AUTO–ID LABS

APriori: A Ubiquitous Product Rating System

Felix von Reischach, ETH Zürich,
freischach@ethz.ch
Florian Michahelles, ETH Zürich,
fmichahelles@ethz.ch

Auto-ID Labs White Paper WP-BIZAPP-051

Abstract:

In this paper, we propose a ubiquitous product rating system. First we provide an overview of state-of-the-art product recommendation, concluding that current approaches do not support in-store consumers; i.e. consumers on the shop floor. Within shops however is where three out of four buying decisions are made. Hence we propose APriori, a new approach towards mobile product recommendation. APriori makes product recommendation available for mobile users. These utilize their phones to identify tagged (barcode/RFID) consumer products. Based on the identification of products, the mobile device communicates with a backend product recommendation system. As a new rating concept we propose the use of user-generated rating criteria. Accordingly, we describe the APriori prototype implementation and first user experiences. We conclude with discussions about future research directions.

Keywords:

user-generated content, product recommendation, mobile applications, web 2.0

Reprinted from Jonna Häkkilä, Gregor Broll, Enrico Rukzio, Derek Reilly, Paul Holleis: Workshop on Pervasive Mobile Interaction Devices (PERMID) at Pervasive 2008, Australia, May 2008. Available from: http://www.permid.org/2008

1 Introduction 2

2 The Need for Apriori 3

2.1 Product Review Systems Today 3

2.2 Mobile Characteristics 4

3. Apriori – System Design 5

3.1 Technical Architecture 5

3.2 Concept of Adaptive Rating Criteria 6

4. Prototype Implementation 7

5. Conclusion and Outlook 8

6. References 9

1 Introduction

Within the last decades, the variety of products in retail stores has increased significantly. Globalization, coming along with the individualization of demands, leads to so called *strategy pluralism* in the retail industry: retailers offer everything for everybody. An example: *Draegers* grocery store in Silicon Valley offers 250 types of mustard, 75 kinds of olive oil and 300 varieties of jam. The vast amount of choices makes it more and more difficult for consumers to take an informed buying decision. This is frequently referred to as *consumer confusion* [1]. Consumers react to this information overflow by retreat, by delaying the buying decision or by randomly buying products [2].

Although the plurality of choices also has positive effects, it remains a challenge to use the advantages of a broad product range without overwhelming consumers at the same time. The advantage however can only be realized if the information about the offered products is structured in a way that can be perceived and filtered by the human brain in an appropriate way.

An approach to structure product data in a way it can support [3] consumers in their buying decision is provided through web-based product recommendation systems[1]. These allow users to submit experiences they have made with particular products and share them with other users in a community-like fashion.

Nonetheless, product recommendation systems in the Internet do not meet the needs of customers of physical stores; they do not meet the needs of so called mobile users. Consumers turn on their computers and make use of the systems mainly if they have a high involvement with a product or when they plan to purchase the product in the Internet anyway (for example for balancing the pros and cons before buying a camera). However, studies suggest that three out of four buying decisions are actually taken within shops [4]. Moreover, we assume that users are preferably motivated to express themselves in the context of actually using a product (most of the time a mobile context). This is when they are emotionally driven.

In parallel, mobile devices are more and more evolving into permanent companions of consumers. In many developed countries, mobile phone penetration is well above 90%, meaning that almost everybody is using a mobile phone. In addition, recent handsets provide extended functionalities such as mobile Internet connection, mobile barcode recognition [7] and NFC (Near Field Communication) [6]. These tendencies enable the interconnection of the physical world with the virtual world, especially since almost all products have been tagged with barcodes and since a broad tagging of consumer goods with RFID tags is possible in the long run [5].

Based on the tendencies outlined above we study: How can mobile users be enabled to actively recommend products and to receive product recommendations?

[1] Examples: http://www.epinions.com, http://www.amazon.com

Our approach is a concept for mobile product rating with user-generated criteria. It allows consumers to submit and receive ratings anytime-anywhere, using their mobile phone as a product interaction device. In Section 2, we survey current concepts of product recommendation systems. We show why they cannot support mobile users, i.e. consumers in shops, in an appropriate way. The result is the need for a ubiquitous product rating system. Section 3 is devoted to APriori, a novel approach towards product rating which is tailored to the needs of mobile users. In Section 4, we describe the demonstrator implementation of the proposed concept. We conclude with a critical assessment of APriori and the discussion of future work in Section 5.

