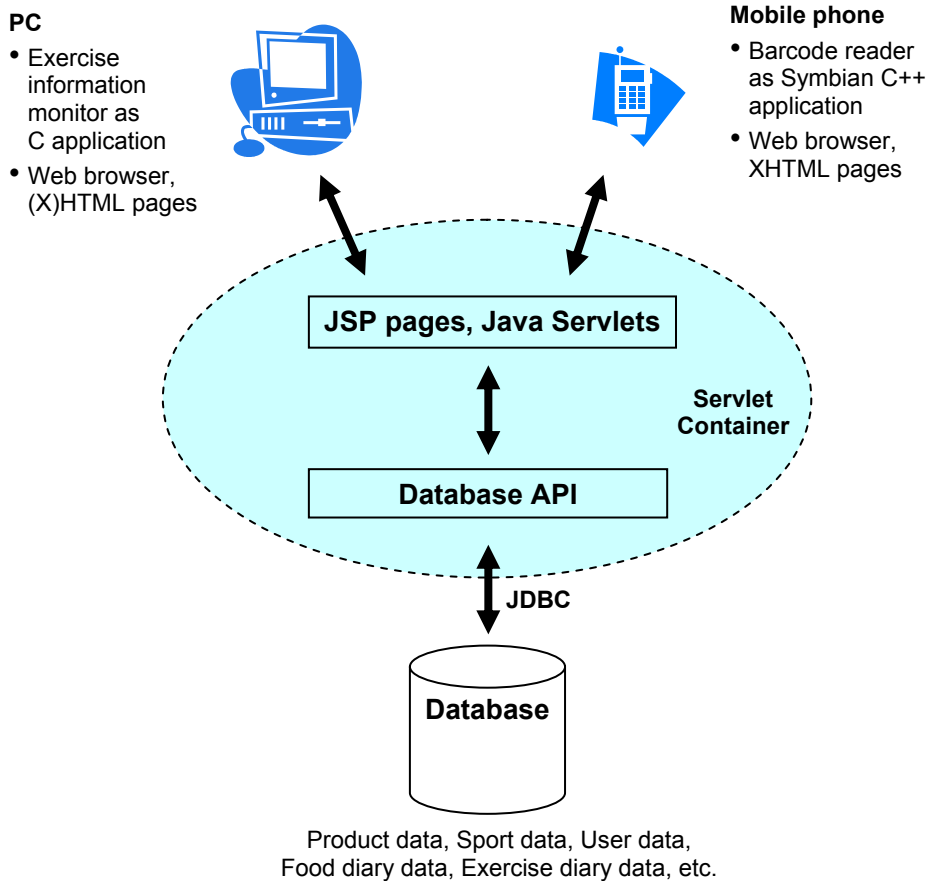


Figure 36. Architecture of the HyperFit system.

The mobile phone has a barcode reader application, which is programmed with C++ language and runs on some Symbian phones. After reading the barcode, the application starts the web browser of the mobile phone to display the product information. Nokia 6630 with an add-on lens was used in the field trial.

The heart rate monitor is integrated into the system using exercise information monitor software, which is programmed in C language. The exercise information monitor automatically transfers exercise information using the infrared port from the heart rate monitor to the PC and further to the HyperFit system.

7.2 Accessing the Database

The JSP pages and Java servlets use a database API (Application Program Interface) written in Java to use the database. The database API makes it easier for the user interface programmers to use database services because they don't need to know the database structure and write SQL (Structured Query Language) code.

The database API was implemented using a design pattern similar to the Data Access Object (DAO) pattern. The DAO pattern is one of the patterns in the Sun Microsystems' J2EE (Java 2 Platform Enterprise Edition) Pattern Catalogue.

Participants to the DAO pattern and the corresponding classes of the HyperFit application are:

BusinessObject – The BusinessObject represents the data client. It is the object that requires access to the data source (i.e. the database) to obtain and store data. The data client of the HyperFit application is described in section 7.3 (User interface).

DataAccessObject – The DataAccessObject is the primary object of this pattern. The DataAccessObject abstracts the underlying data access implementation for the BusinessObject to enable transparent access to the data source. The data access objects are created using the Abstract Factory design pattern. Class UserDao is an example of a DataAccessObject in the HyperFit application. Class UserDao has the method retrieveUser, which

takes the user identifier as the input parameter and returns a User object. It also has method storeUser, which takes the User object as the input parameter, stores a new user into the database and returns the identifier of the new user.

DataSource – The data source of the HyperFit application is a relational database, IBM Informix Dynamic Server. The Informix database has been extended with Excalibur Text Datablade to support full-text searches on product names. Most of the application data, such as product data, sport data, user data, food diary data and exercise diary data, are stored in the relational database.

A remote data source is only needed when product information is searched using the EAN code, e.g. when reading a barcode with a camera phone. If none of the products in the HyperFit database match the EAN code, the application checks from a remote server if there is a Fineli database entry related to the EAN code. If there is one, average nutrition information about the product is displayed. Technically speaking, HyperFit requests the Fineli food identifier (FOODID) by sending a REST-ful (Representational State Transfer) HTTP request to a remote server that hosts the database of EAN code/FOODID mappings. The resulting data is then returned to HyperFit in XML format.

TransferObject – The DataAccessObjects use TransferObjects to return data to the client. The DataAccessObject may also receive the data from the client in a TransferObject to update the data in the data source. Class User is an example of a TransferObject in the HyperFit application. The User class has setter and getter methods for the member variables, such as identifier, name and email address. The HyperFit TransferObject classes may also have methods that both user interfaces (PC and mobile) need. For example, class FoodDiary has method getPercentOfRecommendation that takes the nutritional property identifier and the user as the input parameters and returns a numeric value that indicates how many percentages of the daily recommendation of the nutritional property the user has already eaten.

For more information about the DAO pattern, see java.sun.com/blueprints/corej2eepatterns/Patterns/DataAccessObject.html.

7.3 User Interface

The foundation of the HyperFit web-based User Interface is dynamically generated (X)HTML. CSS (Cascading Style Sheets) is used for layout and styling, while JavaScript is utilised for achieving some of the instant interaction features like product search auto-complete. While a bit of AJAX (Asynchronous JavaScript and XML) is sprinkled across the UI, the site still provides basic functionality as a fallback to users who have disabled scripting or use a browser without scripting support.

From a user point of view, to use the HyperFit web application all you need is a fairly modern browser. Things may also work in older browsers, but for reference the application was tested to work well at least with Mozilla Firefox 1.5 and 2.0, Internet Explorer 6 and 7, and Opera 9.1.

The server side is powered by Java-based technology and applications. The Apache Tomcat servlet container is the main underlying application responsible for serving the pages to clients – the Tomcat 5.5 series was used in our implementation. The pages were created using JSP technology – more specifically, the UI code is written as JSPX documents. For browsers that support it – basically all but Internet Explorer – the pages are served as XHTML, while others send an HTML version. To determine the preferred format, a content negotiation servlet filter does a quick analysis of all incoming requests. Further, all content is UTF-8 encoded, which ensures that no other encoding is needed no matter which language versions are added to a future version.

Building plain JSP pages quickly gets unmanageable as a site grows. Therefore, the Struts MVC framework is used to make the application easier to maintain and to extend. Our form values are checked for correctness using the Struts built-in Validator plug-in.

The User Interface is provided in a multilingual fashion. Users can choose Finnish or English, but there is also an option for Swedish translation. The preferred UI language is stored on the server in the user's profile, but can be changed per session if the browser provides link navigation controls.

Separate language files are kept on the file system in properties files containing key-to-value mappings for all text fragments. Language versions of classifications and food article names are fetched from the database. The localised text fragments are looked up on the fly. For the page texts, our solution is mainly based on a feature of the JSP Expression Language (EL), which lets you call static methods from EL statements in a JSP page. By embedding the EL expression in a page and passing the text fragment key to the function, the page will show the localised value for the key in appropriate language.

A key aspect in planning the user interface was to separate content from styling. CSS is used for all layout and styling, and the markup used for content is aimed to be as semantically correct as possible. This usually serves to make the structure of the pages more clear, and improves accessibility by giving assistive technology a chance to identify page sections correctly. This, in turn, is giving disabled users the opportunity to navigate to the relevant place in the document without wading through all other content first. Using a central file for styling also makes updating visual aspects site-wide a whole lot easier. For browsers allowing style selection, the user can choose between two layouts – one with the submenu column to the left, and one with submenu on the right side of the pages. For the few pages that are primarily aimed at printing, a print media stylesheet is used to hide irrelevant navigation menus.

Native browser support for the XML-based SVG image format is currently emerging. As a vector image file format, SVG is highly suitable for showing charts and is used to implement the HyperFit weight curve. Browsers not supporting it yet are provided with a fallback PNG image, which is generated on the server side from the SVG image side by a servlet using the Apache Batik framework.

7.4 Quick Barcodes

In addition to EAN13 barcodes in product packages, HyperFit system can deal with certain types of service-specific barcodes that are used for quick food diary and exercise diary entries. The three supported barcode types are product, energy and exercise. Product barcodes can be generated for all of the four different product types in the HyperFit system: exact products (with EAN13 codes),

Fineli average products, user’s own foods and compilations. For the three product types without EAN13 code, quick barcodes are generated based on the id generated by the HyperFit system.

The HyperFit-specific barcodes start with three zeros that are followed by the type number (1, 2, or 3) and an 8-digit id or energy amount as shown in Table 5. The last, 13th, digit is a check sum of the EAN13 system.

Table 5. Different types of HyperFit-specific barcodes.

Type	Value (8 digits)	Directed to
1	Product id (Fineli food, own food, or compilation)	Product information page (with the Add to FoodDiary function)
2	Energy amount	Add Energy to FoodDiary
3	Exercise id	ExerciseDiary

An example of a quick barcode for an own product is 0001000043813, where the type is 1 (product id), the product id is 4381, and the check sum is 3.

The 13-digit number is given as input for the Barcode4J servlet that generates barcode images in the EAN13 form. The barcode could also be generated by any other servlet, but Barcode4J was used because it is available for free under Apache Licence Version 2.0.

