Product Recommendations in Mobile Environments*

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Abstract. *In this work we propose a client server model of a product information support system for product recommendations in mobile environments. The system supports clients installed on mobile phones with embedded cameras that are used as optical input devices. Product identification based on 1D barcodes, 2D color codes, and QR-codes is discussed and extensions for product surface mapping with CLUSPI are considered. The server side of the system is envisaged as an ASP.NET application with access control and account management, web and database search frontend, and adaptive smart recommendation facilities.*

Introduction

Almost two decades ago Bill Gates, shared his vision of *information accessible as never before* and suggested that computers would become more personal, powerful communication networks would proliferate, and a broad range of information services would become available on-line. Now we already live in an IT world where people have all the information at their fingertips. Mobile devices with increasing computing and communication capacity are all around us. We reach for our mobile phones not only to talk but also to place and receive video calls. Cell phones support SMS and e-mail messaging, browsing of web pages and much more. Vast majority of people use mobile phones both for business and privately and that is becoming an essential part of their lifestyle.

We treat cell phones as personal assistants, indispensable in our daily activities. The new phenomenon of humans emotionally connecting to their mobile devices is being researches by psychologist and cognitive scientists [1]. The mobile phone has become the most personal part of the huge technological arsenals that surround us and we spend increased amount of time interacting with it every day. In Japan, for example, mobile access already covers the entire transportation network and subway passengers are always busily communicating while commuting.

User Awareness and Mobility

Mobile phones are no more just devices to make calls but rather a versatile mobile computing platform with a variety of applications. According to a survey among iPhone and Android G1 users [2] an average user would download and install more than ten applications per month and at least three applications would be used every day. Because of the readily available cell phone applications, between 24% and 33% of the respondents are reducing the time they spend on reading newspapers, watching TV, and using separate MP3 players, GPS, and gaming devices.

As stated in the previous section, people may emotionally attach to their mobile devices. Indeed, breaking or losing a cell phone with all personal messages, contacts and applets inside may be quite a shocking experience. Users, especially young ones, treasure their mobiles and often treat them as trusted friends. They even become more receptive to advice and assistance by their mobiles rather than via other channels.

Based on that observation, an innovative awareness system for young asthma patients has been designed [3]. The objective of the system is to deliver reminders for using an inhaler to teens with asthma symptoms. The system is implemented as a component of an SMS information service and delivers casual messages, as if from a *virtual friend with asthma*, that are interleaved with other news and gossip.

PmEB [4] is another awareness system that helps people to manage their weight. While users monitor their eating habits and physical exercises, they are sent timely SMS reminders with nutritional and workout information.

The Shopping Jacket [5] created by the Bristol Wearable Computing Initiative is yet another awareness system. The core of the jacket is a GSM mobile phone for spatial awareness and access to internet. Based on the GSM data, nearby shops can be identified and then polled for availability of products that are on the user's shopping list. If matches are found the user is directed to the appropriate shop. This model is even extended to offer shopping plan optimizations for multiple shops and shopping malls where the same product may be available at different outlets.

The above examples illustrate how mobile devices can increase user awareness in regular daily activities. First, the asthma patient awareness system demonstrates how mobile technologies could support proper medication disbursement. While the scope of that example is limited to people on medical treatment, the second example, related to weight management, has a much broader user base. Indeed in the USA 30% of the people over 20 are considered obese and 65% overweighed [4]. And finally, the third example concerns virtually everybody since we are all consumers.

In the following sections we will discuss how mobile devices could increase awareness and augment user experience in daily life even further. Since our target is a wide reach system that provides services and support for different society groups, we have decided to use the consumer market as a reference. We will thus briefly discuss approaches for providing

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product information support to mobile users and will present our client server model of a product information system for mobile environments.

Mobile Access to Product Information

When people make purchase choices they are heavily influenced by the way a product is presented. Commercials and product packing often bring more to the sales than the genuine product qualities. And this is quite unfortunate, especially for food and drinks, since our health and prosperity largely depends on what we use and consume. We believe, therefore, that consumers are entitled to have all the information, about the products they chose, at their fingertips. Such information could certainly be retrieved with a personal computer connected to Internet but when it comes to a mobile device many difficulties arise.

In Japan addresses of web sites with product information are customary printed on product packages as shown in *figure 1*. One can certainly type the URL address and access the site using a mobile phone but in reality consumers would rarely do that while shopping. Main obstacle seems to be the need of typing relatively long URL addresses. One way to avoid typing is to employ digitally encoded web addresses.