2 The Need for Apriori

2.1 Product Review Systems Today

The development and the usage of information technologies in the automotive industry as well as the willingness to adopt new technologies to further enhance supply chain management has always been influenced by recent trends. Although the automotive industry already uses RFID (e.g. in vehicle immobilizers since the 1990s), the adoption in supply chain processes is just at the beginning. This encompasses all those processes that are associated with the movement and shipping of goods from raw-material stage up to the final products which are delivered to customers as well as backwards at the end of the product's life for recycling purposes, i.e. procurement, inventory management, assembly control, order processing, distribution, transportation, quality control, theft control, anticounterfeiting, and warehousing [**Error! Reference source not found.**], [**Error! Reference source not found.**]. RFID applications can be further distinguished in two basic layouts: Closed-loop systems (CL) and open-loop systems (OL).

Current commercial product recommendation systems are accessed on the web and allow users to exchange experiences about products. Prominent examples of web-pages hosting product recommendation functionality are Amazon.com and Epinions.com. While Epinions sees itself as a neutral provider of additional shopping information for online-shoppers, Amazon has integrated recommendation functionality into their own web shop. Further neutral recommendation sites are ratings.net, reviewcentre.com, kelkoo.com and edigitalresearch.com, to name just a few. Almost all web shops have followed Amazon.com and provide product recommendation functionality in one way or the other. Concrete functionalities of current recommendation systems are: searching for product recommendations, creating product recommendations, maintaining user profiles and connecting user profiles to others, building a web-of-trust. In many cases users can also rate

recommendations made by others. All considered recommendation systems offer both *product ratings* and *product reviews*.

Product Ratings: Product ratings are usually visualized on a one-to-five stars scale. They allow the user an at-a-glance assessment of products. Ratings can be made based on specific predefined criteria such as price-performance ratio and quality or can be submitted as an expression of the overall satisfaction.

Product Reviews: In contrast, product reviews allow users to describe their experience with products as continuous text. Different levels of detail are usual for the reviews. At Epinions, for example, users can submit short reviews (up to 100 words) and longer reviews.

In the research domain, product recommendations have mainly been discussed in the fields of marketing and computer science. While in marketing mainly the effects of product recommendations on sales were investigated [8] [9], the research in computer science focused on ways of filtering recommendations for the needs of consumers (e.g. [10] [11]). In the field of mobile computing, amongst others, the approaches of [12], [13] and [14] have made travel location recommendations mobile. However, none of them leverages the possibilities mobile tag reader technologies offer. Thus they do not implement the vision of the mobile phone as a pervasive mobile interaction device.

2.2 Mobile Characteristics

Elaborating the requirements for mobile recommendation systems, we based our approach on [16], who identified characteristics of the mobile user experience in mobile web browsing. We assume product recommendation is a special case of mobile web browsing. Thus we identify the particular characteristics which influence the user experience when accessing product recommendation systems from mobile phones instead from stationary PCs:

The **mental and physical resources** of users are more limited for mobile users, as they frequently have to do parallel actions (e.g. standing, examining a product, using a mobile application).

The **temporal context**, thus the time a user is willing to spend for product recommendation is shorter. A study suggests that mobile users get distracted in average after 4 seconds, when waiting for a computational result in a mobile context [17].

The **task context** in which mobile product recommendation takes place is different. While many people spend time in the Internet without a specific goal, mobile product recommendation is a part of a particular task: shopping, i.e. deciding on a product.

Another obvious difference is **device usability**. Compared to a stationary PC, a mobile phone has a small display, unfamiliar usage patterns (no mouse, small and

less keys, launching of applications), limited connectivity and limited computational resources.

Our takeaways from this listing are that, generally speaking, the system must focus on easy usability while considering the device constraints of mobile phones.

3. Apriori – System Design

Based on the mobile characteristics elaborated above, we devote this section to the design of APriori. In order to meet the requirements of mobile users, we take two steps. Firstly, we design a product rating system accessible from a mobile phone. Thus the system is usable in-situ (e.g. on the shop-floor). Tag readers integrated in mobile phones are used to ease the interaction between physical products and recommendation systems. Secondly, we review the concept of current product recommendations.

3.1 Technical Architecture

A coarse overview of the building blocks of APriori is given in Figure 1. Users access APriori through an application on a mobile phone. In order to receive product ratings or actively rate products, users scan tags which are attached to products already today. This can be any tag which is capable of storing an identifier on product type level and which can be read by mobile phones. Natural candidates are barcodes and RFID tags of all types.

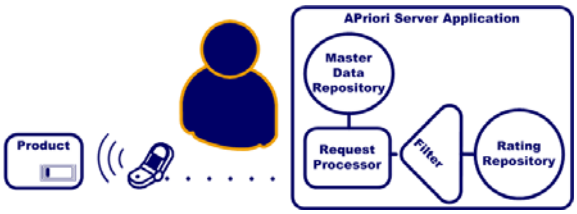

Figure 1: Building blocks of APriori

Having read the product identifier stored on the tag, the mobile application queries a server application for existing ratings the submitted identifier. The server application (request processor) receives the query and authenticates the user with his user profile (user repository). The query is forwarded to the rating repository, a data base which contains all submitted recommendations. The data is filtered in a way the user demands it (filtered for a specific product type or to other characteristics the user has requested in his profile). This procedure is similar as we know it from recommendation systems in the Internet (see also [12]). Then the information is shown to the user on the mobile phone and he can take an informed buying decision.

