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Hybridmedia as a tool to deliver personalised product-specific information about food

Report of the TIVIK project

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VTT Information Technology

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Keywords nutritional information, personalized information systems, health effects of food

Abstract

Consumers wish to have more information on the possible health effects of foods. Personalised self-relevant nutrition information is more appealing to individuals than messages that give general advice. Current package labels can be insufficient or troublesome to read, but other sources of information may not be accessible when the actual need appears.

In the TIVIK project (A context-based personalized information system for delivering product information to the consumer) a pilot system was developed to deliver personalised food product-specific information to the consumer. The mobile application developed in the project utilises wireless Internet, camera phones and food packages. The consumer can collect the information independent of time and location. A barcode reader software application was also created and patented in the project. This transforms a camera phone into a barcode reader device. TIVIK can also be used with a PC's web browser.

The nutritional information provided by TIVIK is displayed according to portion size. TIVIK has services for comparing products, creating a favourites list, maintaining a food diary, using an exercise calculator, and so on. The consumer can also search the food database using various criteria; he or she can read instructions and background information related to food and nutrition. The pilot system was developed for two user groups – those managing their weight and those suffering from lactose intolerance – but the system can be easily broadened to include other personalised user groups as well. The system has around 700 products in its database.

The system was tried in the Helsinki area and Kuopio with a field trial that lasted between two and four weeks. The participants (N = 100) liked the basic idea of the system, and the information based on one's own food choices was regarded as appealing and rewarding. The PC application was evaluated as motivating and easy to use. The food diary for daily food intake and the exercise calculator that could transform the consumed calories into the time needed to expend them in different physical activities or vice versa were the most appreciated features of the system. The preferred location for using the system was at home with the PC. The use of a mobile device was

perceived as troublesome and the small number of products in the database restricted the usability.

Alternative business models for commercialising the system were developed within the project. The models are based on an independent earning logic, societal benefit and a private database. Improved technical usability and establishing an adequate database are the prerequisites for commercialising the system.

Preface

This publication contains the results of the project ”A context-based personalized information system for delivering product information to the consumer” (TIVIK). The two-year project was part of the technology programme ”Interactive Computing” (FENIX) run by the National Technology Agency (Tekes). The aim of the project was to develop a pilot information system that was tried in the field. As part of this, we developed a user interface, information content and service, and a business model.

This publication compiles the main findings that have already been partly introduced in lectures, articles, working papers, interviews and demonstrations. The most important result is a prototype system that around 100 people tried over one month.

Besides the main funders, Tekes and VTT, six companies financed the project and were represented in the project management group. By the end of the project the group comprised Esko Pajunen (*Sinebrychoff*, chairman, deputy Aarno Kallio), Jyrki Aalto (*Ravintoraisio*, earlier Ilmo Aronen), Anna Alasmaa (*Tekes*), Sanna-Maria Hongisto (*Fazer Leipomot*, earlier Tiina Väätäinen), Maija Peltola (*Elintarvikkeiden tutkimussäätiö*), Sami Vilvala (*Valio*, earlier Mikko Sihvonen), Marko Väisänen (*Elisa*), Caj Södergård (*VTT*) and Kaisa Poutanen (*VTT*). The group made a great effort on behalf of the project.

Experts associated with the project were Terhen Järvi-Kääriäinen and Annukka Leppänen-Turkula (*Association of Packaging Technology and Research*), Sven-Gustaf Lindroos (*GS1 Finland*, earlier *EAN-Finland*), Ilkka Nieminen (*Finnish Food Marketing Association*), Marja-Leena Ovaskainen (*National Public Health Institute*), Riitta Tainio (*The Finnish Consumers' Association*), and Leena Nieminen (*The Association of Clinical and Public Health Nutritionists in Finland*, earlier Riitta Stirkkinen). They gave an important contribution to the project.

VTT Information Technology, VTT Biotechnology, University of Kuopio and Helsinki School of Economics carried out the project. WICOL Ltd and Beneway Ltd participated as subcontractors to VTT. The project group members contributing to this publication were Caj Södergård (Sections 1, 6), Liisa Lähteenmäki (1, 2.2, 3.4, 4, 6), Seppo Juurikko (5), Timo Järvinen (3.1, 3.2), Merja Kallio (2.2), Johanna Kuosmanen (2.2, 3.4, 4), Jari Laarni (3.4, 4), and Anne-Mari Ottelin (2.1, 3.3). In addition to the authors, Christer Bäckström, Paula Järvinen, Timo Kinnunen, Ilpo Kojo, Marjukka Kolehmainen, Maarit Korhonen, Hannu Kuukkanen, Raimo Launonen, Magnus Melin, Key Muurikka, Pirjo Näkki, Marketta Puttonen, Timo Saari, Harri Sulku, Minna Suovirta, Sari Vainikainen and the programming team of Beneway Ltd. contributed to the project.

Mobile systems for delivering food-related information to consumers hold clear promise. Hopefully, this publication will provide some new insights and guidance in this new field.

Espoo, May 30, 2005

Caj Södergård

Project leader

VTT Information Technology

Contents

1. Introduction

Modern consumers wish to have more information on food products when making decisions about their daily purchases. Consumers are becoming more and more fragmented in their choices and often the additional value of new and alternative food products is based on information on health effects, ethical production methods or place of origin. The same product can belong to several categories in consumers' minds, but delivering this information through packaging and labelling may be a demanding task. Packages tend to be full of obligatory information and thus all the extra information needs to be delivered with additional materials, such as brochures or a website, that are not available to the consumer in the purchase situation.

There is a vast amount of information on food products, but this material is widely scattered in different places. Manufacturers and retailers are the natural sources for distributing the product specific-information. In Finland the product information is being gathered into a database that is shared by retailers and food producers. The database is designed to fulfil the needs of these two actors, but the information on the nutritional quality of various products is not ready yet and this part of the database is not likely to be available to outsiders. Accessing or constructing and maintaining a database on product information has turned out to be one of the key issues in providing information to consumers.

Health-related information is one of the areas that have received more attention in recent years. The incidences of lifestyle and diet-related diseases, such as obesity, type 2 diabetes and coronary heart diseases, are increasing and escalating the expenses for both private citizens and the national health care system. Although the occurrence of these diseases could be reduced by modifying dietary habits, there are still very few tools to support health-promoting changes. 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 behaviour can be attributed to several factors. First, the main reasons behind food choices are habit, 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 hard for ordinary consumers.