When a barcode is scanned with a mobile phone, the HyperFit system first checks to see if the barcode is a normal product (with a barcode on the package) or a barcode generated by HyperFit. If the barcode starts with the digits “000”, it is interpreted as a HyperFit-specific barcode. According to the fourth digit, the browser is then directed to the right page, as shown in Table 5.

8. Usability and User Experiences

8.1 Introduction

The evaluation of the usability and user experiences of the HyperFit service is based on three different studies on different parts of the system. In the first study the focus was on the usability and user experience of the visual outlook of the 1st iteration version of the PC application. The second study focused on the comparison of the 1st and 2nd iteration versions of the mobile application, and the types of user input in the food diary and the weekly summary page of the second iteration version of the PC application. The third study examined the effects of feedback (no additional feedback, text-only feedback, and virtual trainer feedback) on user experiences of the system. Self-reported emotional responses, immersion into stimuli and perceived media richness, as well as electro dermal and facial muscle activity were examined.

8.2 User Experience of First Iteration PC Visualisations

The focus of the first study was to examine how the visualisations in the 1st iteration version of the HyperFit desktop system are perceived. First, the visualisations were benchmarked against “good practices” described in the literature; second, a small experiment was conducted to compare user experiences of three different web services related to well being, nutrition and weight control; and third, user opinions of different services were gathered.

8.2.1 Visualisations and the Principles of “Good Practice”

The general page architecture, the location of page elements, navigation and readability of the HyperFit web pages were evaluated and assessed against recommendations.

The use of colours and the placing of page elements is consistent and quite clear in the general page architecture in Hyperfit. The colours give a sense of lightness and liveliness, which fits well with a service related to healthiness and weight

control. On the other hand, it seemed that the overall control of the content was not optimal because the information is in bits here and there. A clear opening page would have improved the impression.

Pages are divided into framed areas. The content frames are in 2–3 columns at the bottom of the page. The third column was sometimes unnecessary because there was very little information, which suggests that two columns could have sufficed.

HyperFit navigation was quite clear and understandable. Sometimes the dropdown menus (partly using JavaScript) were difficult to handle. This was especially true with deep sub-links at low level in the hierarchy in the menu.

The dark colour on a light background made the Hyperfit pages fairly readable. Sometimes the font size seemed almost too big (for example in the headers of the tables). The columns are sometimes too wide and not scalable. Therefore, the user has to scroll the page horizontally as well.

When assessing the other elements, the use of pictures in Hyperfit was not always consistent with the content of the page. In general, multimedia could be used to make the content more alive.

8.2.2 User Impressions of Usability, Emotional Responses, and Perceived Media Richness

User responses to three web services focusing on similar content (i.e. well being, nutrition and weight control) – HyperFit, tohtori.fi and verkkoklinikka.fi services – were compared. Twenty subjects (9 men and 11 women, aged 15–62 years; $M = 38.7$) with varying educational backgrounds participated in the study.

The subjects rated their emotional reactions in terms of valence and arousal after each condition, using 9-point pictorial scales on a computer screen (Figure 37).

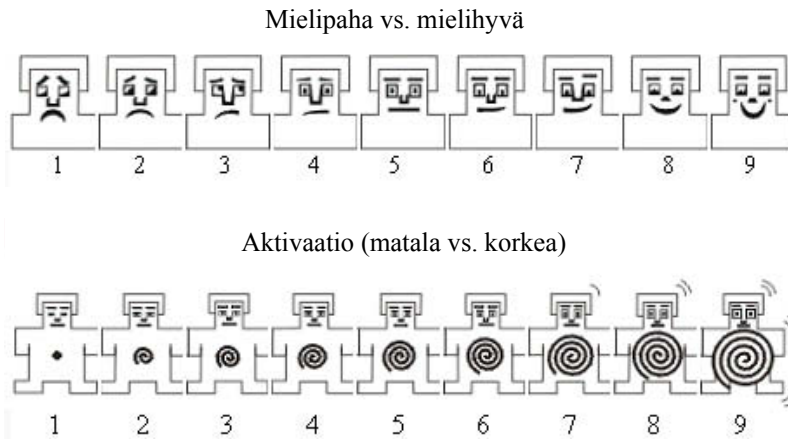


Figure 37. Pictorial scales for valence (top panel) and arousal (bottom panel).

Experience of “media richness” was rated with six bi-polar scales: impersonal-personal, unsocial-social, dead-lively, non-interactive-interactive, unemotional-emotional, and distant-direct, on 5-point scales.

The usability was rated as quality of the pages, readability, cleanness, trustworthiness, ease of searching information, and pleasantness of use on 5-point scale anchored at endpoints with 1 = very low and 5 = very high.

Each participant was shown a set of six pages from each of the three services in random order. The participants assessed the visual impression of the web service from the first two pages, searched for specific information from the next two pages, and read text from the last two pages.

The data was analysed independently using GLM Univariate Analysis of Variance in SPSS when comparing genders and age groups. The differences in responses to HyperFit, Tohtori.fi and Verkkoklinikka.fi services were analysed by the General Repeated Measures Analysis. All reported differences are statistically significant if not otherwise stated.

The ratings for the HyperFit service were relatively positive with means on the positive side of the bi-polar scales. The HyperFit service prompted the highest pleasantness ratings ($M = 4.05$) compared with the other two services ($M_s = 3.7$, and 3.05). Older participants rated the HyperFit service more emotional ($M = 3.73$)

and immediate ($M = 3.73$) than younger subjects ($M = 2.67$ and $M = 3.0$). Women rated the HyperFit pages more positive ($M = 7.00$), personal ($M = 3.64$), social ($M = 4.09$) and lively ($M = 4.00$) than men ($M = 6.11$; $M = 2.89$; $M = 3.56$, and $M = 3.11$).

In connection with the comparison of the user experiences of the different services, the HyperFit service prompted higher sociability ratings ($M = 3.85$) than *tohtori.fi* ($M = 3.05$) and *verkkoklinikka.fi* ($M = 3.05$) services, and higher interactivity ratings ($M = 3.65$) than *tohtori.fi* ($M = 3.15$) and *verkkoklinikka.fi* ($M = 3.15$) services.

The HyperFit service was rated more immediate ($M = 3.7$) than the other two services ($M_s = 3.15$ and 2.75). The *Verkkoklinikka.fi* ($M = 4.0$) and HyperFit ($M = 3.9$) services were rated more clear than *tohtori.fi* service ($M = 3.35$).

Comparing HyperFit and *tohtori.fi* Services

In the second experiment 6 users were given tasks to do using both HyperFit and *tohtori.fi* services. Their oral feedback was compared. Compare to *tohtori.fi* services, the HyperFit service was evaluated as having personal feeling – the colours especially gave a warm and cosy feeling, and they were assessed as fitting perfectly with the content of the pages. The negative aspects mentioned related to navigation and that the web service is still under construction. The points for improvement were described as improving clarity, navigation, interactiveness and information on the source of the materials.

8.2.3 Summary of Results and Discussion

Overall, the visualisations in the HyperFit service were evaluated positively and the service elicited quite pleasant responses in the users. The choice of colours and the general outlook of the pages were described in terms of liveliness, light, and warm, and they were considered consistent with the content of the pages.

The ratings for the HyperFit service were generally more positive (valence, arousal, quality, etc.) than negative. Compared to *tohtori.fi* and *verkkoklinikka.fi* services, the HyperFit service was evaluated as more social, interactive, immediate and pleasant. Many of these effects may be explained in terms of the

colours in the different services. Tohtori.fi and verkkoklinikka.fi services have blue and black text on a white background, whereas the HyperFit service also has yellow and red colours. The colours might also explain some of the differences in gender and age-related effects in the ratings. For example, women evaluated HyperFit pages as more pleasant, personal, social and lively than men. The light and warm colours as well as the pictures of fruit and vegetables may have appealed, especially to women.

Some critical comments were also given, especially when the HyperFit and Tohtori.fi services were compared. Some of the critical comments were related to the fact that not all of the service pages were ready at the moment of testing. However, many of these issues have already been taken into account in later development.

8.3 Second Usability/User Experience Tests: Mobile Application, User Input to the Food Diary, Weekly Summary Page

The second usability/user experiences tests focused on the following specific parts of the system: the comparison of the 1st and 2nd iteration versions of the mobile application, the types of user input to the food diary in the PC application, and the weekly summary page of the second iteration version of the desktop part of the system.

8.3.1 First and Second Iteration Versions of the Mobile Application

Twelve people participated in the usability test. They were given different tasks to do with both the first and second version of the mobile service. In both tasks (1st version, 2nd version) the users first spent 10 minutes on the tasks given by the experimenter, and then used the application on their own for 5 minutes. After each task they rated their experiences in terms of visual attractiveness, trustworthiness, usability, clearness, pleasantness, activation, liveliness and interactivity. The participants were also asked to give oral feedback on the service. Half of the participants performed the tasks in the 1st version and 2nd version order, while for the other half the order was the reverse (i.e. 2nd version and 1st version).

On the whole, the second iteration received slightly higher ratings (Table 6), indicating improvement between the iterations.

Table 6. Mean values for self-report measures.

Measure	1st version mean N = 12	2nd version mean N = 12
Visual attractiveness	3.50	3.80
Readability	2.75	2.78
Usability	3.10	2.98
Clearness	2.85	2.78
Trustworthiness	2.80	2.82
Interactivity	3.1	3.5
Pleasantness	3.4	3.6
Activation	3.0	3.3
Liveliness	2.50	2.50
General impression	3.5	3.9

The best feature of the first iteration in the open comments was that it was simple and clear. On the negative side, searching for a food and adding it to the favourites was difficult, adding data into the food diary was perceived to be difficult and the suggestion was that it should be possible to do this directly from search or from favourites. Iteration 1 also lacked interactivity, navigation was difficult and entering numbers required effort.

The second iteration had attractive features, e.g. energy summary and information about "what's left to consume" was good, the energy calculator was great, adding data to favourites was easy and there were links to the front page. However, the new features had reduced clarity and the black text on a red background (in the menu?) was regarded as unpleasant.

