

# User-adaptive Advertisement in Retail Environments

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**Abstract.** This paper gives an overview of ideas and approaches for context-based, user- and location-adaptive shopping assistance and advertisement in an instrumented shopping environment. Among others, it describes how advertisement in a supermarket can be adapted to a particular customer concerning information from his user profile and how personalized advertising hints can be used in a navigation service, so that they offer a benefit for both retailers and customers. Furthermore, the paper points out different approaches of presenting instore advertisement on digital and projected displays.

**Key words:** user-adaptive advertisement, shopping assistance, digital signage, projected displays

## 1 Introduction

Technology finds only slowly its way into traditional supermarket environments. However, recent research, like e.g. the MyGROCER project [1] or the enhanced shopping approach described in [2] and [3], shows that shopping assistance is a highly relevant topic. Although digital signage can be found in more and more public places for advertisement purpose, most of the advertisement found in supermarkets, regardless of their size, is paper-based. The main reason for the reluctance of these environments towards modern ways of advertisement is most probably the small revenue range inherent to typical articles in such environments and thus the pressure on keeping the costs down for retail companies. Still, from the perspective of personalized and pervasive shopping research, these environments seem to bear a huge potential as test domains. Personalized advertisement and tailored suggestions might have the potential to help shoppers and retailers alike. On the one hand, well placed and selected advertisement helps to increase the possibilities to enjoy retail shopping more than expected and on the other hand, it will increase opportunistic shopping and thus also raise the overall revenue for retailers. Embedding advertisement into the shopping routine of users and allowing them to interact with it even in a playful way has not been explored in a sufficient way so far. This article tries to make a contribution

into this direction. In particular, we will present initial ideas on how to advertise products in a retail environment, which is equipped with digital signage. We will further discuss how navigation instructions can be combined with product information and how shoppers' profiles can be used to personalize advertisement. A focus will also lie on technologies that seamlessly integrate product information into the environment by using projected displays.

The paper is structured as follows. The next section will present the Innovative Retail Laboratory, which will be used as a testbed for our ideas to illustrate different aspects of personalized shopping and advertisement. Then, we will present a shopping scenario, before introducing the main ideas and technologies that we envision for future personalized advertisement. The paper closes with a summary and an outlook on future work.

## 2 Innovative Retail Laboratory

Our research in the area of shopping assistance is conducted at the Innovative Retail Laboratory (IRL) [4], which is an application-oriented research laboratory of the German Research Center for Artificial Intelligence (DFKI)<sup>1</sup>. It is installed in the head office of the German chain store GLOBUS SB-Warenhaus Holding<sup>2</sup> in St. Wendel, Germany. This allows a close cooperation with retail experts, which provides the possibility to concentrate on the precise demands and potentials of future self-service stores and accelerates the implementation of research results.

At the IRL, we conduct testings in a large number of different fields all connected to intelligent shopping consultants, which range from a virtual assistant responsible for matters of dieting and allergies, over a digital sommelier, to personalized cross- and up-selling, smart items with digital product memories as a further development of the RFID technology, indoor positioning and navigation as well as new logistics concepts, in order to find out if they are suitable for everyday life and useful for customers.

However, the concepts and technologies that regard the self-service store of the future as a place for shopping are not IRL's only focus. The relation between the store and its customers begins way before the shopping trip itself takes place. It starts with an individual shopping preparation and a personalized presentation of offers and advertisements at home and will be continued afterwards through advice and hints that are given about purchased goods and information about their use.

New ways of customer interaction are developed and tested for implementation, like e.g. an instrumented shopping cart, which plans and shows the way through the store according to the customer's shopping list. Further digital assistance systems can give advice on what to buy for the recipes the customer has in mind, they compare products, point out special offers in a personalized way and give additional information about the products.