Many producers in Japan have adopted QR-encoding of URL addresses on their goods (*figure 1*). Since most mobile phones in Japan have a built-in QR-code reader, such URLs can be extracted by simply taking pictures of the corresponding codes. The problem with this model is that the content printed on the product package, including the QR-code, is entirely controlled by the merchant. When a customer follows a printed or QRencoded URL, s/he will still be getting only the producer's view of the product. It is important, therefore, to extend this model to provide consumers with multiple views of the product, and to ensure access to independent opinions and information that producers have no control over.

A lot of information about different products, including personal opinions, consumer reports, and even professional product evaluations is already available on the net. While shopping, however, searching and finding the right information with a mobile phone is quite a challenge. First one inputs certain information about the product of interest. Then a search engine such as Google is invoked. Finally browsing of the obtained references is conducted. And if no satisfactory information is found the process may need to be repeated.

A Client Server Model for Mobile Access

We propose here a product information system that is specifically designed to address the needs of the mobile users.

The system is attempting to:

- minimize and even eliminate typing;
- make searches transparent to the user;
- manage user profiles and histories;
- offer adaptive smart recommendations;
- accept and manage user opinions.

The system organization is illustrated in *figure 2* where different mobile devices connected to Internet, the system server and database, the image acquisition, etc. are depicted. System components and functionality will be discussed in more details in the following subsections.

The client side. To get access to product information, one has to identify the product in concern. Such identification is quite a common task and most of the shops nowadays employ standard 1D barcodes similar to the samples shown in the upper part of *figure 3*. The same approach could be used to identify products by mobile phones. A standard barcode, for example, could be scanned with a camera, embedded in a cell phone, and then decoded to extract a unique product ID. The decoding can take place either in the cell phone or on a remote server.

In the first case a special applet, much similar to the one for QR-codes discussed earlier, is necessary. Although such applets are already available, for our system, we need a customized one. The applet should not just handle acquisition and decoding of 1D barcodes but should also allow integration with the mobile browser. In particular all decoded barcodes should be converted to HTML GET requests directed to the portal site of our system.

Similarly a customized applet for QR-codes could also be prepared. In contrast to 1D barcodes, employed QR-codes contain URL addresses rather than digits. The standard QRcode applet forwards the decoded URLs to the mobile browser, as shown in *figure 4*. The customized applet, however, has to convert the URLs to HTML GET requests directed to the portal site of our system.

Another 2D barcode that would be good to support is the *color code*. This code is not so widely spread in Japan but it is sometimes printed on product packages next to the QR-code as shown in *figure 1*. The main advantage of the colour code is that it is perceived more as a picture than as a barcode. While its content may be adjusted and beautified to a great extent without damaging the encoded information, its shape and margins still need to meet the standard 2D barcode requirements. This is clearly seen in *figure 1* where both the QRcode and the colour code have the same square shape and large white margins.

Treating barcodes as images may actually bring some advantages. Indeed, if a picture is taken by the mobile phone camera and then sent for processing at a remote server we will need only one applet. The applet would be responsible for acquiring and then transferring the image to the portal site of our system via the HTML POST method. On the server side, images of 1D barcodes, and 2D colour codes and QR-codes can be decoded, and converted to numbers or URL addresses. Other images could be used for content-based image retrieval in image databases and on the web [6].

With the appearance of the colour codes, borders between barcodes and images are getting fuzzy. Even traditional barcodes on many products are nowadays beautified and given picture like appearances as shown in the lower part of *figure 3*. This comes of no surprise, since producers are using every square inch on the packing to promote their goods.

With this in mind one can easily see the limitations of the barcode approaches. Whatever beautification techniques are used, the barcodes will always be bound to some rigid shape, size,