8.3.2 User Input to the Food Diary in a PC Application

Based on the oral feedback, the users had individual preferences in the way of input to the system; therefore, all input means should be available. Favourites were considered important because people often eat the same foods and searching was considered a useful and fast way of getting the information about the products even though some problems occurred (e.g. using a synonym that was not in the dictionary or misspelling a word). It is also important that manual input is possible because it is flexible. Input using the catalogue was considered most difficult because there are so many products in the database (and the lists are long).

8.3.3 Weekly Summary Page on the PC Application

The test participants initially had some difficulties in managing the information on the weekly summary page as there seemed to be too much information. However, as people used the application for a longer time this problem seemed to decrease.

The data was presented clearly, and the graphs helped in the interpretation of the data. The virtual trainer gave a “human touch” to the system.

The energy summary was very informative and the data was quickly accessible. The facial expressions of the virtual trainer were not always optimally consistent with the textual feedback. The logic of the links was not always intuitively clear. For example, when one clicks the word “energy summary” one stays in the same page, whereas when one clicks the calories value, the service jumps into the food diary.

Exercise, diet and nutritional values were quite clearly implemented, even though the use of colours is sometimes confusing. The presentation of feeling is very intuitively clear.

8.4 Third Usability/User Experience Test: Effects of Virtual Trainer

8.4.1 Introduction

In the third study the aim was to examine how the system feedback has an impact on user responses while using a service for personal management of nutrition and exercise. The expectation was that the presence of a virtual trainer would increase engagement on, and positive responses to, the system and thus probably encourage stronger commitment to the personal management of nutrition and exercise.

8.4.2 Subjects and Materials

Twenty-eight people with varying educational backgrounds participated in the study in return for two movie tickets. They were 13 Finnish males and 15 females ranging from 17 to 51 years of age ($M = 33.4$). Eighteen of the participants were also included in psycho physiological measurements in addition to self-report measures.

Three versions of the HyperFit service were produced: (a) one with no feedback other than the usual graphs and numerical values in the system, (b) one with additional textual feedback, and (c) a third with a text and picture feedback (“virtual trainer”, see Figure 38). Nutrition and exercise information was pre-input to the system so that the system gave the same kind of response in each version.



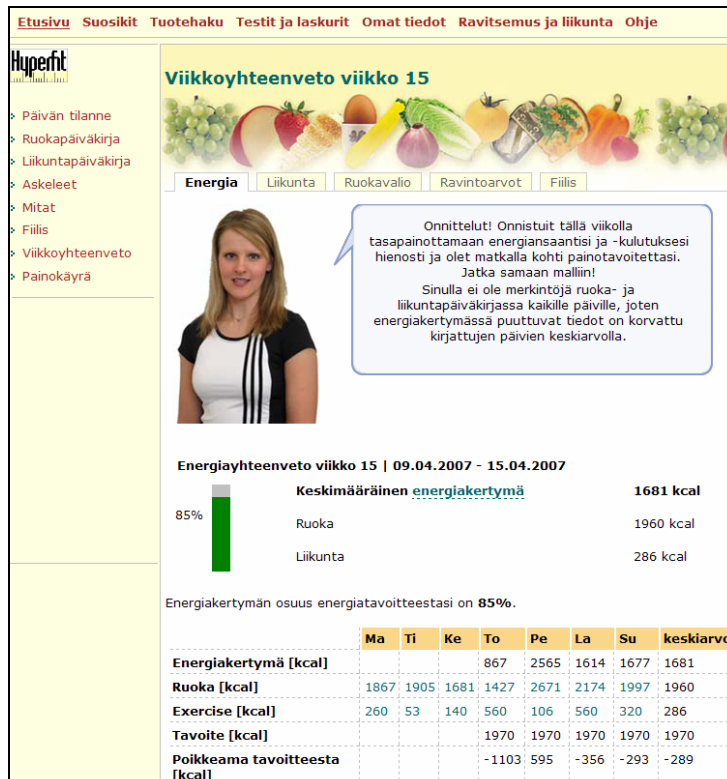


Figure 38. Feedback stimuli: no feedback (top panel), textual feedback (middle panel), and virtual trainer feedback (bottom panel).

8.4.3 Measures

Engagement/ Immersion was assessed using a self-report measure consisting of the following four items: “When I did the task I felt clear and concentrated”; “It would have been difficult to stop doing the task”; “While and after doing the task I noticed that I have lost my sense of time and location”; “When I was doing the task I felt I was intensely absorbed in it”. Each of the items was rated on a 7-point scale ranging from 1 (very untrue for me) to 7 (very true for me). The sum of the 4 items was used as an index of involvement (see Nunnally, 1978).

The participants rated their emotional reactions in terms of valence and arousal after each condition using the same 9-point pictorial scales as in the earlier experiment (Figure 37). These scales resemble Lang's (1980) Self-Assessment Manikin.

Persuasiveness was assessed by two self-report questions with ratings on a 5-point scale ranging from 1 (not at all) to 5 (very much): “How willing would you be to use this kind of system” and “Would you be willing to pay for this kind of service”.

Perceived media richness was assessed by adjective descriptions that were adopted from Lombard’s (1999) Television Questionnaire. The participants were asked to evaluate the impression the service made on them after each task by rating the following adjectives on a 5-point scale ranging from 1 (very low) to 5 (very high): personality, liveliness, responsiveness and immediateness. The sum of the four items was used as an overall index of media richness.

8.4.4 Procedure

The experiment consisted of three parts: rehearsal, tasks and filling in background questionnaires. The rehearsal consisted of the same tasks as the actual experiment tasks in the same order. In the experiment the subjects performed the same tasks under three user conditions (7.5 minutes each): no added feedback, textual feedback, and virtual trainer (text plus picture). The participants were randomly assigned to one of the six orders, which captured all the possible manipulation orders. After each task each participant rated the self-report questionnaire, which was presented on a computer screen.

8.4.5 Data Analysis

The data was analysed with the General Linear Model (GLM) Repeated Measures procedure in SPSS, with valence, arousal, engagement/immersion, persuasiveness and perceived media richness, each in turn, as with-in-subjects factor and age as covariate. All reported differences are significant unless otherwise stated.

8.4.6 Results

The ratings for engagement/immersion were higher for the virtual trainer ($M = 10.89$) than for the other two feedbacks (for textual feedback, $M = 10.14$;

for no feedback, $M = 10.54$). However, the difference between virtual trainer vs. other conditions was not significant ($p = .059$).

Arousal ratings were higher after the virtual trainer ($M = 5.86$) than the textual-only ($M = 5.36$) or no feedback ($M = 5.21$) conditions. The users were also more willing to use the system with the virtual trainer ($M = 3.07$) than without the virtual trainer ($M = 2.86$).

Media Richness

As illustrated in Figure 39, younger participants rated the highest overall media richness in connection with the virtual trainer, but the older participants rated it in connection with the no feedback condition. There was also a main effect when the model controlled the age, so the ratings for overall media richness were higher for the virtual trainer ($M = 10.93$) than for the textual-only ($M = 10.39$) or no feedback ($M = 10.61$) conditions.

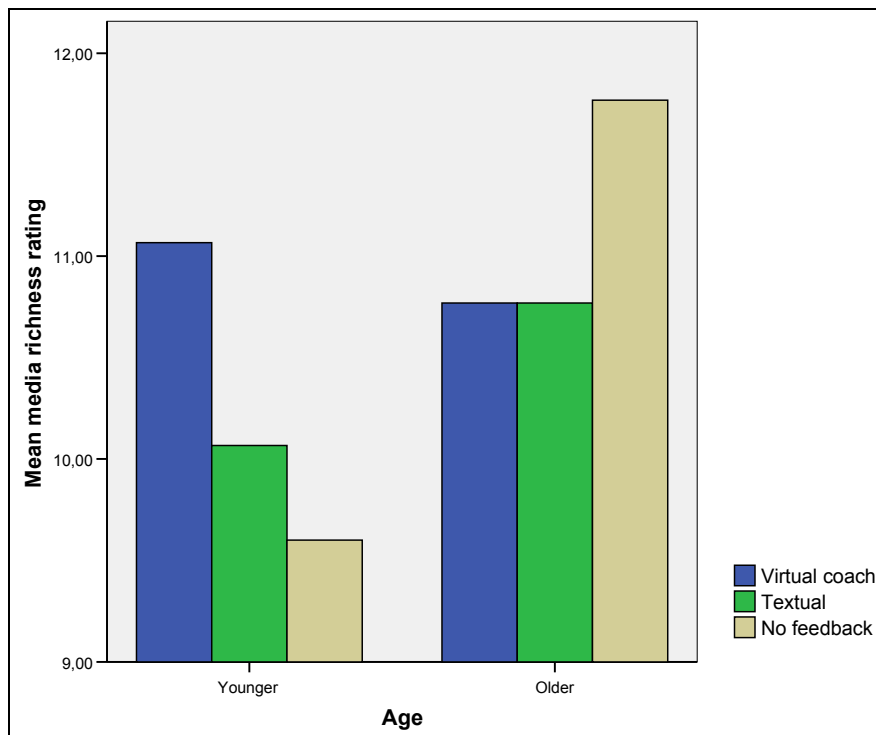


Figure 39. Mean media richness ratings as a function of age.

Facial Electromyography and Electro Dermal Activity

There was more CS activity during textual-only feedback ($M = 3.78$) than during virtual trainer feedback ($M = 3.45$) when the effect of gender was controlled in the analysis ($p = .048$). There were no other main effects in predicting EMG or EDA.

8.4.7 Discussion and Conclusions

As expected, the virtual trainer feedback elicited higher stimuli than textual-only and no feedback, even though the difference between them was not significant. As also expected, the virtual trainer feedback elicited higher perceived media richness, supporting previous research that suggests the richer and more complex the stimuli, the higher the perceived media richness. Given that this was especially true for the younger subjects, age may play a role in responses to media because of different levels of experience of digital media (i.e. younger subjects have more experience of complex media than older subjects because of the rapid development of media technology).

As also expected, the participants were more willing to use the system with the virtual trainer feedback than other feedback, implying that the more appealing (i.e. more engaging and richer) media might encourage user commitment. However, given that this interpretation is not based on direct evidence, this notion must remain conjectural and should be validated in future studies.