The future consumer need for information will become more diverse and new tools are required to deliver personalised information. The TIVIK project has tried to respond to

this need by developing a prototype for a communication system that can provide personalised product-specific nutritional information to consumers with no time or location restraint. The information can be targeted according to the respondents' own important issues. The information can be reached via mobile devices outside the home or with a PC via the Internet, and these two channels support each other so that relevant information can be transferred between the devices. As the system has to store personal profiles for the users, confidentiality, discretion and reliability are key factors in creating trust in the system.

The ability to read barcodes with a mobile phone as the access key to the system provides an interesting option when building the system. This is hybrid media, the combination of printed and electronic communications (see www.printaccess.org). Food packages with printed barcodes and other information represent printed media; displaying detailed product information and other services on the web browser of the mobile phone represents electronic communications. In the future, other technological solutions – e.g. rfid (radio frequency identity) – are possible. VTT Information technology has previously developed a system of reading barcodes in cooperation with WICOL Ltd (Wireless Information Collector). Other projects have developed solutions to realise personalisation with different terminal devices. Research on novel packaging materials and logistics is also underway in VTT "Active and Intelligent" theme projects.

The aim of this project has been to construct and pilot a prototype of a two-way communication system, the TIVIK pilot system, for food products. The system can be used with a camera phone (so-called mobile application) and the web browser of a PC (so-called PC application). The project has been divided into 1) mapping the consumers' and experts' views and wishes on health-related information and studying the ways of presenting this information, 2) mapping the potential user groups for this kind of system, 3) developing system requirements that take account of the users' views, 4) implementing the pilot system, 5) investigating the usability in short user trials and in a 2–4 week field trial, and 6) developing possible business models for commercialising the prototype.

2. Information needs regarding food supplies

2.1 Consumer information needs

A literature survey was carried out at the start of the TIVIK project to determine consumer information needs regarding food supplies. A pilot information system was designed on the basis of the literature survey to target consumer groups wanting to manage their weight and those suffering from lactose intolerance.

2.1.1 Health issues

According to the literature survey, most consumers are seeking advanced information regarding food supplies on the grounds of health issues. Major consumer groups needing information on the basis of health are those suffering from diet-related diseases such as obesity, cardiovascular diseases and diabetes. People with allergies and lactose intolerance are also major consumer groups needing advanced information. The information needs and estimations of the size of consumer groups seeking information regarding food supplies based on health issues are shown in Table 1.

Table 1. Major consumer groups requiring advanced information on food supplies based on health issues.

Consumer group	**Estimation of the size of the group in Finland and in Europe**	**Prediction of the size of the consumer group in Finland/ Europe in 5–10 years**	**Information needs regarding food supplies**
Overweight consumers	650,000 [Männistö et al. 2004] 70–140 m [International Obesity Task Force 2003]	Growing strongly	Energy content, the amount of fat, saturated fat and sugar
Consumers with elevated blood pressure	935,000 [Vartiainen et al. 2003] 130 m [Wolf-Maier et al. 2003]	Remains stable	Energy content, salt content, the amount of fat and saturated fat
Consumers with high cholesterol levels	650,000 [National Public Health Institute 2003] 140 m (Estimation according to Kuulasmaa et al. [2000])	Remains stable	The amount of fat and saturated fat, dietary fibre content, energy content
Diabetics	180,000 [Finnish Diabetes Association 2000] 32 m [International Diabetes Federation 2003]	Growing strongly	See information needs of overweight consumers and consumers with elevated blood pressure and high cholesterol
Food allergy sufferers	65,000–160,000 [Allergia- ja Astmaliitto 2002] 28 m [EFA 2003]	Growing moderately	Does the food product contain allergens?
Consumers with lactose intolerance	26,000–52,000 [Parkkinen & Sertti 1999] 7–70 m (Estimation according to Parkkinen & Sertti [1999] and Collin & Pikkarainen [1998])	Remains stable	Lactose content

2.1.2 Religious and ethical issues

Other than health, religious, ethical and environmental issues also require advanced food information. The size of these consumer groups is difficult to measure, but it has been estimated that the largest consumer group in this segment are vegetarians. Other groups following a special diet for ethical reasons are consumers using organically grown or domestic or locally grown foods and consumers avoiding genetically modified food or animal testing. In Finland, only a small segment of consumers need information regarding food supplies on the basis of religion, but worldwide this segment is significant. The information needs and the estimations of the size of consumer groups seeking information regarding food supplies based on ethical and religious issues are shown in Table 2.

Table 2. Major consumer groups requiring advanced information on food supplies based on religious or ethical issues.

Consumer group	**The estimation of group size in Finland**	**Future predictions of the group size in Finland in 5–10 years**	**Information needs regarding food supplies**
Vegetarians	98,000 (Estimation according to Laatikainen et al. [2003])	Growing moderately	Animal constituents of food supplies
Consumers using organically grown food	630,000 (Estimation according to Finfood Luomu [2004])	Growing moderately	Is the food product organically grown?
Consumers using domestic or locally grown food	?	Remains stable	Is the food product domestic or locally grown?
Consumers avoiding genetically modified food	?	Moderately growing	Is the food product genetically modified?
Consumers avoiding animal testing	?	Moderately growing	Has animal testing been used during production?
Adventists	5,500 [Suomen Adventtikirkko 2002]	Remains stable	Is the food product suitable for lactovegetarians?
Jehovah's Witnesses	17,000 [The Evangelical-Lutheran Church of Finland 2002]	Remains stable	Does the food product contain blood or components of blood?
Muslims	10,000 [The Evangelical-Lutheran Church of Finland 2002] In Europe 30 m [Adherents.com 2000]	Moderately growing	Does the food product contain blood, pork or pork-derived constituents, or meat from carrion animals?
Jews	1,300 [The Evangelical-Lutheran Church of Finland 2002]	Remains stable	Is the food product kosher?

2.2 Interviews with experts and consumers

2.2.1 Health-related information needs on food products

The aim was to study consumers' health-related information needs in a shopping situation. A total of 57 consumers and 12 nutrition experts were interviewed with half-structured individual interviews. The most important product-specific pieces of information for consumers were price, origin of the product, fat content, energy content, food additives, salt content, vitamin content and the quality of the fat. Important food-related information was strictly linked to health.