Concerning the tags used: barcodes are already attached to nearly all products. There exist a range of approaches to use camera-phones to read them with mobile phones [7]. Interaction-wise the use of NFC, thus touching physical objects for interaction provides advantages to users [15]. However, it can be doubted if all consumer products will be tagged with NFC tags in the nearer future like we experience it with barcode technology today.

3.2 Concept of Adaptive Rating Criteria

We see isolated product ratings as not expressive enough for the user. They usually only provide information about few, predefined criteria (e.g. overall satisfaction, price-performance ratio, quality). This is why in the Internet product ratings are always combined with detailed textual product reviews. This combination provides users with both: easy at-a-glance assessment of a product and differentiated experiences of users written down textual. As the requirements for mobile product recommendation demands little user interaction and the display of product recommendations on small screens in a user-friendly way, we think *product reviews* do not make sense for mobile devices.

This is why we extend the approach of product rating. We make product ratings more expressive by introducing adaptive rating criteria. The goal is to leverage the advantages that product ratings provide (quick entry, easy to display) and reduce the shortcomings they have (limited expressiveness).

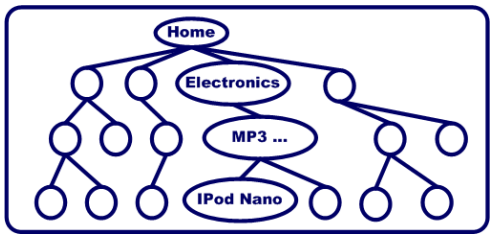

Figure 2: Product tree in recommender systems

In APriori, just as in most existing product rating systems, products are arranged in a tree-like hierarchy (see Figure 2). The leaves of the tree represent product types, all inner nodes are product categories. Let us assume a consumer is looking for ratings for the iPod Nano at Epinions. The product recommendation system would find this product type in the following product hierarchy: Home → Electronics → MP3 and Digital Media Players → Apple iPod Nano.

For a given product type (here: iPod Nano), there is a predefined set of standard rating criteria available. In our example, these are *overall rating, sound, ease of use, durability, portability, battery life*. Predefined rating criteria however limit the power of consumers to express themselves. For example, there is no information in them

which expresses something about the scratch sensitivity of the MP3-player. This is why APriori features additional adaptive rating criteria: users create their own rating criteria. We distinguish:

Standard Criteria: Standard criteria are well-known criteria which apply for many product categories. For example the price-performance ratio is important for almost all product types and product categories. This is how it is done in the product review systems of today.

Adaptive Criteria: These are criteria which extend the standard criteria by what the community thinks is important to rate. This is how we exceed the state-of-the-art. Adaptive criteria are created by users. Coming back to the iPod Nano, examples for dynamic criteria are sensitivity of casing and quality of headphones. Thus, features that were expressed through textual reviews in traditional product recommendations systems.

In order to not make product rating too complicated for users in a mobile context users maintain the possibility to submit an overall rating on a one-to-five scale without rating all possible criteria. APriori uses the well-known one-to-five stars scale users are familiar with from conventional product ratings.

What are potential drawbacks and challenges with adaptive criteria? In order to prevent users from generating too many criteria and unrelated criteria, there is need for a moderator who is able to delete criteria if they are becoming too many or if they do not fit. This is a similar approach to how it is done in Wikipedia[2], for example. Of course the moderator does not need to access the system on a mobile device. A web-based interface is provided. In addition, users can submit warnings to the moderator on their mobile, if they feel a criterion should not be where it is. In order to prevent the multiple creation of the same criteria and to prevent spelling errors, there is an auto-completion feature when entering the criteria.

4. Prototype Implementation

We implemented a first simple prototype of APriori on an NFC phone (Nokia 6131 NFC). Yet we have not implemented user-generated rating criteria. Users so far can only make an overall rating for a product. As test products, we tagged four bottles of olive oil with HF RFID tags. Why olive oil? Olive oil is relatively expensive (average price of the selected bottles: 14.82 USD) and is offered in a broad range of quality. Frequently, olive oil of low quality is offered at high prices. But consumers notice that only when they try the oil, which they usually cannot do before buying it. All this makes olive oil a good example for product recommendation. For tag detection, NFC instead of Barcode recognition was chosen as it allows easier interaction and enables the automatic start of the mobile application upon reading of a tag.