9. Field Trials

9.1 Evaluating User Experience in Field Trials

In order to estimate the future success of hybrid media solutions that provide support for consumers' healthy food choices, the HyperFit system was tested with potential end users. Allowing the actual target groups to try out the system as part of their everyday dietary practices or counselling activities enables pointing out which features are regarded as the best and which still need improvement or can be omitted.

The user trials in the HyperFit project have been carried out in an iterative manner so that the first field trial with individual users was carried out straight after compiling the first version in the spring of 2006. The feedback from this trial was used to further develop the system and the second trial with the new version was carried out in the autumn of 2006. Since the results from this latter trial better describe the user experiences of the final version developed in this HyperFit project, this report concentrates on those results and just gives a shorter overview of the first field trial with the emphasis on points that needed further development.

In addition to field trials with the original target group – namely those individual people who want to either reduce their weight or maintain their current weight – two trials in the spring of 2007 tested the use of the HyperFit system as part of the nutrition counselling. The first trial was carried out with nutritionists giving advice to their customers and the second trial with groups that contained weight management and diet quality as one of their target healthy behaviours.

The special feature of the HyperFit system is the way it utilises hybrid media. Since most of the net-based services only exploit a portal user interface, the ability to use the HyperFit system with a mobile phone and the possibility to enter products into the system via reading their printed barcodes with a mobile phone camera made it interesting to study how these mobile features impact on the overall picture users get from the HyperFit system.

9.2 Potential Users and User Groups

The HyperFit system has been targeted at people interested in managing their weight through diet and exercise. Yet the basis of the system has been developed with a wide angle of being able to follow the diet composition; therefore, it can easily be applied to other solutions as well. This approach allows treating eating as an entity of cumulative choices that also take account of the dose aspect without the need to imprint single foods as good or bad.

The objective of the field trials was to find out what kind of expectations potential users have for this kind of service and how they feel about the service (usability, usefulness and appeal) after trying it out as part of their normal everyday routines (field trials 1 and 2) or how this kind of service would function as part of nutrition counselling either in one-to-one situations with a nutrition expert or as supportive tool for health promotion groups (field trials 3 and 4).

9.3 Field Trials 1 and 2 with Independent Users

9.3.1 Participants and Methods

The participants were recruited from various work and leisure activity establishments that were not directly health or information technology-oriented (e.g. council employees, swimming pools, food stores, etc.) with both electric advertisements in the internal web pages and paper versions on notice boards. With this approach we could achieve study groups that contained people with varied backgrounds. The target group was defined as 25 to 65-year-old men and women who are interested in weight management and who have an Internet connection at home.

A total of 97 participants tried out the HyperFit system as part of their everyday practices (Table 7). Of these, 45 took part in the first field trial run in the spring of 2006 and 52 in the second trial run in the autumn of 2006. In both trials the group was randomly divided into two groups: one had both mobile and PC applications (mobile +PC group) and the other only used the PC application (PC group). With this division we could study whether the mobile version adds value to the HyperFit system.

Table 7. Description of participants.

	Field trial 1		Field trial 2		Total
	M+PC	PC	M+PC	PC	N = 97
Gender					
Women	15	22	12	15	64
Men	6	9	11	7	33
Age (years)					
25–34	7	8	3	8	26
35–44	8	10	7	4	29
45–54	3	9	4	5	21
55–64	3	4	9	5	21
Socio-economic status					
Managerial/ expert status	7	15	9	8	39
Official/ worker	12	12	8	8	40
Other (e.g. student)	2	4	6	6	18
Size of household					
1	5	5	3	3	16
2	9	11	10	10	40
3 or more	7	15	10	9	41
	Mean				
General health interest (max 7)	4.8	4.6	4.9	5.1	4.9
Restraint eating (max 5)	3.0	2.7	2.6	3.0	2.8
Satisfaction with own weight (max 7)	3.4	3.2	3.7	3.3	
Satisfaction with own appearance (max 7)	4.4	4.4	4.8	4.7	

In general, the participants were interested in healthiness in food choices but not overly when compared to previous findings from Finnish data (Roininen et al., 1999). The participants were not over-restrained in their eating and satisfaction with their own appearance was on the neutral level on average. The satisfaction with one's own weight was clearly below a neutral value on the scale, which is a likely motivator to enrol in a study on weight management.

All participants had a mobile phone, which was mainly used as a phone or for sending text messages; web-based services were used by a few and only occasionally.

The majority of the participants followed a diet that can be described as omnivorous (71–83% depending on the group). The rest avoided red meat, with the exception of four participants out of the total 97 who had other restrictions in their diet.

The field trials were carried out with identical procedures. After volunteering to take part in the study, the participants received a questionnaire on their food-related practices and attitudes, use of mobile and PC devices, and socio-demographic background variables. This survey was returned when the participants took part in a short, less than an hour, introductory session where the service was introduced and they were registered as users of the HyperFit system. After this, the participants in the mobile + PC groups received a HyperFit phone that had the application and all the required extra equipment installed for use. Before leaving the introduction sessions, the participants filled in their expectations of the service by rating several 7-point rating scales on expected usefulness, interest and ease of use.

The participants used the service for two weeks as part of their normal everyday activities as they pleased. After the trial period the equipment was returned and the participants answered a short questionnaire that assessed their use experiences with similar scales as they had rated their expectancies. Finally, the participants were interviewed about their use experiences in order to learn about the possible strengths and shortcomings of the service, and to get further ideas for developing the service further.

In addition to user experiences, the actual use of the service could be followed by tracking the number of sessions the participants had had and the pages they had visited during these sessions.

9.3.2 Results

User Expectations and Experiences

The expectations towards the service were high in both user trials and in both Mobile+PC and PC trial groups. The participants looked forward to the service with enthusiasm and interest. After the trial period the enthusiasm came down considerably but the interest remained high, although the mean of the experience

ratings was slightly lower than the expectations (Figure 40). The evaluated benefit of the service and ease of use ratings behaved alike, except for the mobile+PC group in the second trial where the ease of use remained on the expected level. Overall, the evaluations after the trial period were rather positive, or at least neutral, suggesting that the service was received positively although it could not completely fulfil the participants' high expectations. Furthermore, the responses in the group using both mobile and PC applications remained more positive, suggesting that the mobile application gives additional value to the service.

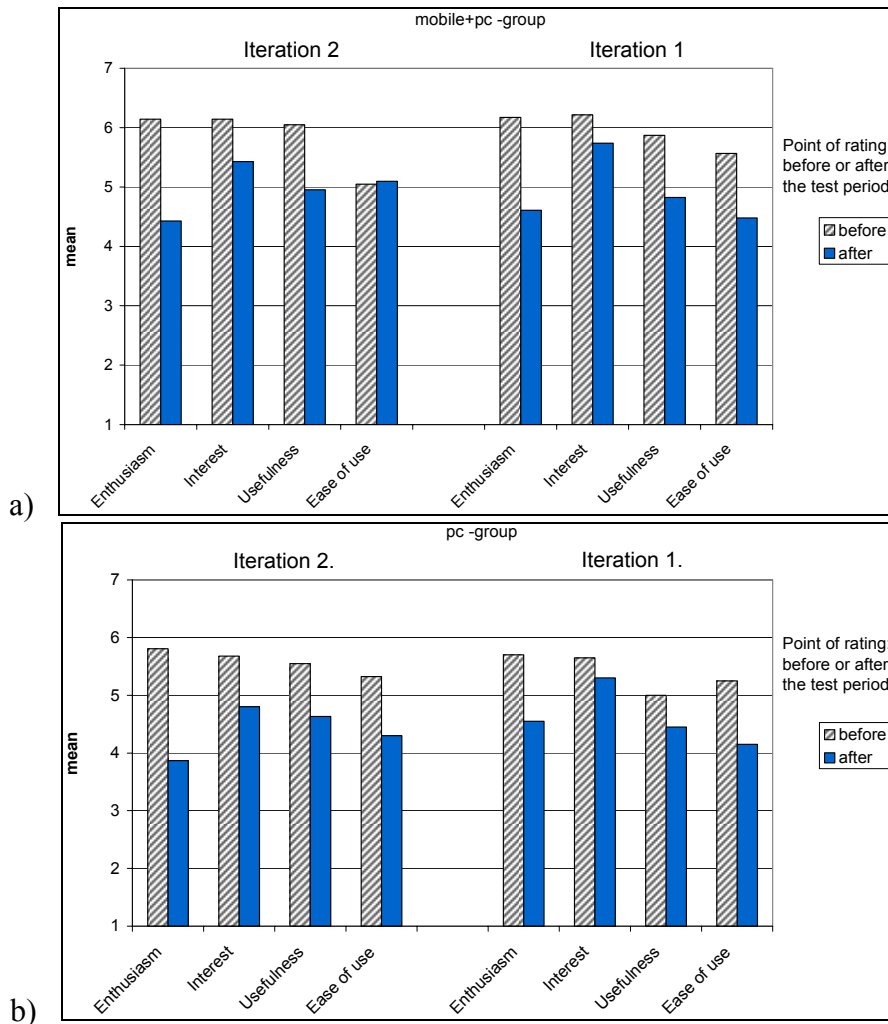


Figure 40. Expectations before using the service and assessments after the two-week use trial for a) Mobile + PC group and b) PC group.

When the mobile group was asked about the interest to use and the ease of use of the two applications, PC and mobile, the PC was perceived to be more interesting and easier to use (Figure 41). However, the use of a mobile device as part of the service (e.g. taking photos of barcodes) was not perceived to be embarrassing or awkward by participants in the second trial. The mobile application was mostly used at home (95% of participants), whereas only 35% reported having used it at work and 25% in the shops or other public locations. Yet the participants reported higher willingness to use the mobile device outside the home, so that 60% said that in the future they would use it in the shops.