In the main, the views on the required food product information were similar for consumers and nutrition experts. Only the origin of the food product was an issue the specialists did not pay any attention to in this context. The biggest disagreement between nutrition experts and consumers was that consumers were interested in the product-specific nutrition content while the experts underlined the importance of the total diet.

The nutrition experts stated that consumers have problems understanding messages related to the quality of fat and amount of salt. Moreover, the consumers do not know how much fibre is recommended per day. Allergic and celiac people have problems recognising ingredients on labels. Diabetics tend to misunderstand the intake of fibre, carbohydrates and fat. Overall, these results imply that food-related information should be delivered in a more understandable and descriptive form. Furthermore, the meaning of total diet should be highlighted in consumers' minds.

2.2.2 Opinions of the mobile application

Consumers' and nutrition experts' opinions of the developed TIVIK mobile application were examined with half-structured individual interviews. The aim of this study was to find out how product-specific information provided by the TIVIK mobile application is understood. Two target groups participated in these interviews: people suffering from lactose intolerance and those managing their weight. The interviews with experts (n = 6) focused especially on the correctness of the information and how the information should be presented in order to make it more understandable by lay people, whereas the interviews with consumers (n = 43) concentrated on how they perceived and comprehended the information.

The feedback from the nutrition experts was mainly positive or neutral. Proposals for improvement concerned the format of the information. The size of the text was

perceived to be too small, and bar charts of nutrients per 100 grams of product were regarded as unnecessary. A picture of the energy profile (proportional energy coming from fat, protein, carbohydrates and alcohol) was thought to be too complicated for consumers. Some information related to the vitamin and mineral content was pointed out as meaningless in the shopping situation.

The target groups' opinions on the idea of the TIVIK system could be divided into three categories: positive, negative and hesitant attitudes. The majority of the consumers in the weight control group regarded the TIVIK system in a positive light. In addition, the format of presentation was perceived favourably. Generally, bar charts were perceived as useful and illustrative. The interviewees gave negative feedback on the picture of the energy profile and the picture of how much a portion contributes to energy intake divided into energy nutrients. Some consumers had difficulty in understanding these pictures. Moreover, the label information on food additives and product origin caused some confusion, and the participants hoped this information would be presented in a more detailed manner. Almost all interviewees stated that the most important information in the shopping situation is the fat and energy content. The rest of the information could be examined at home via the Internet.

The interviewees proposed that a calculator for the nutrient content of meals would be an improvement to the TIVIK system. Some of the participants assumed that the system would automatically calculate their daily energy intake and the commonly shared opinion was that this kind of calculator should be included in the TIVIK system.

3. Pilot system

3.1 Description

In the TIVIK project, a pilot system was developed to deliver food product information to the consumer according to his or her interest. The chosen target groups for piloting the system were those who wish to manage their weight and those who suffer from lactose intolerance. The system can be used with a mobile phone (so-called mobile application) or a PC (so-called PC application). The language of the pilot system is Finnish. The figures in this section have been translated into English for the purpose of this report.

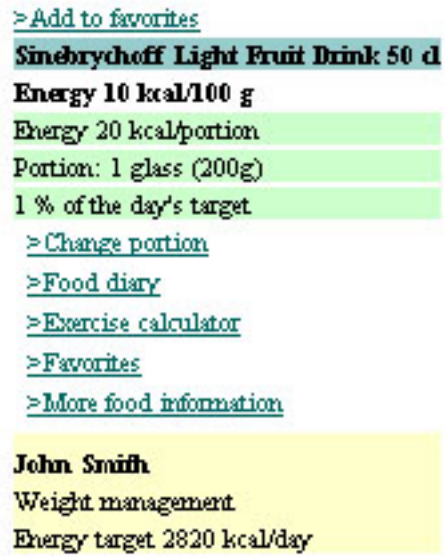

Figure 1. Product-specific food information is displayed on the web browser of a mobile phone immediately after reading the barcode. This user wishes to manage his weight, so the energy amount is displayed on the top of the page.

The user can obtain product-specific information by reading the barcodes on food packages with a camera phone. This enables access to the information regardless of time and location. A barcode reader application was created and patented in the project. Reading barcodes requires a Nokia 3650/3660 phone with an add-on macro lens, making it possible to focus the camera to a distance of 5 cm.

After reading the barcode the product information is displayed on the web browser of the mobile phone. The phone uses a GPRS (General Packet Radio Service) data connection to make the Internet connection. The newest mobiles also use third-generation (3G) connections. The most relevant information is displayed first, but the link ”More food information” provides more detailed information. The user can then

use all the services of the TIVIK mobile application. Figure 1 illustrates the mobile application after reading the barcode. Product-specific food information is displayed on the web browser of the mobile phone. Because the user wishes to manage his weight, the energy amount is displayed at the top of the page.

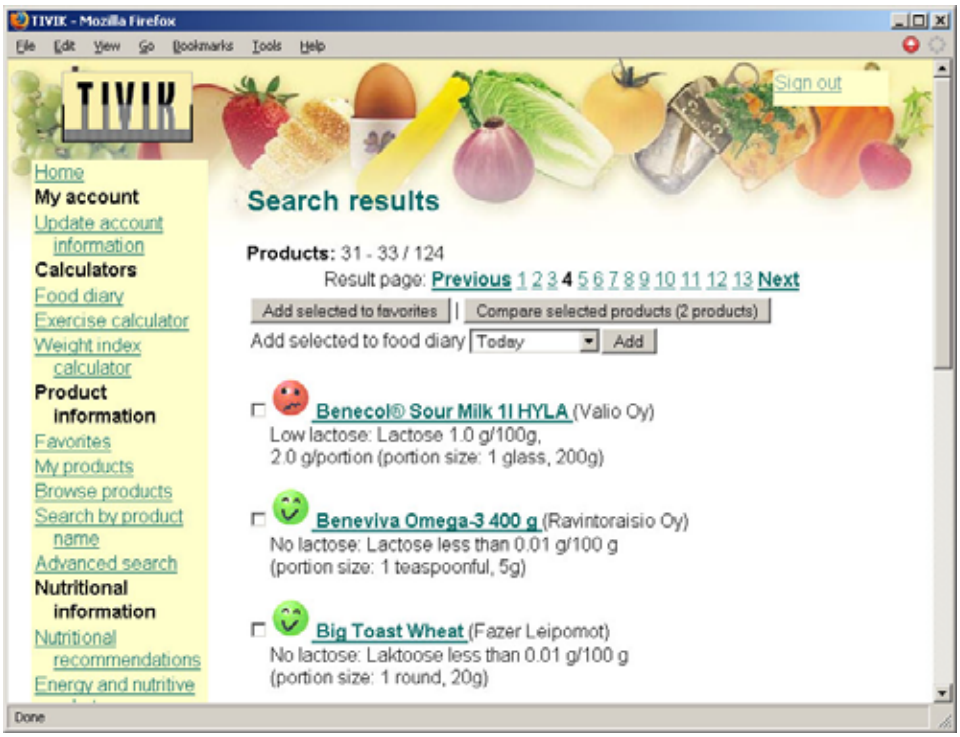

Figure 2. TIVIK on the web browser of a PC. This user suffers from lactose intolerance, and the faces on the list indicate the amounts of lactose in the products.