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<sup>1</sup> [www.dfki.de](http://www.dfki.de)

<sup>2</sup> [www.globus.de](http://www.globus.de)

### 3 Shopping Scenario

According to consumer studies, shopping lists play a central role in the shopping process [5, 6]. Therefore, we divide the shopping process into two parts. The first part addresses the preparation for the next shopping tour, encompassing e.g. the creation of a shopping list. In contrast to the actual shopping tour, which we regard as the second part of the shopping process, the preparation phase usually does not take place in a supermarket but is often carried out at home. In the following, we will point out how advertising and personalized advisory services can be integrated in both phases of the shopping process.

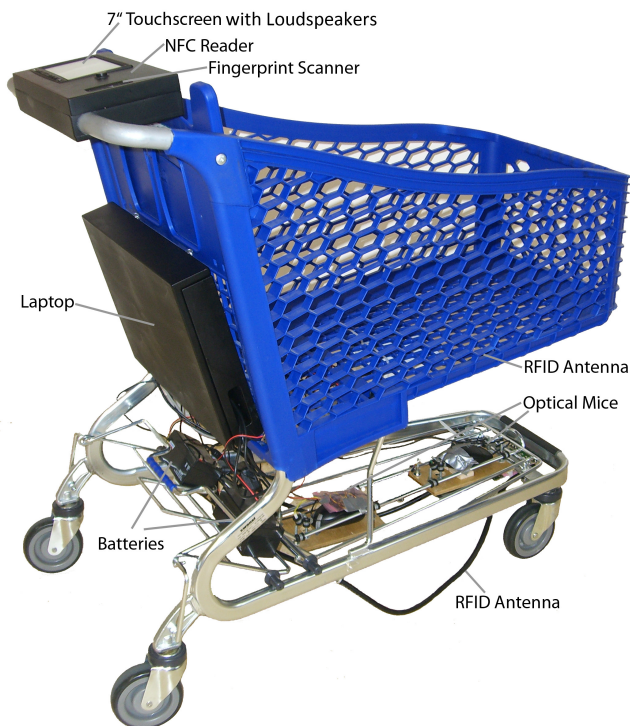
#### 3.1 Preparation Phase

When preparing his next shopping tour, the customer has the possibility to create an electronic shopping list at home. For this purpose, we have implemented a web service whose interface is showing the current weekly offers of the customer's preferred supermarket. Using drag and drop, the customer can easily add the desired products to his shopping list. In order to facilitate the search for a specific product, the entries on the electronic flyer are subdivided in different product groups, which are represented through a tag cloud. When the customer clicks on an entry in this cloud, the system displays only the pages that contain products of this specific class. If the customer needs to find products that are not among the current offers, he also has the possibility to browse through the complete product assortment of a given supermarket, which is sorted in a hierarchical structure. Apart from the browsing through the hierarchy, it is also possible to use free text search to find the desired product. The prepared shopping list is stored in the customer's user profile on a web server and thus it can be accessed and modified anywhere and at any time using e.g. a mobile device, like a mobile phone or a PDA.

User profile data is also used to adapt the shopping list preparation interface to the customer's personal preferences. For example, the tag cloud can be restructured in such a way that it shows only the product classes that the customer is interested in. Currently, we use a predefined static user model in which the user preferences are stored. As an enhancement, the customer's interests could be automatically identified using the history of previous shoppings which can be stored as a part of the user profile. The detected user preferences could then also be employed to automatically generate personalized and context-based recommendations of alternative products. If e.g. the user puts a specific pizza on his shopping list, the system can recommend another pizza that is currently in the special offers or it can propose to buy a pizza without cheese if the corresponding user profile contains an entry about lactose intolerance. In a next step, the system could recognize that the customer is regularly buying a specific pizza and it can inform him proactively if this pizza is on offer.