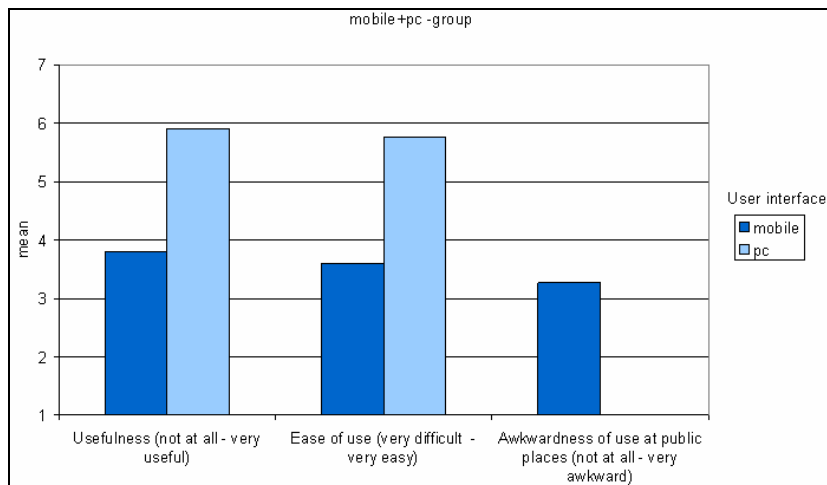


Figure 41. User experience of mobile and PC interfaces in the mobile+PC group in the second trial (iteration).

Interest in Different Parts of the Service

The most useful functions in the HyperFit system were the food and exercise diaries and the weekly summary reports based on the two diaries (Figure 42). The possibility to look at the product information, carry out self-evaluation tests on eating and exercise habits, and get personalised feedback were moderately useful. The mobile group had some additional features that were rated as moderately useful. These were the ability to use barcodes that were linked to the approximate energy content of meals (“Quick barcodes”), counting steps with a pedometer and adding them to the exercise diary, and the ability to read food product barcodes. The mobile group rated the usefulness slightly higher than the group that only had the PC.

When asked about how interesting the different features were, the order of the ratings reflects the perceived usefulness (Figure 43); the food and exercise diaries got very high ratings, especially from the mobile group.

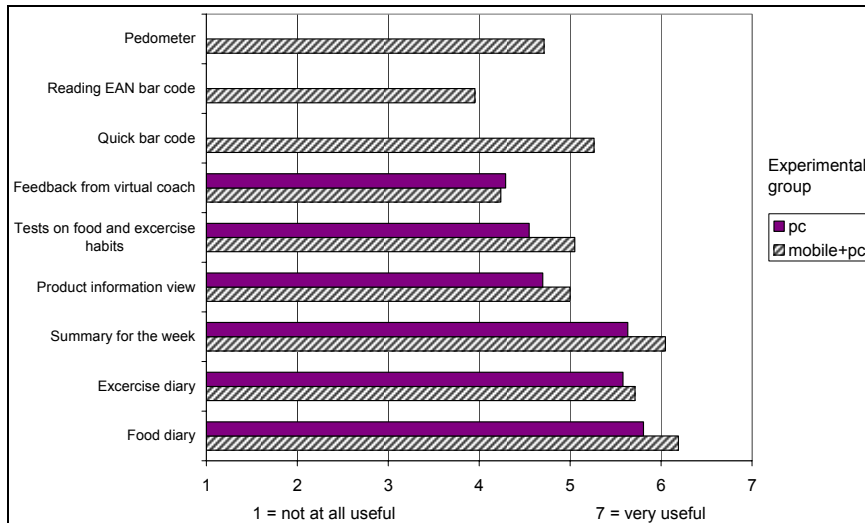
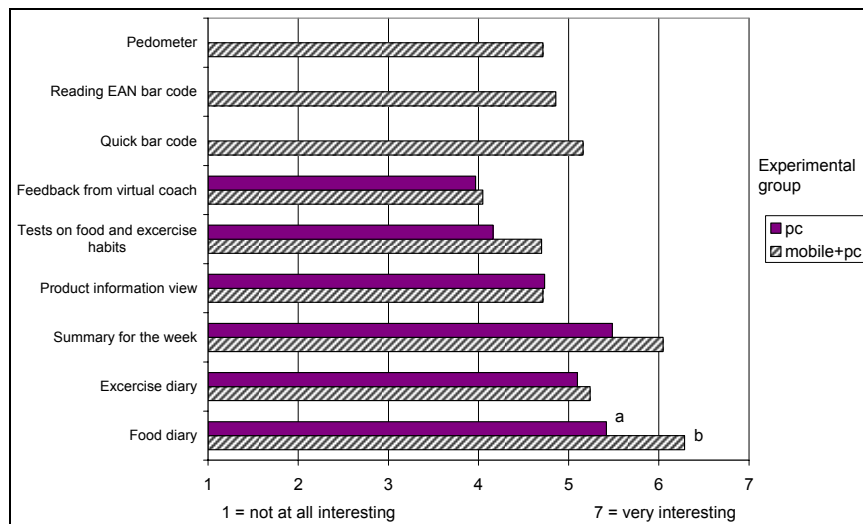


Figure 42. Usefulness of the different service functions by the mobile+PC and PC groups in the second trial.



*Means marked with different letters indicate statistically significant ($p < 0,05$) differences between study groups.

Figure 43. Interestingness of the different service functions by the mobile+PC and PC groups in the second trial.

Tracking the actual use of the service showed that the most used feature was the food diary (up to 90% of sessions) followed by search for product information (up to 70% of sessions) (Figure 44). The exercise diary or weekly summary was used in about 40% of the sessions. The mobile application in the mobile+PC group was mostly used for adding items to the food diary or searching for product-specific information with barcodes or other means.

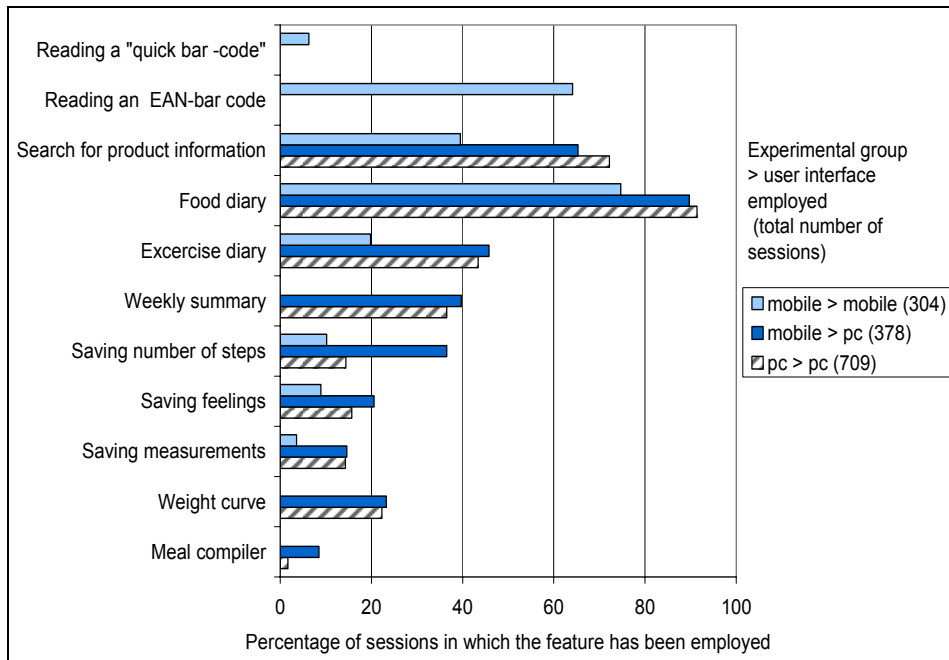


Figure 44. Use of HyperFit features as percentages of all sessions by mobile+PC and PC groups. The mobile+PC group's sessions are divided into mobile and PC sessions according to the used interface.

Searching for information about products is one of the specific features of the HyperFit system. Product information can be searched by product name, by browsing lists of food categories or by EAN code. These searches were frequently used by the participants. Search by name was most commonly used searching method, and was employed in 52% of all sessions. Browsing was used in 21%, and EAN code in about 30% of all sessions.

The users had several alternative methods of feeding data into the food and exercise diaries: product browsing and search, favourite lists, and reading barcodes from food packages with a camera phone. All of these methods were employed by the participants. When used via the PC interface, the list of favourites was the most common way of feeding data into the food diary (employed in 60% of the PC sessions). Search by product name was used in 53%, and browsing in 21% of PC sessions. Data was mostly fed into the exercise diary via the list of favourites.

Willingness to Pay for the Service

Willingness to pay for the service can be treated as a proxy to the overall acceptability of the service. The willingness to pay for the service (Figure 45) was clearly higher for the group that had the mobile device, suggesting that this feature provides additional appeal. The second trial resulted in a higher proportion of participants in the PC group who were willing to pay, suggesting that the added interactive features, such as weekly summaries and feedback from the virtual trainer, had improved the attractiveness of the service although it was not directly shown in the evaluations of the service.

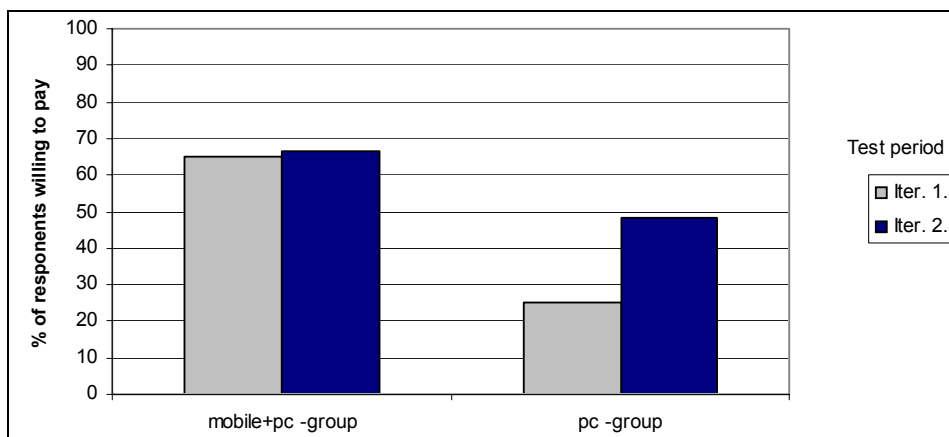


Figure 45. Willingness to pay for the service after the first and second trials.