Because TIVIK utilises food information provided by the food manufacturers, it provides product-specific food information rather than calculated averages. The nutritional information is displayed according to portion size. TIVIK has services for comparing products, creating a favourites list, maintaining a food diary, using an exercise calculator, and so on. The consumer can also search the food database using various criteria; he or she can read instructions and background information related to food and nutrition. The TIVIK mobile application only contains a subset of these features, but the PC application provides all of them. Figure 2 illustrates the TIVIK PC application. This user suffers from lactose intolerance, and the faces on the list indicate the amounts of lactose in the products.

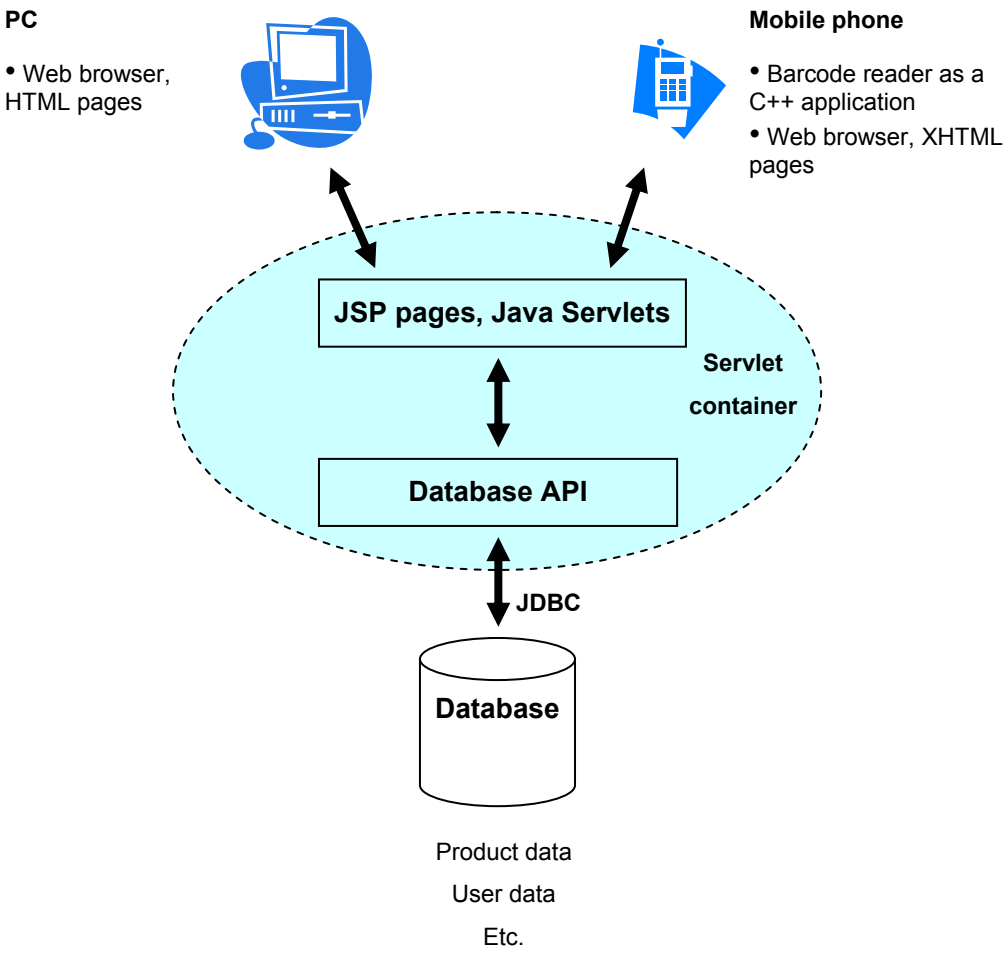

Figure 3. Architecture of the TIVIK pilot system.

3.2 Architecture

The TIVIK pilot system has a three-tier software architecture (Figure 3). The PC and the mobile phone display user interfaces on their web browsers as HTML and XHTML pages. The mobile phone also has a barcode reader application, which is programmed with C++ language. After reading the barcode, the application starts the web browser of the mobile phone to display the product information. 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 use the database. The database API makes it easier for the user interface programmers to use the database services. A relational database was used to store the application data.

3.3 Product information

Product-specific nutritional information required in projects like TIVIK can be obtained from the food manufacturers direct or from the Sinfos product information database (coordinated by GS1 Finland Oy). Sinfos is a database for industry and trade. As of spring 2005, 300 Finnish manufacturers have provided information on their products for the database to be used by retail marketers. In addition to product-specific information, the average nutrient content of foods can be obtained from the national food composition database Fineli®, established by the National Public Health Institute in Finland. The Fineli® database contains information on 48 nutrient factors and over 1,800 foods.

At the start of the TIVIK project the idea was to obtain all product information from the Sinfos database, however this was unsuccessful. For the pilot system, product information was obtained direct from the food manufacturer companies involved with the TIVIK project. The information was evaluated by a nutritionist prior to being stored in the main database established for the project. The advantage of asking for product information direct from the producers is that the information will be accurate. However, the process is demanding for both the manufacturers and the database administrators. For the last group in the field trial, average food information from Fineli® was added to the TIVIK database as well.

In the future, the best potential source of food product information will be Sinfos, as it contains food composition, nutritional content and nutritional properties in one database. Projects like TIVIK could copy the required information from the Sinfos database at regular intervals. Although Fineli® contains average nutritional values, it still has potential for use in the future, especially as a source of nutritional information regarding unpacked perishables (e.g. fresh vegetables) and whole dishes.