### 3.2 Shopping Tour

When arriving at the supermarket, the customer has the possibility to download his personal shopping list on his mobile phone or on an instrumented shopping cart - the so-called *IRL SmartCart* -, which acts as an input and output interface for assisting the customer during his shopping tour. Figure 1 shows the instrumentation of the SmartCart. It is equipped with a touch screen integrated in its handle and it uses RFID technology for recognizing RFID-tagged products placed in its basket. The customer can identify himself at the SmartCart using



**Fig. 1.** SmartCart instrumentation.

the built-in fingerprint sensor or an NFC card. After the customer is identified, the SmartCart's system loads the corresponding user profile, which among others contains the customer's current shopping list. This list can be sorted according to a preferred route through the supermarket, which again can be extracted from the history in the customer's user profile. If a product matching an entry on the shopping list is inserted into the instrumented shopping cart, the corresponding entry is checked (crossed out) and the shopping list is resorted, so that the en-

try for the newly fetched product is moved to the end of the list and thus the products which still have to be found remain on top (see Fig. 2).



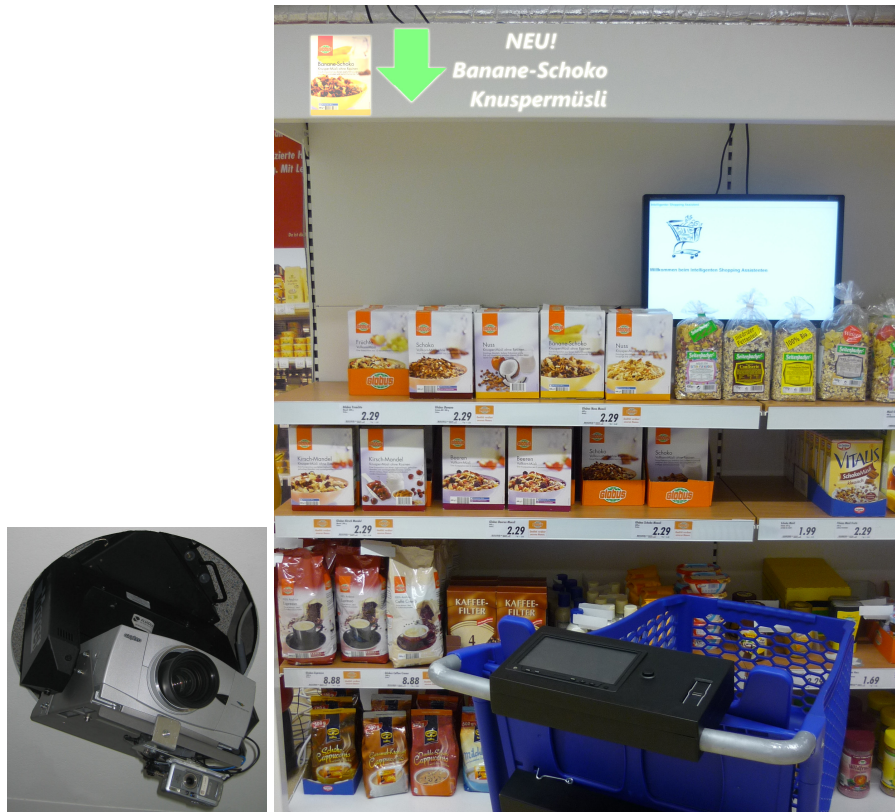
**Fig. 2.** SmartCart’s user interface.

Furthermore, the instrumented shopping cart is capable of recognizing its own location in the shopping environment, which in combination with a 3D representation of the supermarket modeled in Yamamoto [7] is used for the realization of a navigation service. The self-localization of the SmartCart is realized by means of a second RFID antenna mounted at the lower part of the cart, which recognizes RFID tags placed in a grid under the flooring of the shopping environment. The current location of the cart is calculated using the *Always Best Positioned* algorithm by Schwartz et al. [8, 9].