User Experiences Based on Interviews

After the first field trial the participants were in principle content with the service and its features, and the comments were positive overall. The wide and detailed information on the user's own diet and exercise practices was regarded as a particularly positive feature. The information was provided in an easy format and helped to understand how certain choices contributed to the overall quality, e.g. fat content, of the diet. There were several features the participants thought should be developed further. The ease of product searches, more processed results from the searches and the way the chosen options could be entered into the food diary were the main targets for the development. There seemed to be two types of users in the study group: 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. The use as such was not regarded as difficult, but it was laborious and time-consuming. There was also a demand for a more entertaining version of the service that would provide interactive feedback on how well or badly one's own weight management is progressing.

Based on the feedback and suggestions coming from the first trial users, new features were added to the second iteration of the service. An easy-to-use version that applied approximate and average energy values of simple meals as product information was developed ("Quick barcodes"). This information could be read from a barcode with the mobile phone camera. A virtual trainer was added to the service and the messages were tailored according to the user's own test results and diet and exercise habits.

After the second field trial the comments from the interviews were very similar to those received after the first trial. The participants felt that the service is clearly aimed at weight management and provides a lot of information on the user's own diet, and some of the information gave a new perspective on how different food products really contribute to the energy, fat, sugar and sodium intake. The amount of available information is huge and to get accurate feedback from one's own behaviour requires time and effort. This means that users need to be motivated to use the service; therefore, the most natural way of using the service would be short one to two-week periods at certain intervals. This would enable following how diet and physical activity have changed over a time when deliberate changes have been made.

In both field trials the use of the HyperFit system was regarded as more comfortable and effortless with a PC than with the mobile device. However, the mobile was considered an appropriate and useful tool for keeping the food diary since the recording can be done directly after consumption regardless of the place and time. Reading the barcodes with the camera phone to enter foods into the food diary was seen as an easy way, if the information about the products is available. The list of favourites that contained all foods that had been entered into the food diary was judged a positive feature, but there were also wishes that this list could be more easily manipulated by the user. When examining the diet and exercise records, the PC was seen as the best option as there was less need to scroll and more information is available in a single view.

The easy-to-use version of the example meals and food combinations using barcodes for approximate energy value (“Quick Barcodes”) received an ambiguous welcome. It was welcomed as an easy option to record the eating occasions when one had little time or could not know what the exact ingredients of the meal were, but, at the same time, there was a loss of detailed information about the fat or other nutrient content of the choices.

The feedback from the trainer figures (virtual trainer) in the service was basically positive. However, there should be more variance in the messages and the non-verbal image of the trainer photograph and the messages should be better coordinated. In the system the picture was just randomly selected from a number of possible alternatives.

The informative feedback from the daily and weekly summaries of the food and exercise diaries was mentioned as the best feature of the HyperFit system. The visualisation of the energy and nutrient intake over the seven-day period was judged revealing and useful. The lists of highest sources of fat or sugar were deemed extremely valuable.

The service functioned relatively well and the instructions given in the first session on how to use the service were sufficient in most cases. There were 27 contacts during the first trial and of these nine were related to technical problems in getting or entering input to the service, eight reported errors they had found and two finished the trial before the end of the trial period. In the second trial there were 16 contacts, of which five were related to technical problems, three

reported finishing the trial the rest were single problems related to one of the features of the software. Apart from those individuals who found the service hard to use, the instructions and logic of the service seemed to be sufficient for almost all participants since the requests for help were single cases of various specific features within the service.

9.3.3 Conclusions from the User Trials

The field trials with individuals who are interested in weight management suggest that a HyperFit-type of service can be used as a tool to promote independent weight management. The wide range of information derived from the service was appreciated as personally rewarding. The possible barriers to use are the effort required to keep the food and exercise diaries and the possible technological problems related to the use of the mobile devices. The latter is likely to fade away with overall technological development and the former can be overcome by making the product searches and diary keeping easier. Yet, the mobile application seemed to give extra value to the service since those who could enter the service with both mobile and PC interfaces were more positive about the service at the end of the trials.

9.4 HyperFit as a Tool for Professional Nutritionists

The objective of this HyperFit field trial was to evaluate the applicability of the HyperFit system as a tool in professional nutritional counselling.

9.4.1 Participants and Procedure

The participants for the field trial were recruited through RTY, the Association of Clinical and Public Health Nutritionists of Finland. An announcement concerning the study was posted on their website and an e-mail with the same information was sent to all members of the association. A total of 27 nutritionists replied to the e-mail and expressed their interest in the study. Eleven nutritionists from southern Finland were chosen to participate in the field trial, but only nine of them were able to use the system.

All participants were individually introduced to the system and guided on its use. Following the guidance session, the participants were asked to briefly evaluate their expectations of the system. Following this, the participants used the system according to their own needs and interests for three weeks. At the end of this period all subjects were interviewed individually by phone.

9.4.2 Results

The main impression of HyperFit was positive. It was regarded as easy to use, clear and fairly fast to use. Almost all of the participants immediately mentioned the target group the system would be most suitable for: young adults and those who use a computer frequently.

The use of the system varied between participants. The use was greatly affected by a general lack of time in the nutritionist's schedules. More time was needed to get acquainted with the system and its various functions in order to be able to properly make use of it with clients or patients. A few participants used the system themselves and the rest used it with one or more patients.

The most used element was the food diary. Information was added to it either by the participant themselves or together with the patient. In addition, the tests concerning food and exercise habits were frequently used to quickly obtain information about the status of the patient's dietary and exercise habits.

Overall, the system was regarded as a useful tool in nutritional counselling. Its easily comprehensible language and clear graphics were especially appreciated; with these it was easy to illustrate the effects of small changes in the diet and the importance of dietary routines.

The lack of time was, however, considered a problem as more time was required to get fully acquainted with the system. In addition, the system was not considered suitable for all patients as many have very negative attitudes towards computers and consider the computer sets a barrier between the interactions between the patient and the nutritionist.

The system was considered fairly easy to use once it had been tested for a while and the participants were more familiar with it. After this, the system was considered fairly user friendly. A few technical features made the system harder and slower to use, i.e. page length and the need to always scroll downwards, the automatic time change and the lack of a proper printing possibility.

The information provided by the system was regarded as professional, clear and comprehensible.

9.4.3 Conclusions from the Trial with Professional Nutritionists

Some regarded the system as being a suitable tool for nutritional counselling in its current state, yet others considered it needed some changes in order to be successful. For those with conditional acceptance, the service would have to be even faster and easier to use, some technical changes made (minimising of page length, printing possibility, etc.), and possibly the addition of some more nutritional information regarding, for example, some vitamins and minerals, fatty acid composition, cholesterol amounts, etc. In conclusion, these modifications from a professional's perspective would make HyperFit a very useful tool. In addition, the price of the service should be competitive with those that are currently used and updates would be required on a regular basis.

9.5 HyperFit as Tool to Support Group Counselling

The objective of this field trial was to study whether HyperFit can be used as a tool in group counselling.

9.5.1 Participants and Procedure

The participants for the second part study of the third HyperFit field trial were recruited by contacting various organisations (e.g. nutrition-education and consumer organisations) that arrange weight management or diet counselling in groups. Five groups from the region of northern Savo, Finland, were recruited for the study. Altogether, 5 groups with 6 instructors and 39 group members (25

women, 14 men; age range 28 to 70 years) participated in the starting session of the field trial and 31 of them participated in the group session where the HyperFit system was used as part of the regular group meeting.

This part of the study consisted of several stages. First, a starting session was organised separately for each participating group. In the starting session the group members were introduced to the HyperFit system, registration into the system was demonstrated and the background questionnaires were filled out. The group members were given two tasks to be completed with the HyperFit system at home before the next group meeting. The tasks involved keeping food and exercise records for 2–3 days and illustrating the effects of small changes in the quality and energy balance of the diet based on their own records. The purpose of the tasks was to familiarise the group members with the HyperFit system. The tasks were later processed further in the group meeting under the guidance of the instructor. The group members also received user rights for the HyperFit system for independent use of the system and were spurred on to use it freely according to their own needs and interests. During the field study 23 group members used the system independently alongside the group meetings. At the end of the study all group members filled out a final questionnaire and were individually interviewed by phone. The group instructors were interviewed in person.

9.5.2 Results

The overall impression of the HyperFit system for both group members and the instructors was positive and it was regarded as an interesting and beneficial system.

Separate questions about the use of HyperFit in a group meeting and in independent use were asked during the interviews of group members. In the group meeting situation HyperFit was considered a tool for illustrating the effects of diet and exercise on energy balance and weight. In this study this was done by presenting a hypothetical person's diet and exercise practices, which had been created by the study organiser. Group members liked viewing the graphs in the HyperFit system because they documented the food eaten or exercise done and made it easy to compare diet or physical activity with their own targets or goals. In general, the system concretised the interactions of food and exercise in a fast and interesting way with the help of calculators and bar diagrams.

The use of HyperFit was considered to be most beneficial to participants who had, in addition to the group meetings, used the service individually. Since these participants were most familiar with the system they were able to elaborate and reflect the example information in their own food and exercise patterns. In the group member interviews and final questionnaires the independent use was rated as more informative and rewarding than the use of the HyperFit system in the group meeting.

The instructors also regarded HyperFit as a useful tool in nutritional counselling in group meetings, but, most of all, HyperFit was seen as a tool to support group counselling outside of the group gatherings. The HyperFit system personalised the group meeting by giving each group member individualised food and exercise counselling. It also offered a tool for group members to control their own food and exercise habits between the organised group meetings and in this way motivated them to maintain a healthy lifestyle. Ideally, according to the instructors, HyperFit would be used alongside the group meetings to motivate and support the group members to achieve their own lifestyle goals. The instructors considered the most attractive elements in the system to be the food records and the calculator for energy consumption in different sport activities.