3.4 Usability

The usability of the TIVIK system was tested (n = 10) before the actual field trial. The participants were from targeted consumer groups – seven practising weight control and three suffering from lactose intolerance. The PC and mobile applications and the database of products were used in the pre-testing. After being shown how to use the system, the consumers tested TIVIK system independently at home and in the grocery store. The pre-testing, held between 18 and 21 October 2004, ended in a feedback session.

The results showed the problematic nature of the mobile application and were related to the small text size, the speed of the GPRS connection and difficulties in reading the barcodes with the mobile camera; the user interface of the PC application was considered easy to use. In addition, the product-specific food information was perceived as comprehensive. The consumers wanted more basic information on nutritional issues using the PC application. The basic idea of the TIVIK system received positive feedback.

These pre-testing results were utilised when carrying out the actual field trial.

We also recorded the participants' eye movements as they used the TIVIK system. Eye tracking provides more specific information as to which areas of the interface cause problems and which cognitive processes are needed, and it can thus complement more traditional usability methods. The participants' task was, for example, to search for food products and product-specific information in the database and test calculators using both the PC and the mobile applications. Eye movements were measured by a head-mounted eye tracking system (SMI iView).

Completion of the tasks took significantly longer when the participants used the PC application than when they used the mobile phone. Overall, however, the participants could complete the tasks successfully with both applications. When using the PC application, the participants had problems with finding the products in the database, but once they had found the product it did not take very long to complete the task. When using the mobile phone the participants had problems with finding a target link from the link list. Providing the barcode was not very small, taking pictures of the barcodes with a mobile phone was quite easy.

Since taking pictures from the barcodes is a faster operation than searching for the products in the database, the total time to complete the tasks was not much longer with the mobile phone. Taken together, the use of the system via the mobile phone provided a good alternative to the PC.

4. Field trial on the usability of the pilot system

4.1 Background

Consumer acceptability and willingness to use a product or a system is the crucial factor for its future success. In order to get a real idea of the acceptability the prototype needs to be tried among potential users who will use it as part of their normal activities. The personalisation features of the TIVIK system were made for weight management and lactose intolerance, so these groups were selected as the target groups for the field trial. They represent two groups with different kinds of information requirements. For lactose intolerance the decisive factor is the amount of lactose in the product, whereas the information on the relative contribution of a product to the daily intake of energy is the most vital piece of information in weight management. The product information needs to be processed in relation to the person's energy target and portion size.

In addition to overall acceptability of the system, the possible personal and attitudinal factors that promote or hinder its acceptance are also important to know. There are several ways of expressing healthiness in behaviour and this kind of system may be more appealing to some individuals than to others. The possible person-related factors measured in this study were related to behavioural tendencies to interact with the environment and to attitudinal factors reflecting the role of health and technology in life.

The aim of the field study was to study how the users perceived the pilot system, whether they were willing to use it, and even pay for its use, and what personal factors influenced participants' willingness to use the system.

4.2 Methods

4.2.1 Respondents

A total of 100 participants were recruited from work places through advertisements in their internal newsletters or notice boards: 75 were controlling their weight (WC groups; 50 from Helsinki area and 25 from Kuopio) and 25 were lactose intolerants (LI group from Helsinki area). The study was carried out in four groups of 25 participants due to the number of mobile telephones (Nokia 3660 with extra lens) available.

The study groups had both women (59%) and men (41%). Sixty-one per cent were over 35 years old. Typically, the respondents had either high school education (43%) or a university degree (39%). The size of household was divided evenly across one-person (35%), two-person (33%) and more than three-person (32%) households.

The WC groups were less happy with their weight (mean 3.2; max 7) than the LI group (mean 4.4; max 7), but not with their appearance (means 4.4 and 4.6, respectively). The two target groups did not differ in their perception of their own health status (WC: 5.3 and LI: 5.1; max 7) or general health interest (WC: 4.6 and LI 4.5; max 7).

With one exception, all respondents had a mobile phone and the device was mostly used as a telephone (75%), but a quarter (25%) also utilised WAP services on a monthly basis. The majority (82%) had their own PC with an Internet connection and the rest of the group could access the Internet at work.

4.2.2 The procedure

The study consisted of several stages. Those who volunteered to take part in the study were sent a background questionnaire and invited to attend a starting session in small groups of 1–6 people where they were introduced to the TIVIK system, registered in the system, and received guidance in using the mobile and PC applications. The background questionnaire with the socio-demographic and attitude measurements was returned to the organisers at the starting session. After the training part they filled in their expectations regarding usability, personal utility and willingness to use the system. After that they could take the mobile phone with them and use the system freely as part of their normal daily activities for 14 to 28 days.

Due to the limited number of products in the TIVIK database, the procedure was slightly changed after the first group so that the participants received a package of 8 products (bread, spreads, dairy products and beverages) that were in the TIVIK database so that they could practice the using the system at home. Some technical changes were also made – e.g. the first page was simplified to shorten the time required for downloading the information to the mobile from the server. Because these changes were made to the protocol, the results are reported separately for each group, but for the weight control the main points arising from the results are mostly based on the WC2 and WC3 groups. These changes should be borne in mind when interpreting the differences between WC1 and the other WC groups.

At the end of the trial session the respondents returned the mobile device and filled in a questionnaire on their experiences (usability, utility and willingness to use). They were also interviewed on these same issues in order to get data on how they had perceived the system personally.

In addition to the data gathered directly from the respondents. the information on their actual use of the system was used as a measure of interest in the system.

4.3 Results

4.3.1 The acceptability of the system

The interest at the beginning of the trial period was clearly higher than at the end for each of the four study groups (Figure 4). The high interest levels reflect the participants' high expectations for the system. The relatively large drop in interest among the first group during the trial period could be identified as partly caused by technical problems, and this led to some changes in the study protocol. With more products available for the TIVIK system the decline was smaller in the following groups and the mean values for the final interest after the trial were rather high (over 5 with max 7).

