Informing Customers by Means of Digital Product Memories

Alexander Kröner[1], Patrick Gebhard, Lübomira Spassova,
Gerrit Kahl, and Michael Schmitz
German Research Center for Artificial Intelligence
Stuhlsatzenhausweg 3, 66123 Saarbrücken, Germany

Abstract. The continuous collection of digital information via smart labels attached to physical objects is a promising way to support information availability across all stages of a product's lifecycle. Since such "digital product memories" may contain a vast amount of heterogeneous data, we expect a strong demand for user support in tasks related to information retrieval and discovery. In this article, we focus on the interaction between consumers and digital product memories in a retail scenario. On the basis of several prototype implementations, we summarize various ways of retrieving and presenting product-related information with the goal to shed some light upon aspects of relevance for the interaction between users and object memories in general.

Keywords. smart items, digital memories, tangible user interfaces, retail experience

Introduction

From a customer's point of view, product-related information has a broad range of applications. For instance, it helps in choosing a product based on its features, judging its quality, applying it, and learning about it. A retailer may comply with this interest by offering such information in order to increase customer satisfaction (cf. [1]). The basis of such a service is a rich pool of product-related information, whose completeness and soundness is a direct reflection of the product's integrity (cf. [2]). The building of such a pool requires the continuous collection of information across all stages of a product's lifecycle, ideally on the level of objects, in order to achieve a unique and detailed view on the particular situations a product individual is exposed to. This task can be supported by smart labels, which can be beneficial for all partners of a business process (cf. [3]). Further potential arises from the connection of the physical item with a dedicated storage for digital data – a *digital product memory* [4]. If such a memory is open to access for any party along the value chain, then it might become a key element of new business models on the basis of ambient intelligence (cf. [5]).

The interaction between the user and such extended products may benefit not only from a rich resource of object-related data, but also from technical extensions attached to the product. In the context of this article, we will discuss selected product information systems, which are part of a complex shopping environment installed at the

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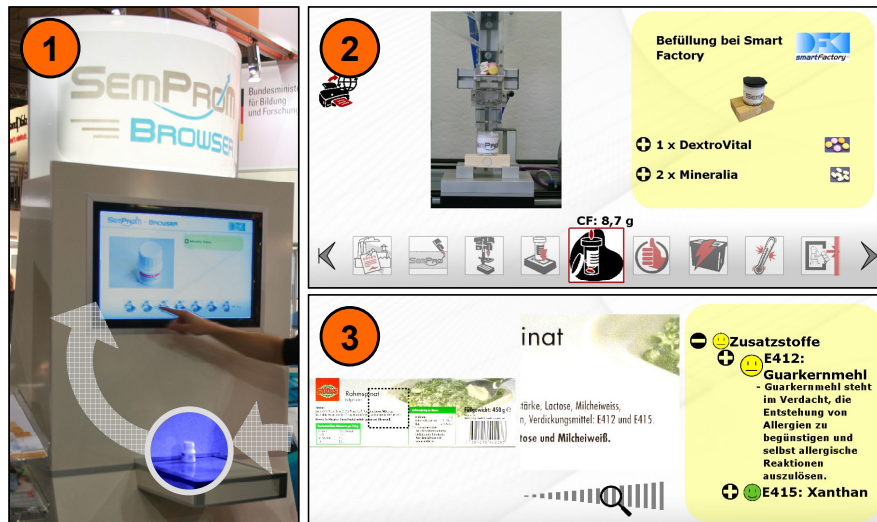[1] Corresponding Author, email: Alexander.Kroener@dfki.de.

Figure 1: A kiosk-like system enables the customer to retrieve and explore contents from a digital product memory. By placing the product on an RFID antenna, the respective memory is accessed (1). A diary-like view supports the exploration of the product's history (2). A feature-oriented view combines memory contents with external information sources in order to explain the product's features (3).

Innovative Retail Lab (IRL, see http://www.dfki.de/irl/). The systems are connected to the Internet, the store's backend, and a so-called *Object Memory Server* (cf. [6]). Each product is equipped with a smart label providing a pointer (on the basis of a URL) to the respective product's memory. However, in contrast to these commonalities, the individual systems vary in the technical nature of the smart label (which ranges from RFID to sensor nodes) and put emphasis on different aspects of a digital memory in order to illustrate its diverse applications.

1. Browsing a Digital Product Memory

The access to digital information via a tangible product enables a broad range of customer-oriented services. For instance, such information may be exploited to retrieve multimedia content that fits to a product in focus and to express recommendations based on product similarity and compatibility [7] – services which can be exploited to enrich the customer's retail experience in shopping environments such as [8].