When problems and barriers to the use of the HyperFit system were asked about in the interviews, the lack of time was considered the biggest one. Record keeping was time consuming for group members, and for the instructor it took time to get fully acquainted with the system. However, a detailed user instruction along with the “demonstration case” given to the instructors at the beginning of the field trial made their work easier and was greatly appreciated. Another barrier to the use of the HyperFit system that came up during the field trial was the lack of computer skills and/or the lack of computers. It seemed that the technology either set a barrier to the use of the system or the system as such was perceived as easy to use. Due to these problems the instructors also thought HyperFit would be most suitable and useful for groups with young adults using a computer frequently.

9.5.3 Conclusions from the Group Counselling

The HyperFit service received mainly positive feedback. It was regarded as modern and interesting. Group instructors found the HyperFit system to be a useful tool in nutritional and healthy lifestyle counselling. The system was considered to be most useful if it were to be used by the patient individually alongside the counselling to monitor and support dietary and exercise goals. The most significant barrier to the use of the HyperFit system was considered its time-consuming nature and possible lack and or negative attitude towards the use of computers, especially among the elderly participants.

9.6 Overall Summary of Field Trials

The HyperFit system was received in a positive manner by most of the users taking part in the field trials. The system provided a huge amount of information for those who were ready to put in the effort of keeping their diet and exercise records with care. The feedback on one's own behaviour was regarded as rewarding and also educational as it demonstrates the relevance of different choices in the diet. Some users expected less time-consuming and more easy-to-use options in the service. The future challenge is to ease the different mechanisms for keeping the records so that achieving personal feedback will become effortless. The service may be more easily accepted by young and middle-aged people, but once the threshold of getting familiar with the service was conquered, the use was found to be rather uncomplicated.

10. Business Opportunities

10.1 Background and Actions

A special group was selected to develop business activities in the HyperFit project. Companies that were potential initiators of business activities, or somehow important organisations from the point of view of business, were represented in the group. The group defined its mission as: “To find commercial and other utilities for the innovation prototypes and thereby finish off the results of the project into practical application”. The group had three formal sessions and several informal discussions and meetings. When Tuulia International decided to take in the HyperFit system for further development, the project decided to close the business activity group. The discussion on the business activities continued in the executive group of the HyperFit project.

The HyperFit project is based on the preceding TIVIK project (a context-based personalised information system for delivering product information to the consumer [Järvinen, 2005]), which was finished in 2005. In TIVIK the business start-up operations were defined relatively widely. The TIVIK project created the necessary tools for the economical prognosis to start up business operations. The HyperFit project has exploited these simulating models and all other experiences of the TIVIK project. During 2007 all the technical and other conditions for starting up the business operations came true.

10.2 Market Pull, Technology Push

Consumers need reliable and detailed information on food. This need is related to weight watching and to other facts that have influence on health and wellbeing, but also on allergy, diabetes or heart illness, sometimes even related to philosophy of life, religious or ethic values.

The food industry and trade need to give information on the foodstuffs they produce and distribute. The main reason for this is marketing, but also that information increases confidence and, thereby, demand for products, as well as customer and product loyalty. Society has an interest in funnelling the citizens

towards more healthy living. Thus many of the illnesses can be prevented beforehand and cost savings for society and individuals can be reached.

The producers of communication devices and services related to new communication habits have an interest in making content providers catalyse services that entertain and benefit consumers. The services that relate to health and wellbeing are things that interest many consumers.

The HyperFit application takes advantage of 1D barcodes to pass information to consumers. 1D barcodes already exist and are printed on all product packages. Later RFID tags do this too. The number of mobile phones that can read the codes on product packages will grow rapidly also in Finland after the negotiation of operators' contracts with smartphone deliverers.

As far as is known, no workable system with features such as in Hyperfit exists. It is anyway probable that something similar will be on the market sooner or later. Consequently, the timing of the HyperFit project is fortuitous.

10.3 Other Business Conditions

The HyperFit project has paid special attention to user-friendliness, correctness of information and the attractive manner of the information representation.

The essential element of the system is the comprehensive food database. The relevant sources of food data are the food industry covering their own products, retail companies' with their own products and public database such as Fineli® by the National Nutrition Council of Finland.

In Finland the chains of stores have chosen the German Sinfos as a common food database to rationalise their logistic operations. Sinfos also includes nutrition information on packaged foodstuff. The same database is used in Austria and Denmark. In Finland the Sinfos database is organised through GS1 Finland Oy, which is a company jointly owned by the trade and food industry.

Tuulia International Oy, which is developing HyperFit for a commercial service, has a foodstuff database that includes tens of thousands of packaged and loose foodstuffs.

During the project the whole value chain, or rather the value network, was investigated. The conclusion was that all the essential actors in the food branch and consumer organisations should be included in one way or another. Important partners in the cooperation are firms that invest in employee healthcare as well as the media, which has developed its own services for weight watching.

Since the question of public health is a significant interest, a very important issue is: what type of enterprise is appropriate for running Hyperfit service – a firm that pursues profit, a non-profit corporation, a model where the community has an essential role, or some other model?

One of the key issues the business activities group investigated was the basis for the commercial activity. To what extent are the food industry and trade, as well as the physical exercise branch, willing to benefit from the HyperFit service, and to what extent are the end users willing to use chargeable services? How much can value-added services that can increase the willingness to pay for additional services be included? In addition, the group thought over such questions as to what extent will new technical solutions increase effectiveness, deepen, strengthen and make the interactive communication easier, and reduce the threshold to giving feedback, and in general to utilise the system?

As a result, the business activities group gingerly concluded that the consumer financing can only be a part of the whole financing, or it can only be free for consumers if the volume is really large. The trade and food industry, which benefits most from the HyperFit system, is the most natural party to cover the costs. The trade and food industry can consider HyperFit a system that is an effective aid for sales and marketing that is not dependent on time and place, and is based on consumer's personal interests.

The business activities group investigated the possibilities of starting up a firm that benefits the results of the project, but there was not enough willingness to do this within the project. The problem was settled when Tuulia International Oy announced its interest in developing the HyperFit system into a commercial service.

11. Summary

The overall objective of the HyperFit project was to develop and try out communication tools for personally tailored nutrition and physical activity management. The multi-channel (PC, mobile) system provides new tools for monitoring and maintaining the balance between eating and exercise. High and flexible usability was pursued by making it possible for a mobile phone user to access data by scanning the product barcodes and using the mobile device as a recording tool.

The HyperFit project was built on the idea of iterative processes where background overviews were shortly followed by software and technology development that were tested in usability and field trials, and based on the feedback from these the process was started again with the necessary background overviews.

The project started with a survey of existing nutrition and exercise counselling tools. Several Internet-based tools maintained by various organisations (e.g. government agencies, professional, nutrition-education and consumer organisations, food industry, commercial organisations) were found, both non-commercial and commercial either freely accessible or fee-based services. Typically, these tools help users to monitor their eating and exercise behaviour with diaries and the service provides suggestions on how to stay within the given goals.

The survey of the Internet sites revealed that many of the existing tracking tools and diaries have several defects. They are complicated to use, no instructions for portion estimation are offered, and the selection in the food and physical activity databases is limited with the focus only on calories with no advice on how to improve the overall diet. The accuracy and scientific validity of the services also varies widely. Since the services are provided by both untrained laypeople and degree-trained professionals, the recommendations given do not always comply with the recommendations currently accepted by nutrition and health professionals.

The food-related information on the Internet was also surveyed and the level of interest in this information from the consumer's perspective was evaluated. A great number of food-related sites were found: food product manufacturers' websites, websites of associations, restaurants and food stores containing

product information, recipes, and food knowledge and food culture. At the moment, food-related information is scattered on the Internet in several places and in different forms, making the information hard to use. Linking external information as a part of a diet and exercise management service would require tailoring the information to the specific needs and interests of the specific consumers.

A survey of food composition databases was performed in the project. The databases provide detailed information on the nutritional composition of foods and are used for many different purposes. Food composition databases can be classified based on the origin of the food information (product specific or average information), who has developed the databases (research or governmental institutes, food industry or service developers) and the purpose of use (e.g. dietary surveys, health services, product development and food labelling). Some databases are aimed at the public and some are only for professional use.

Technology watching and surveys were performed all along the project. The main interest was in hybrid media and mobile technology. A market survey of step and heart rate monitors was also done.

An Internet service for personal management of nutrition and exercise – the HyperFit system – was developed. This provides tools for promoting healthy diet and physical activity.

The principle of the service is to mimic the process of personal nutrition counselling. It includes self-evaluation tools for assessing eating and exercise habits, and for defining personally set goals, food and exercise diaries, and analysis tools. The service also gives feedback and encouragement through a virtual trainer. Recommendations by the Finnish National Nutrition Council are used as the nutritional basis for the service.

Hybrid media and mobile technology was utilised in the development of the HyperFit system. The term hybrid media means the combination of printed and electronic media (www.hybridmedia.org/). The best-known hybrid media application is reading the barcodes with a camera phone. The HyperFit system can be used both with a mobile phone and a PC. Information can be searched

and added to the system by scanning product barcodes with a camera phone. Exercise data can be entered into the system direct from a heart rate monitor.

HyperFit uses a food database that contains the nutritional information on approximately 2,500 foods, both product-specific and average. Because the HyperFit database only contains a fraction of the real products with barcodes, the barcodes of the missing products have been mapped to the average Fineli-database (from National Health Institute in Finland). In this way, users reading barcodes from packages with a mobile phone always get information on the product, either product-specific or average. Users can also complement the database with their own products. They can also add dishes and meals composed of other products or ingredients.

A “Quick barcode” system was built in order to lower the threshold to adding food and exercise data to the diaries. With the quick system users can print lists of barcodes presenting favourite foods, exercise activities, common meals and snacks, and then insert them into the diaries with the camera phone.

The usability and user experiences of the HyperFit service were evaluated in three different studies on different parts of the system. The first study focused on the usability and user experience of the visual outlook of the 1st iteration version of the PC application. The second study focused on a comparison of the 1st and 2nd iteration versions of the mobile application, and the types of user input in the food diary and the weekly summary page. Several usability improvements were made to the system based on the studies. The third study examined the effects of the feedback given by the virtual trainer on user experiences of the system. Self-reported emotional responses, immersion into stimuli, and perceived media richness, as well as electro dermal and facial muscle activity were examined. The results showed that the presence of the virtual trainer significantly influenced user evaluations, for example by increasing user arousal and willingness to use the system.