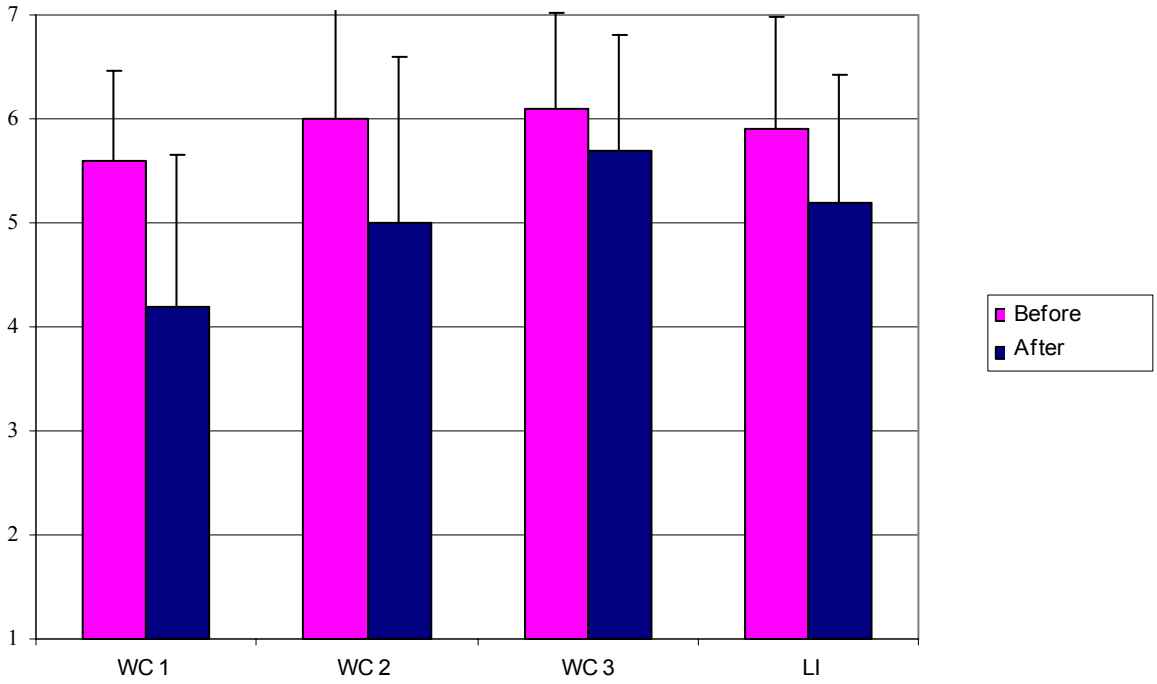

Figure 4. The interest in using the TIVIK system at the beginning and at the end of the trial period.

The acceptability of the system was measured with three variables that consisted of several individual items. These were named as willingness to use (4 items, mean 4.6; max 7), usability (4 items, mean 5.0; max 7) and utility (2 items, mean 4.8; max 7). The means indicated that the system was considered relatively useful and easy to use, and, on average, the willingness to use was also rather high.

Most of the participants (77%) preferred to use the PC application, but 23% reported that preferred the mobile application. This result is clearly reflected in the evaluated

utility and usability of these two parts of the system (Figure 5). The PC application was found to be very easy to use and was perceived as beneficial. The mobile enabled use of the system with no limitations on time or place, but still 82% of the respondents preferred to use the system at home and only 18% preferred the shop environment.

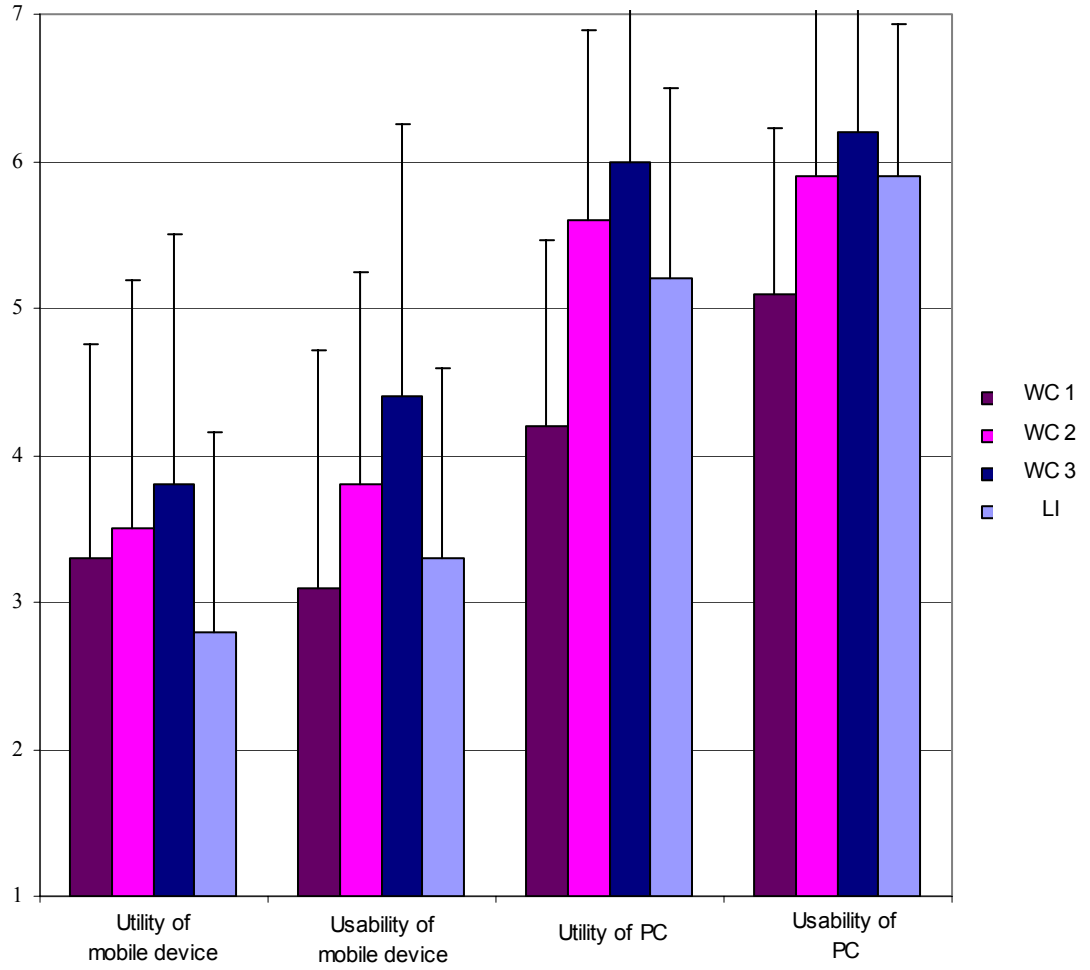

Figure 5. The perceived utility and usability of the TIVIK system.