In order to research access to a digital product memory, we realized a prototype of a public access point, which enables a customer to explore a product memory without additional equipment. This *product memory browser* uses a kiosk metaphor: if the user places a product on a sensitive surface, then the system presents product information compiled from the respective memory, the store's backend, and the web.

Designed for machine processing, the content of a product memory may be difficult to interpret by a user without additional support. Therefore, digital assistants are required which perform a translation and visualization of memory contents which meets the user's abilities and goals. For instance, in the context of quality control, an ecologically-oriented customer might be interested in the product's carbon footprint. Often the aggregated value of all events related to this particular value will be sufficient

to satisfy this interest. If the user is willing to learn about the rationale behind this value, then she may explore processes applied to the product via a list display where related events arranged in a timeline. Touching an event puts it into the focus of the browser, which in turn displays the status of the product as well as the process applied for the selected point of time.

This approach emphasizes an explorative interaction with the historical aspect of memory contents. In contrast, the so-called "product lens" provides a feature-oriented perspective on the product. First of all, it enables an optical zoom of the product's packing. On the basis of a digital model, the user may select different perspectives of the product's packing and magnify these in order to obtain easy access to information printed there. In parallel, the system displays the matching digital representation of that information from the product's memory.

Here, the system exploits an OWL-based semantic encoding of the product features. First of all, it allows for translating memory contents into a terminology familiar to the customer. For instance, the system may extract a notion such as "E415" from the memory, exploit "same as" relationships in the underlying ontology to obtain the alternative notion "Xanthan", and then exploit both notions to extract a matching description (e.g., "A food additive used to increase the viscosity of a liquid.") from a public web service. In this way, the user may "zoom" into information exceeding the one printed on the packing on the basis of the meaning of product features, similar to the idea of a "semantic zoom" (cf. [9]). Similarly, the system exploits the semantic encoding in order to provide support on the basis of feature interpretations. For instance, in **Figure 1** the system guides the user via "smileys" through the zooming process to the information that an ingredient is suspected to cause allergies. Thus, a customer interested in a quick overview may get an idea of a potential risk, while other customers may exploit the combined information sources of product memory and the web in order to learn about the rationale behind that hint.

2. The Product as a Means of Interaction

An aspect shared by these examples is that the physical object becomes part of the interaction between user and information service. This matches the idea of tangible interfaces, which aim at a direct manipulation and experience of digital information in the real world [10].

A particular advantage of this kind of interaction is the seamless integration of the communication between man and machine in procedures the user is familiar with. The *Digital Sommelier* [11] illustrates how this idea can be transferred to a product recommendation process (see **Figure 2**). Via RFID, a shopping assistant recognizes if a customer has just removed a product from a shelf. Without interrupting that action, it proactively responds with information regarding that particular product's features. This content is retrieved from the product's memory, and displayed on a mobile PC mounted to the shopping cart. The display combines static aspects (such as vineyard and type of grape) with dynamic data (such as current temperature) retrieved from a temperature sensor attached to the bottle. The assistant exploits the combined data to provide recommendations for the general kind of product (e.g., matching dishes) as well as for the particular instance (e.g., "This bottle should be cooled before serving.").
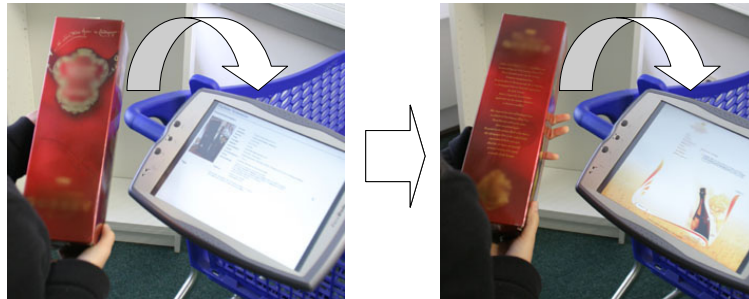
Figure 2: An accelerometer attached to the packing enables the shopping assistant to capture the customer's interaction with the product. The assistant interprets a turning movement as an information search gesture, and responds with a presentation of additional information on a display attached to a shopping cart.

If the customer is turning the product package (e.g., in search of more information), the assistant switches the displayed content as well – e.g., to the homepage of the manufacturer. This support is enabled by an acceleration sensor attached to the product's packing. Thus, the product becomes a *means of interaction*. The combination of this approach with additional output channels – e.g., speech output –, allows for creating products, which serve the customer as a communication partner. Such objects can be used within an intelligent environment for achieving a symmetric multimodal interaction, where physical objects mimic the user's interaction behaviour (cf. [12]).