The ability of the SmartCart to locate itself in the environment together with the knowledge about product placements in the supermarket and the customer’s user profile could enable the generation of user-adaptive advertisement and product recommendations. These hints could appear on the cart’s display when the customer is entering regions of interest. Beside that, for showing these location-based advertising hints, we could also use a variety of stationary displays placed at different strategic positions in the supermarket. Another possibility to display visual content at arbitrary locations that we have already implemented in the shopping environment is offered by the steerable projector system *FluidBeam* [10]. It enables a distortion-free projection of images and videos on a display continuum covering the surfaces of the environment. In this way, projected virtual displays can be created and placed at specific locations where they are made visible when the steerable projector is directed at them. In combination with the navigation service offered by the SmartCart and the user profile information, the FluidBeam system enables the creation of location-based user-adaptive advertisement. If the customer has e.g. the entry ”muesli” on his electronic shopping list and he is approaching the shelf with the cereals, he is proactively informed about a new sort of muesli which, according to his prefer-

ences, he might be interested in. Figure 3 shows such a user-adaptive projected advertisement displayed at the top part of a shelf.

In this case, the projected ad does not only have a persuasive aim but it also serves as a navigation hint indicating the position of the appropriate product. We refer to this type of navigational hints as *micro-navigation*. In contrast to the *macro-navigation* mode, which is performed as long as the customer is further away from the searched target and aims in leading him to the vicinity of the searched product, the micro-navigation starts as soon as the navigation target comes in sight and is intended to help the customer in finding the exact position of the desired product in the shelf. The macro-navigation is integrated in the SmartCart's system and it is visualized in the form of map navigation on the cart's interface whereas the micro-navigation uses stationary or projected displays in the vicinity of the target to indicate its exact position.



**Fig. 3.** Steerable projector unit of the FluidBeam system (left) and projected advertisement with micro-navigation hint (right).

In our example, the projected micro-navigation hint consists of an arrow displayed beside an advertisement hint at the upper part of a shelf containing the searched product (see Fig. 3). However, it is also possible to project the placement hint directly on the target, e.g. in the form of a projected spot like the ones created by the *SearchLight* application [11].

A further possibility of integrating interactive projected displays in a shopping environment is offered by the so-called *Product Associated Displays* (PADs) [12] in conjunction with the *Mobile Shopping Assistant* (MSA) [13], which is running on a mobile device and offers multimodal input and output in order to assist customers in retrieving information about products of interest. One possible form of interaction with the MSA consists in a direct manipulation of the products in the shelf. If e.g. a product is taken out of the shelf, this action is recognized using an integrated RFID antenna and this event leads to the creation of a PAD projected at a location that is spatially linked to the interaction product, like e.g. the gap left by this product in the shelf. After that, the customer can use a variety of modalities like e.g. speech or written text in order to obtain information about the product he is holding in his hands. Figure 4 shows a customer interacting with a product (digital camera), retrieving price information on a PAD.



Fig. 4. Product Associated Display with price information.

## 4 Our Vision of Advertising and Shopping

With the increasing influence of digital media and novel technologies finding their way in the area of shopping, in the next decades, the retail sector will undergo a significant change. The increasing customer and product transparency will enable retailers offering a more personalized shopping experience to each individual customer. This personalization will probably not encompass only personalized advertisement and product suggestions but it might even allow the production of personalized products, which will be perfectly adapted to the specific needs of each customer. With online shopping becoming more and more popular, it seems quite plausible that in the near future, customers will be able to combine online and traditional shopping in order to have the benefits of both. The supermarkets will offer their customers services which will facilitate the regular shopping, e.g. by an automated collection of the usually bought products, which will be prepared for the customers when they come to their preferred supermarket. In this way, the shopping experience will be enhanced as the customers will no longer have to waste their time with the weekly shopping routine but will have the opportunity to spend more time with the more enjoyable explorative shopping.

## 5 Conclusion

In this paper, we have presented some initial ideas to provide personalized and contextualized advertisement and product information in an instrumented retail environment. We believe that through a combination of personalization and seamless integration of information into a shopping environment the shopping experience will be intensified. We have presented how to integrate navigational instructions into the environment along with product information. Seamless integration into shelves is realized through Product Associated Displays, which provide further information on products users may like. We believe that in the future, retailers will offer their customers a variety of services aiming at facilitating the shopping process and enhancing the shopping experience. In this way, the customers will be mostly relieved of the unpleasant duty of their regular shopping and they will have the opportunity to focus on the more exciting explorative shopping.

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