[2] http://www.wikipedia.com

Figure 3: Screenshot of an overall rating for olive oil in APriori

The user interface implementation was a challenge. We designed a simple user interface (see Figure 3), making use of the well-known 5-stars visualization of ratings. In the future, users will be allowed to switch between an *overall rating* view of a product and a *detailed rating* view with the adaptive rating criteria using the direction keys of their phone.

Preliminary user experiences (both consumers and retail professionals) indicate a high potential in the application. Many praised the few interaction steps necessary to receive and submit product ratings. However, also criticism has been expressed: some users doubted that they would trust the opinion of other random consumers. Others indicated they do not believe in people actively rating products without additional incentives.

5. Conclusion and Outlook

Today product recommendation is accepted and used on the web, but does not yet support consumers in-situ, where they need recommendations most. APriori is a step towards an understanding of product recommendation for users in a mobile context. Still there are a range of functionalities which can extend APriori in the future. Some of them are: The integration of user data maintained in social networking websites. As users tend to have extensive profiles on these sites, it is promising to use personal data and friendship relations between users as a tool to define networks of trust. In other words: members of social networks (e.g. Facebook) could decide to trust only people they have as friends or that have certain characteristics (e.g. hobbies). Another possible extension is to provide consumers, despite community-based ratings, with product reviews carried out by consumer associations[3]. We believe that mobile product recommendation is a powerful tool to help consumers to take better buying decisions. Thus we will continue to evaluate its utility in a comprehensive user study.

[3] See for example http://consumersunion.com

6. References

[1] Rudolph, T., Schweizer, M., and Wagner, T. 2004. *Consumer Confusion in Retail Environments: An Adoption of the MR Model*. AMA Winter Educators Conference 2004 - Scottsdale, Arizona.

[2] Gross, P. 2004. *Consumer Confusion und Multioptionsgesellschaft*. Thexis Fachzeitschrift für Marketing, 4.2004.

[3] Pham, A. and Healey, J. 2004. *Telling you what you like*. Los Angeles Times, 20 September 2004.

[4] *How to annoy your customers.* The Economist, 5 January 2008.

[5] O'Connor M. C. 2006. *Wal-Mart Seeks UHF for Item-Level.* RFID Journal, 30 March 2006.

[6] NFC Forum. http://www.nfc-forum.com.

[7] Adelmann, R., Langheinrich, M., Flörkemeyer, C. 2006. *Toolkit for Barcode Recognition and Resolving on Camera Phones – Jump Starting the Internet of Things.* Workshop Mobile and Embedded Interactive Systems (MEIS'06) at Informatik 2006.

[8] Cooke, A., Sujan, H., Sujan, M. and Weitz, B 2002. *Marketing the unfamiliar: the role of context and item-specific information in electronic agent recommendations.* Journal of Marketing Research 39(4):488-497.

[9] Senecal, S. and Nantel, J. 2004. *The influence of online product recommendations on consumers' online choices.* Journal of Retailing 80:159-169.

[10] Du Boucher-Ryan, P. and Bridge, D. 2006. *Collaborative recommending using formal concept analysis*. Knowledge-Based Systems 19(5):309-315.

[11] Weibelzahl, S., Bergmann, R., Weber, G. 2000. *Towards an empirical evaluation of CBR approaches for product recommendation in electronic shops.* In Proceedings of the 8th German Workshop on Case-Based Reasoning.

[12] Wietsma T.A. and Ricci, F. 2005. *Product reviews in mobile decision aid systems*. PERMID Workshop at Pervasive Conference 2005.

[13] Van Stetten, M., Pokraev, S. and Koolwaaij, J. 2004. *Context-aware recommendations in the mobile tourist application COMPASS.* Adaptive Hypermedia and Adaptive Web-Based Systems, LNCS 3137, Springer, 234-244.

[14] Tung, H.W. and Soo, V.W. 2004. *A personalized restaurant recommender agent for mobile e-service.* In Proceedings of IEEE International Conference on E-Technology, E-Commerce and E-Service (EEE04), IEEE CD Press, 259-262.

[15] Boll, G. et al. 2007. Comparing techniques for mobile interaction with objects from the real World. PERMID Workshop at Pervasive Conference 2007.

[16] Roto, V. 2006. *Web browsing on mobile phones – characteristics and user experience.* Dissertation at Helsinki University of Technology.

[17] Roto, V. and Oulasvirta, A. 2005. *Need for non-visual feedback with long response times in mobile HCI*. In Proceedings of the 14th International World Wide Web.

[18] F. von Reischach, F. Michahelles. APriori: *A Ubiquitous Product Rating System.* Workshop on Pervasive Mobile Interaction Devices (PERMID) at Pervasive 2008, Australia, May 2008.