The mobile phone product information service was adjusted for visually impaired people. A beeping sound was added to the barcode reader to give an indication of the reading process. After recognition, the product information was converted to speech from the HyperFit web pages in the mobile phone.

The usability and user experiences of the HyperFit service were tested with potential end users in four separate trials. The first two trials involved individuals interested in weight management, the third studied the service as a supportive tool for weight management groups and the fourth, use of service in professional nutritional counselling. In total, 97 individual end users, nine nutritionists and five weight management groups have tried out the HyperFit system during the project. User expectations, experiences, interest in different parts of the service and willingness to pay for the service were measured both by qualitative interviews and by quantified ratings. The individual end users were divided into two groups: those who used both mobile and PC application and those who only used a PC. The expectations towards this kind of service were very high and enthusiasm to use the service decreased during the two-week trial period, but the interest still remained good at the end of the trials and the service was regarded as easy but demanded effort in use. Having the mobile device seemed to increase the interest in the service, although the PC was regarded as an easier interface to use. The service was also acceptable as a tool to support weight and lifestyle management in weight management groups and nutrition counselling, with some reservations.

A special group viewed the business activities in the HyperFit project. Companies that were potential initiators of business activities, or somehow important organisations from the point of view of business were represented in the group. The group studied the conditions and means to start up a business based on the HyperFit system. The group stated that there is both the market pull and technology push for a HyperFit type of service and no system based on the HyperFit model exists. The group also concluded that for a successful service, all the essential actors in the value chain should be involved. The conclusion was that all the essential actors in the food branch and consumer organisations should be included in the value chain. Important partners in the cooperation are firms that invest in employee healthcare as well as the media. When Tuulia International Oy decided to take in the HyperFit system for further development, the project decided to close the business activity group.

12. Conclusions

In general, the HyperFit service was well accepted by different user groups. With the large variety of tools and extensive substance content the HyperFit service covers the requirements for acting as a supportive package for nutrition and physical activity management. The iterative process took the user feedback into account. The mostly positive responses from the extensive user trials with end users, nutritionists and weight management groups indicate that the target of developing an improved service system was well reached. The trials suggest that the HyperFit service is a feasible tool for promoting weight and physical activity management. The possible barriers to use are the effort required to keep the food and exercise diaries and the possible technological problems related to the mobile devices. Both are likely to fade away with technological development.

The use of hybrid media seems to give extra value to the service since those who could enter the service with both mobile and PC interfaces were more positive about the service at the end of the trials. The Internet-based services have been considered especially acceptable by young and technology-oriented people, but once the threshold of getting familiar with the techniques is conquered the usability is rather uncomplicated within other groups as well.

The product database based on the preceding TIVIK project complemented with the average nutritional information from the Fineli® Finnish Food Composition Database was sufficient for weight management purposes. However, in the future, a comprehensive food data base would give added value to the service.

The business partners in the project have considered the nutrition and physical activity theme of the project important and interesting. The project has widened the awareness of the partners in the areas of healthy eating and exercise habits, hybrid media, and mobile and communication technologies, and kept them up to date in these fields. The project has also pointed out how to overcome the challenges in the development of hybrid media systems.

The final indication of the success of the project is that the project has brought one patent application and the commercialisation of the HyperFit system is on the way.

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Appendix A: Food-related Websites

Food Manufacturers

www.valio.fi

www.fazergroup.com

www.vaasan.com

www.raisiogroup.com

www.ingman.fi

www.saarioinen.fi

www.atria.fi

www.hk-ruokatalo.fi

www.lannen.fi

www.findus.fi

www.unilever.fi

Associations

www.finfood.fi

www.finfood.fi/luomu

www.finfood.fi/liha

www.finfood.fi/kananmuna

www.kotimaisetkasvikset.fi

www.maitojaterveys.fi

www.martat.fi

www.sydanliitto.fi

www.diabetes.fi

Restaurants and Other Mass-Catering Services

www.mcdonalds.fi

www.hesburger.fi

www.picnic.fi

www.subway.fi

www.kotipizza.fi

Retail Store's Services

www.pirkka.fi

www.plussa.com

www.yhteishyva.net/ruokamaailma

www.spar.fi

Others

www.ruokala.tv

www.kotijakeittio.fi

www.mainio.net

www.soneraplaza.fi/ellit/ideakeittio

www.anna.fi

elisa.net/ruokajaviini

www.hs.fi

www.maku.fi/makuaskeleet/videot

www.uktvfood.co.uk

www.foodnetwork.com/food/video_guide

Author(s) Järvinen, Paula (ed.)		
Title Hybrid Media in Personal Management of Nutrition and Exercise Report on the HyperFit Project		
Abstract The purpose of the HyperFit project was to develop communicational tools for personal nutrition and exercise management. The main result of the HyperFit project is the HyperFit application, 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 counselling. It includes self-evaluation tools for assessing eating and exercise habits and for defining personally set goals, food and exercise diaries, and analysis tools. The service also gives feedback and encouragement from 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 on approximately 2,500 foods, either product-specific or average. The products that are not included in the database are replaced with the average foods. However, HyperFit is able to use a more comprehensive product specific food database. Hybrid media and mobile technology are applied to improve the usability and interest to use the system, especially among younger and technically-oriented people. The service can be used both with a mobile phone and a PC. A camera phone can be used to add food and exercise entries to the diaries by reading product barcodes. Exercise data can be inserted directly from a heart rate monitor to the system. The usability and user experiences of the HyperFit service have been tested throughout the development process. Furthermore, HyperFit has been tested with potential end users, weight management groups and professional nutritionists as part of their weight management efforts or professional counselling in several field trials. The participants in the trials have been content with the system and, on the whole, comments have been positive. 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 commercialisation of the product is on the way.		
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Series title and ISSN VTT Publications 1235-0621 (soft back ed.) 1455-0849 (URL: www.vtt.fi/publications/index.jsp)		Project number 1340
Date October 2007	Language English, Finnish abstr.	Pages 121 p. + app. 2 p.
Name of project Hyperfit – Hybrid media in Personal management of nutrition and exercise		Commissioned by TEKES, Elisa, Finnish Hearth Association, Beneway, Finnish Federation of the Visually Impaired, Raisio, Valio, Tuulia International
Keywords pervasive healthcare, nutritional information, hybrid media		Publisher VTT Technical Research Centre of Finland P.O. Box 1000, FI-02044 VTT, Finland Phone internat. +358 20 722 4404 Fax +358 20 722 4374

Tekijä(t) Järivnen, Paula (toim.)		
Nimeke Hybridimedia ravitsemuksen ja liikunnan henkilökohtaiseen hallintaan		
Tiivistelmä HyperFit-projektin keskeisin tulos on HyperFit-järjestelmä: internet-palvelun prototyyppi ravitsemuksen ja liikunnan personoituun hallintaan. Se tarjoaa työkaluja terveellisen ruokavalion ja fyysisen aktiivisuuden edistämiseen. Järjestelmän perusajatuksena on jäljitellä ravitsemusterapeutin ohjauksessa tapahtuvaa painonhallintaprosessia. Järjestelmä sisältää välineitä ruokailu- ja liikuntatottumusten itsearviointiin, painonhallinta- ja liikuntatavoitteiden asettamiseen, ruoka- ja liikuntapäiväkirjan sekä välineitä ruokavalion ja liikuntatottumusten analysointiin. Käyttäjä saa palautetta ja kannustusta virtuaalivalmentajalta. Järjestelmän ravitsemussuosituksukset perustuvat valtion ravitsemusneuvottelukunnan laatimiin suomalaisiin ravitsemussuosituksiin. HyperFitissä on käytössä tuotetietopankki, joka sisältää ravitsemukselliset tiedot noin 25 000 ruoasta. Tiedot ovat joko tuotekohtaisia tai keskiarvotietoja. Keskiarvotietoja käytetään korvaamaan puuttuvia tuotetietoja. HyperFitin tietokanta on helposti korvattavissa kattavammalla tuotekohtaisella tietokannalla. Toteutuksessa on sovellettu hybridimediaa ja mobiiliteknologiaa, joiden avulla käytettävyyttä voidaan edistää sekä lisätä nuorten ja tekniikkaorientoituneiden kiinnostusta Järjestelmää voi käyttää sekä matkapuhelimella että tietokoneella. Päiväkirjoihin voi lisäksi tallentaa tietoa syödyistä ruoista ja liikuntasuorituksista lukemalla tuotteen tai liikuntasuorituksen viivakoodin kamerapuhelimella. Tiedot liikuntasuorituksesta voi myös tallentaa suoraan sykemittarista. Palvelun käytettävyyttä ja käyttökokemuksia on testattu kehitysprosessin eri vaiheissa. Lisäksi HyperFitiiä ovat koekäyttäneet yksittäiset käyttäjät, painonhallintaryhmät ja ravitsemusasiantuntijat työssään. Kokeisiin osallistujat ovat olleet tyytyväisiä järjestelmään, ja palaute on ollut pääosin myönteistä. Kokeiden perusteella voidaan päätellä, että HyperFitin kaltainen järjestelmä soveltuu painonhallinnan tukemiseen ja että hybridimedia tuottaa lisäarvoa palvelulle. Järjestelmästä on tehty patenttihakemus ja kaupallistaminen on meneillään.		
ISBN 978-951-38-7047-8 (nid.) 978-951-38-7048-5 (URL: www.vtt.fi/publications/index.jsp)		
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Increasing overweight and lack of exercise are growing problems in modern societies. Tools that promote and support independent weight management are important aids in tackling this issue. Self-monitoring dietary and exercise habits combined with counseling and encouragement can help individuals to change their behavior and promote successful weight management. In HyperFit project "Hybrid Media in Personal Management of Nutrition and Exercise" an Internet service for personal management of nutrition and exercise was developed. Hybrid media and mobile technology were applied in the implementation.

This report contains the results of the HyperFit project. The two-year project was part of the FENIX Technology Programme (FENIX – Interactive Computing) run by the Finnish National Technology Agency (Tekes). The service has been tried out in excessive user trials and it was well accepted by different user groups.

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