4.3.2 Personal factors and attitudes explaining the acceptability

Before the field trial, all the participants completed several validated verbal scales that measured different dimensions of personality and attitudes.

The BIS/BAS Scales form a 20-item self-report questionnaire assessing individual reactivity to reward and punishment [Gray 1982]. The impulsivity scale comprises eight items from the Zuckerman-Kuhlman Personality Questionnaire [Zuckerman 1994]. The

Desirability of Control (DC) Scale is a 20-item questionnaire measuring people's motivation to control events and their environment [Burger & Cooper 1979]. The WLOC is a four-item measure of weight locus of control [Saltzer 1982]. It was, for example, hypothesized that users high in desire for control and high in weight locus of control would rate the system more positively than users with lower scores on these scales.

Correlation coefficients were computed between personality factors and variables that were based on the items of the follow-up questionnaire. These variables (i.e., willingness to use, utility, usability or willingness to pay) assess the degree to which the participant is willing to use the system and how useful he/she thinks the system is for him/her. Only the correlation between subjective usability and weight locus of control was significant. Participants who scored in the internal direction on the weight locus of control scale thought that the system was more usable and pleasurable than those who were external in this scale. None of the other hypotheses between personality and the dependent measures were supported.

The general health interest was measured with an 8-item scale [Roininen et al. 1999]. Domain-specific innovativeness was measured in two domains – technological devices and food – with 6 items on each [Goldsmith & Hofacker 1991] and attitude towards technology was measured with four items. These attitudes were not related to willingness to use, perceived utility, usability or actual use during the trial. The only correlations approaching significance were those between technology attitude and willingness to use and actual use, and general health interest and perceived utility.

4.3.3 The use of the system during the field trial

The first WC group only used the mobile phone a few times to retrieve product-specific information, but the later groups were more active (Table 3). The increase in activity was probably due to the changes in the study protocol.

Table 3. The number of searches for product-specific information in mobile and PC applications.

Mobile searches	**Over 31**	**21–30**	**11–20**	**1–10**	**0**
WC Group 1	–	–	3	15	7
WC Group 2	2	1	6	15	1
WC Group 3	2	7	2	13	1
LI Group	1	1	4	18	1
PC searches					
WC Group 1	–	–	1	5	19
WC Group 2	1	2	2	9	11
WC Group 3	3	2	3	8	9
LI Group	5	1	5	11	3

The effect of background variables on the number of searches was analysed using ANOVA models, but there were no statistically significant main effects or interactions between the variables.

4.3.4 Willingness to pay

The majority of respondents (84 out of 100) said that they would be willing to pay for use of the system if the price stayed relatively low. In the first WC group and the LI group the willingness to pay was slightly lower than in the second and third WC groups.

For most respondents the most appropriate mode for paying would be an annual fee with no restriction on the use of the system (73%). The payment should be made separately from other mobile services (63%). Sixty-nine per cent were ready to pay up to 20 € per year for use of the system. If the charge were to be based on individual queries, 60% would be ready pay one cent per query and 27% even 5 cents per query.

The willingness to pay results do not directly answer the question of what consumers are actually ready to pay, but they do reflect consumer interest in the system.

4.3.5 Interviews

During the interviews the participants were asked how they had experienced the use of the system, what had been good and beneficial for them, and what should be improved. The respondents were also asked for ideas on how the system could be improved.

The overall impression of the system was positive and it was regarded as beneficial, especially among the WC groups. The LI group felt that they could get the relevant lactose information from the package with the same amount of effort as from the TIVIK system. The overall usability of the system was assessed as good: the system had a pleasant appearance, and the PC and the mobile applications both had a clear rationale that made it easy to use. However, the system was perceived as not being ready yet and the ease of use was evaluated as it was expected to be in the final product.

The idea of being able to get product-specific information with the help of a mobile device was considered a novel and excellent idea. The use of mobile technology had even encouraged some participants to volunteer for the field trial. At the end of the trial most respondents preferred the PC application; the mobile application lost some appeal due to technical problems – the reading of the barcodes was sometimes difficult with the mobile device, the connection could collapse several times when trying to reach the data from the server and carrying the extra device around was awkward.

The presentation of information in the PC application was perceived as interesting and informative; in particular, the portion-based personal information about one's own choices was perceived as rewarding. The most attractive elements in the system were the calculators for daily energy and nutrient intake, and energy consumption in different sports activities.

The participants thought that the system would be most useful for those groups that have special dietary requirements, such as vegetarians, celiacs and people with allergies. Weight management was also regarded as a potential target for use, especially if the energy and exercise calculators are further developed to provide more general information on the management of a healthy lifestyle.

One problem that most participants brought forward was the limited amount of product-specific information. The most interesting part of the system was the possibility to compare the nutritional composition of product alternatives, which clearly showed the relevance of different options in contributing to energy intake. One category of products that was frequently missed was the meals eaten outside of home, either at work or in fast food restaurants.

The participants suggested the system should be more interactive and aim to make the following of one's dietary choices a less solitary activity. There could also be mechanisms to alert and guide the user if the diet fell short of some nutrients.

4.4 Conclusions

The field trial showed a consumer interest in this kind of system. Personalised, product-specific and visualised information about own choices were perceived as interesting. The system was regarded as suitable for many groups suffering from nutrition-related restrictions.

The PC application was liked and assessed as easy to use. The calculators that provided processed information about one's own behaviour were especially appreciated. The further development of this kind of system should be towards a more interactive and comprehensive tool for managing a health-related lifestyle.

The technological problems in the use of the mobile application limited its acceptance and perceived usability, and the database for products should be widened to attract more attention from the consumers. If these two problems can be solved, this kind of system is likely to have potential users among all kinds of consumers.

5. Business opportunities

5.1 Introduction

The project has clearly shown that consumers have needs for food information and are willing to pay for it. Based on the results of the pilot study, consumers need information about the foods they use and those they should avoid. The project also showed that TIVIK can serve general public health goals, which is why the parties in charge of these issues (The Social Insurance Institution of Finland, Finnish Heart Association) have shown interest in developing the system in order to reach the goals.