Figure 1. A product with printed and bar-coded URL address

Figure 2. System organization

Figure 3. Standard and beautified 1D barcodes

Figure 4. Accessing a QR-coded URL with the mobile browser

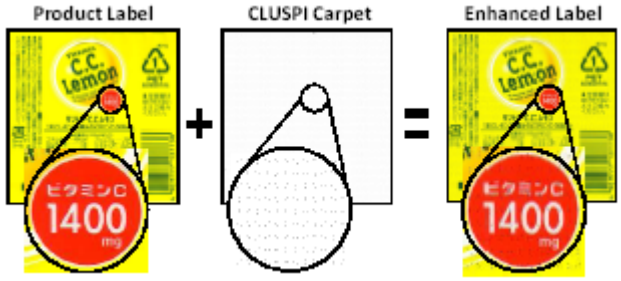

Figure 5. CLUSPI code blending in a product label

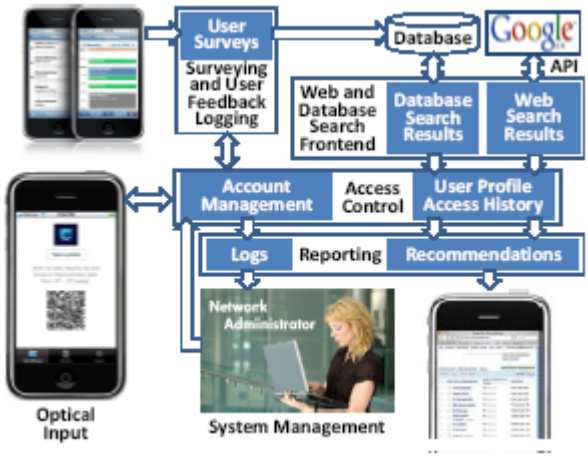

Figure 6. The server side of the system

and border requirements. Reaching beyond such limitations would only be possible if other types of encoding are employed.

For that purpose, one can use, for example, some digital watermarking techniques or surface encoding schemes. Digital watermarking allows encoding and hiding limited amount of information in digital images. In principle, such information could be used for product identification based on the content printed on product packages. Surface encoding schemes, go one step further and allow not only to identify products, but also to precisely determine positions and orientations in respect to product packages.

The Cluster Pattern Interface (CLUSPI) surface encoding scheme has been invented and patented by the last two authors of this work [7]. It employs clusters of graphical objects for reliable digital encoding based on interrelations of cluster members. Such an approach allows seamless blending of the digital code and the existing printed content, and creates virtually no disturbance to the user, as shown in *figure 5*. As discussed in [8], CLUSPI supports direct point-and-click functionality and allows matching of printed and digital content for easy referencing. Based on that, experiments with tangible interfaces have been conducted and digitally enhanced product labels and surfaces have been employed as interface controls [9]. Regarding product information support, we have reported on CLUSPI based surface encoding and linking to product related digital content for health awareness in our earlier work [10]. There we have employed both, barcodes for product identification, and surface encoding for digital content mapping.

In this work we continue developing the ideas from the previous projects and discuss the design and development of a more advanced product awareness system for consumer support. For improved interactivity we have recently implemented a new CLUSPI extension that embeds sheet and object identifiers directly into the digital surface code. Product IDs can now be transferred from the barcodes to the CLUSPI encoding and therefore no barcode space would need to be reserved on the packing. Note that traditional barcodes can only be scanned if properly positioned and oriented in respect to the barcode reader. The new CLUSPI code, however, could cover the entire product package so the product ID could be obtained from any position and orientation.

The server side. We deem Microsoft .Net Framework a good basis for experiments and implementation of the proposed system. Its ASP.NET subset offers groups of classes and diverse built-in controls specifically designed for web development. It supports powerful models and advanced means for server side development. Since ASP.NET Mobile Controls follow the traditional ASP.NET development models development for mobile platforms is greatly simplified.

The server side of our system is outlined in *figure 6* and consists of the following main components:

- access control and account management;
- web and database search frontend;
- reporting and recommendation;
- surveying and user feedback logging.

The access control and account management component is responsible for distinguishing users and for creating and keeping up-to-date user profiles and access histories. Since most of the personal communication devices in Japan have built-in IDs, once a device is activated by the user, immediate access to the account could be provided. In this way user authentication is made to the device and the device authentication is made to the system that can keep track of the device profiles, too.

The web and database search frontend is a component, which accepts HTML GET and POST requests and rewrites them according to stored user profiles and histories. Based on that, queries are generated and used for local database searches on the server, and global searches on the web. The web and database search frontend generates as a result a list of links that are passed to the reporting and recommendation module.

In the reporting and recommendation module links are rated and rearranged according to the preferences stored in the user profile. More link rating hints could be obtained from the link access histories and feedback logs. The ordered list of links is then optimized for presentation on mobile devices. Specific parameters of the employed mobile device could also be taken into account, since the device profile is linked to the current user account.

Surveying and user feedback logging is also an important feature of our system. Publicly available user opinions and consumer reports on different products are sometimes very difficult to rate in terms of reliability. When our system gets user feedback about consumer products, however, the feedback provider is well known to the system. This allows, therefore, not only to register the user feedback as a product report but also to assign to it a confidence level, consistent with the data available in the user profile.

Conclusion

In this work we have presented a mobile user oriented client server approach for providing product information and recommendations.

On the client side we have considered alternative input methods such as barcodes and digital surface encoding that minimize the typing for better mobility. We have also designed a customized applet for converting decoded URLs to HTML GET requests and seamless mobile access to the portal site of the system.

On the server side, access control and account management with user and device profiling is envisaged for better mobile support. In this way the web and database search and reporting components could adapt to users on-the-fly, and provide smart recommendations.

We are planning to continue this research and to carry out experiments and implementations for more platforms and providers.

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