3. Employing Digital Product Memories for Interactive Product Exploration

Beside other methods for conveying product information, we also aim to present product information in a narrative style. This should enable customers to look into products interactively in a playful and enjoying manner. Since products provide different types of information (e.g., facts of the product memory or the narrative structure), customers have different interactive experiences that invite to explore products directly in the store. We explore this idea in a setting, which applies a narrative structure that comes with the product itself to control the interaction with *virtual characters*. Especially intuitive interfaces, like tangible objects, that are used to communicate with virtual characters help to attract users and engage them in interacting with the system. This approach seems to be appropriate for consumer service systems that (1) inform customers about individual product information and (2) advertise related products.

Virtual characters (VC) have been used in many applications in various fields for more than ten years [13]. Their human-like communication skills can be exploited for the creation of powerful and engaging interfaces. In addition, VCs can easily take different roles, e.g. a guide, a companion, a trainer or an entertainer. Their appearances and their communication skills enrich interactive systems, such as kiosk systems, virtual training systems [14] and museum guides [15]. Especially systems with full-body and human-sized VCs in public spaces, trade fairs, entrance halls and museums draw users' attention and invite them to interact. In such settings, the use of digital product memories can improve the interaction experience substantially. Based on

individual product information, the interaction with customers is colored individually (e.g. verbal comments, special actions performed by virtual characters that represent individual facts, which are stored in the product's memory). As a result, the interaction experience varies and gets livelier.

For the realization, we rely on the *SceneMaker* approach for modeling interactive performances with virtual characters. It follows the concept of content separation and narrative structure, which we have introduced in [16] and successfully used for the creation of interactive systems. The content is organized in *Scenes* and a *Sceneflow* represents the narrative structure. Scenes are pieces of author-edited contiguous dialog. Additionally, they can contain commands for controlling the characters' non-verbal behavior and for the presentation of media objects (e.g. showing pictures or videos). Authors usually refer to a scene as a coherent and closed unit regarding a message or a comment. They can define the narrative structure by linking the scenes in a graph called Sceneflow. Transitions in a Sceneflow are triggered by transition events. These events represent the user's actions. In the case of a customer service system, an event would be e.g. the placement of an object in a designated area as described in the section before. The content for interactive presentations (the Scenes) is created by the authors using standard text processing tools. The creation of the Sceneflow is done by means of a graphical user interface, which is part of the SceneMaker tool and can also be used by non-programmers.

The use of digital product memories offers different ways for controlling an interactive presentation involving virtual characters. One approach is to store a Sceneflow and Scenes for each product in a product's memory. This would ensure that each product holds the information (and the interactive) structure for its presentation. When a customer brings a product to this system, the virtual characters are controlled by the product's individual Scenes and Sceneflow and the interaction is individually adapted to the product's specific knowledge. However, a general Sceneflow and additional Scenes are needed to embed those from a product seamlessly for an interactive presentation. Both can be individually tailored to customers and individually created by the manufacturers of products or influenced by retailers. In general, this approach would enable a new way for product information and advertisement.

4. Discussion

Within the aforementioned examples, a basic function of the physical product item is the one of an *information key*. It grants access to a broad range of information about the object itself (from the product memory), the kind of object, and related information (taken from the web). This information pool will easily exceed what a user is willing to handle in a shopping situation, an issue which can be addressed in various ways. For instance, we presented a feature-oriented presentation as well as a diary metaphor. The former focuses on a quick summary of the product's current status and thus it is more appropriate for immediate shopping decisions. In contrast to that, the diary metaphor enables the user to learn about the evolution of these features (and thus about cause and effect), which requires that the user is in a situation with little time pressure.

The design of a digital product memory may support these processes through the employed hardware as well as the respective memory contents. For instance, attaching sensors to the product is not only a way to capture product-related data, but also to emphasize the physical item's potential role as a *means of communication* or even as a

communication partner during the presentation process. Furthermore, a presentation may benefit from the well-defined semantics of memory contents. In addition, we suggest deploying presentation knowledge (ranging from presentation style to dialog structure) within the memory, which enables parties contributing to the memory (e.g., manufacturer, retailer) to take influence on the way the product is presented – or is presenting itself.

The discussed information systems could further benefit from information about the particular customer. Here, we see further potential in dedicated memories which save a (personal) dialog state in order to enable consistent and coherent dialogs across information points (in potentially varying contexts). The presented research was partially conducted in the project "Semantic Product Memory" (SemProM), which is funded by the German Ministry of Education and Research under grant 01 IA 08002A. In this project, we want to exploit the lessons learned so far for the general design of a digital product memory and for the realization of novel applications based on digital memories along the supply chain.

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