The globalisation and centralisation of trade and industry, strengthening of cheap store chains, increasingly narrow product ranges and other similar development trends further increase consumers' need for information about the true content of products, their country of production, production methods etc. Genetic modification, an increase in allergies, the private label system and various ethical principles spur discussion about foodstuff and will likely lead to consumers having the right to get all the information they need and, correspondingly, to trade and industry being responsible for providing such information.

The increasing number of statements and opinions voiced by various influence groups is likely to create social pressure for trade and industry to offer consumers more detailed food information that is accurate, sufficient and easily available in the user's own language irrespective of time and place. In the long run, a broader range of information and the ensuing confidence in the products sold will ultimately be of most benefit to the trade and industry participating in the system.

Developing the TIVIK service into a volume product calls for other commercial and beneficial support services, such as calculators, characters, recipe services, special offers, lotteries and other motivators, as well as camera phones that can read bank codes to enable the payment of bills.

5.2 Alternative models for launching business

5.2.1 Business model based on own earnings logic

Carrying on business independently, at one's own risk and using an own organization and earnings logic requires access either to an own database or GS1 Finland's database, which has so far not been possible.

5.2.2 Operating model based on utility to the public

The state and organizations engaged in public health improvement may show great interest in participating in the development and maintenance of TIVIK operations. Thus, another alternative is doing business without generating profit, the objective merely being to improve public health and cover operating expenses.

5.2.3 Business model based on own database

Groups and individuals looking to manage their weight are the biggest target group of potential TIVIK users. It is possible to gather information that satisfies the needs of this group in cooperation with parties already active in the field. Applications that increase motivation and add fun, such as the simulation of reality and objectives with a character, may further stimulate consumers' interest in the service, as well as enable trade and industry to expand and enhance their marketing channels.

6. Conclusions

The results indicate that there is interest in this kind of personalised communication system among consumers – the feedback on one's own behaviour and calculators of energy intake and expenditure received a particularly positive reaction. The home was the preferred environment for the use of the system and the mobile application did not gain as much attention as was expected. This may be due to technological problems in the use of mobile device and this part of the system should be further developed by utilising the possibilities for more audiovisual messages and increasing the interactivity of the system.

The limited number of products in the database and the lack of product-specific information emerged as the key question for the future functionality of TIVIK system. The missing data clearly lowered consumers' enthusiasm towards the system in the field trial. Retailers and food manufacturers in Finland are building a common database that contains nutritional information on their products. GS1 Finland is responsible for creating the database, but it is not ready yet and the possibilities of letting outsiders use the database are not known. This database is planned to aid the communication between retailers and manufacturers, but it could provide a good source for systems like TIVIK that aim at providing product-specific information. The average information is available, but the differences in fat, sugar and salt content are wide among products with the same generic name. If no product-specific database is available, the alternative way is to create intelligent systems that can process and unify information from different data sources varying in format.

The limitations of modern technology influenced the results of the field trial. The field trial participants found reading barcodes with the mobile phone troublesome. One reason was the slow speed of the GPRS connection, especially when retrieving the first product information, but mobile technology is developing quickly and will bring solutions to these problems. Faster connections (GPRS-Edge, 3G, WLAN) will enable faster data transfer, and more accurate lenses in mobile phones will make reading barcodes easier, even in difficult conditions. Furthermore, the rfid solutions will bring new possibilities to data transfer, and the mobile technologies are becoming more familiar to people, especially among the younger age groups.

On the whole, the consumers who participated in the project at different stages found the realisation of the system pleasant and usable, if one does not include the technical problems. The manifold information about their own energy and nutrient intake was regarded as rewarding and the participants hoped that the calculators for following the daily intake and expenditure of energy could be further developed into an interactive system that supports a healthy life style in an individual and personalised way.

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Title

Hybridmedia as a tool to deliver personalised product-specific information about food
Report of the TIVIK project

Abstract

Consumers wish to have more information on the possible health effects of foods. Personalised self-relevant nutrition information is more appealing to individuals than messages that give general advice. Current package labels can be insufficient or troublesome to read, but other sources of information may not be accessible when the actual need appears.

In the TIVIK project (A context-based personalized information system for delivering product information to the consumer) a pilot system was developed to deliver personalised food product-specific information to the consumer. The mobile application developed in the project utilises wireless Internet, camera phones and food packages. The consumer can collect the information independent of time and location. A barcode reader software application was also created and patented in the project. This transforms a camera phone into a barcode reader device. TIVIK can also be used with a PC's web browser.

The nutritional information provided by TIVIK is displayed according to portion size. TIVIK has services for comparing products, creating a favourites list, maintaining a food diary, using an exercise calculator, and so on. The consumer can also search the food database using various criteria; he or she can read instructions and background information related to food and nutrition. The pilot system was developed for two user groups – those managing their weight and those suffering from lactose intolerance – but the system can be easily broadened to include other personalised user groups as well. The system has around 700 products in its database.

The system was tried in the Helsinki area and Kuopio with a field trial that lasted between two and four weeks. The participants (N = 100) liked the basic idea of the system, and the information based on one's own food choices was regarded as appealing and rewarding. The PC application was evaluated as motivating and easy to use. The food diary for daily food intake and the exercise calculator that could transform the consumed calories into the time needed to expend them in different physical activities or vice versa were the most appreciated features of the system. The preferred location for using the system was at home with the PC. The use of a mobile device was perceived as troublesome and the small number of products in the database restricted the usability.

Alternative business models for commercialising the system were developed within the project. The models are based on an independent earning logic, societal benefit and a private database. Improved technical usability and establishing an adequate database are the prerequisites for commercialising the system.

Keywords
nutritional information, personalized information systems, health effects of food

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Consumers wish to have more information on the possible health effects of foods. Personalised self-relevant nutrition information is more appealing to individuals than messages that give general advice. Current package labels can be insufficient or troublesome to read, but other sources of information may not be accessible when the actual need appears.

This publication contains the results of the project "A context-based personalized information system for delivering product information to the consumer" (TIVIK). The two-year project was part of the technology programme "Interactive Computing" (FENIX) run by the National Technology Agency (Tekes). In the project, a communication system was developed to deliver personalised food product-specific information to the consumer. The system can be used with a PC's web browser or a camera phone, which is used to read the barcode of a food package. The feasibility of the system was assessed in a field trial of 100 participants.

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