The Hybrid Shopping List: Bridging the Gap between Physical and Digital Shopping Lists

Felix Heinrichs
Telecooperation Lab
TU Darmstadt
Hochschulstr. 10, 64289
Darmstadt, Germany
felix.heinrichs@cs.tu-darmstadt.de

Daniel Schreiber
Telecooperation Lab
TU Darmstadt
Hochschulstr. 10, 64289
Darmstadt, Germany
daniel.schreiber@cs.tu-darmstadt.de

Johannes Schöning
Innovative Retail Laboratory
DFKI GmbH
Stuhlsatzenhausweg 3, 66123
Saarbrücken, Germany
schoening@dfki.de

ABSTRACT

Shopping is one of the most frequently occuring tasks in our daily lives, and creation and management of shopping lists is an important aspect of this task. Given the recent adoption of mobile devices, the process of writing lists is not only limited to the use of pen and paper, as a good number of digital tools and applications are available. The goal of this paper is to study and understand the transition between paper-based and digital shopping lists. We analyze how people interact with paper-based shopping lists and derive design implications for our own hybrid shopping support application, which combines paper-based lists with a mobile application. We contribute the study and the design and implementation of a hybrid (pen-and-paper-based UI and mobile GUI) application for the creation of shopping lists.

Keywords

Shopping lists, Pen and Paper based Interaction, Shopping experience, Mobile Devices, Mobile Interaction

Categories and Subject Descriptors

H.5.m [**H5.m. Information interfaces and presentation (e.g., HCI)**]: Miscellaneous

1. INTRODUCTION

Recently, Apple reported over 350,000 applications and 10 billion downloads in their app store [6]. Many of these applications are little helpers for what we call *everyday tasks*. Everyday tasks are weakly structured personal tasks that are carried out repeatedly. One can see from the Apple figures that there clearly is a demand for applications supporting us in our everyday tasks. However, we conjecture that pen and paper will prevail in everyday tasks, as these often require the flexibility and robustness offered by paper, e.g. in the note taking domain [4].

Our goal is to find a way to combine the benefits of digital applications with those of pen and paper in the domain of everyday tasks.

We chose the task of grocery shopping as example for our research. The relevance of application support for this particular everyday task can again be estimated by looking at figures from the Apple App Store. A search for "shopping list" delivers more than one hundred different applications for creating and managing shopping lists. Additionally, such applications are offered as Web applications. For example, our project partner, a big German retailer, offers a web-based shopping support application. Using an application to manage the shopping list offers several features for the user that pen-and-paper-based shopping lists do not have, e.g., an electronic shopping list can easily be shared with other people via e-mail. Nevertheless, as shown by our study, the majority of people stick to paper-based shopping lists.

We make the following contributions: We analyzed the practices for using pen and paper in the everyday task of grocery shopping in the literature and conducted a field-study in a big German retail market. Second, we use the results of this analysis to derive a set of design implications that inform the design of hybrid mobile applications supporting the shopping task. Third, we present the design for a mobile shopping list application using pen and paper as input modality, along with its general architecture. This application is a prototypical example how the benefits of mobile applications and pen and paper can be combined.

2. RELATED WORK

The everyday task of grocery shopping has been extensively studied in the consumer and retail research community, e.g., by Puccinelli et al. [10]. In most cases, the planning phase for grocery shopping is quite extensive [12, 3] and can be distinguished from the actual purchase phase. Block and Morwitz refer to these distinct phases as the *List Writing Stage* and the *List Fulfillment Stage* [3]. Most households make use of grocery lists in the process, although sometimes the list is only mentally maintained [2]. Grocery lists are typically prepared either collaboratively, or by a person responsible for the need management of the household [2]. However, written grocery lists often not only serve as an external memory aid [3], but also as a way to communicate needs to other household members [2]: The grocery list is passed as planning document to the person doing the actual shopping [3]. Block and Morwitz also found that there are not only need based, but also financial incentives for assigning groceries to the list, i.e., coupons or bargain offers found in leaflets [3]. This means that these paper documents are also included in the shopping planing process.

Shekar et al. suggest a smart-phone based grocery shopping application to provide ubiquitous access to a digitally managed grocery list [11]. Although the proposed application provides several means to add items to the shopping list, e.g., a barcode scanner, it does not support paper lists, as typically used in the shopping planning process. Another PDA based approach was suggested by Newcomb et al. [8]. Its design is based on an extensive ethno-

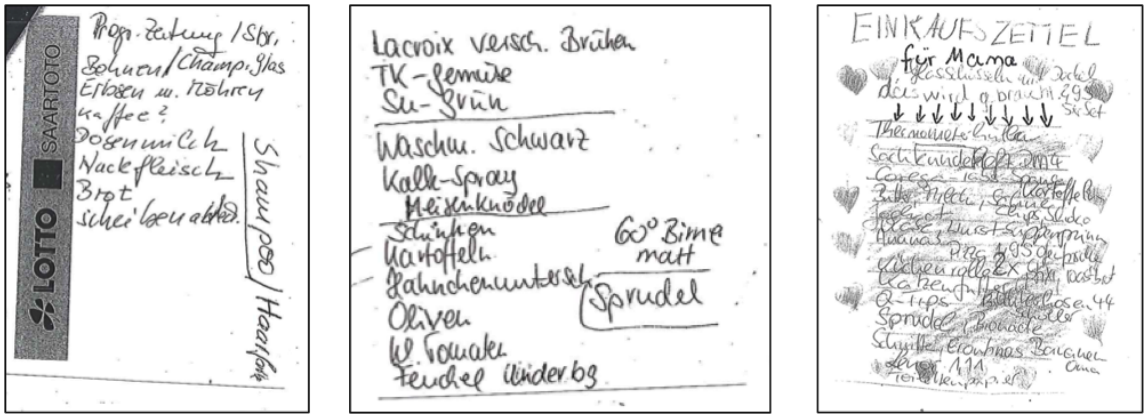

Figure 1: Paper-based shopping lists: a) A list mainly containing only product categories. b) A list containing product instances grouped into categories. c) A list containing promotion articles designated for a special person (in this case "mama").

graphic study. Their findings highlight the importance ubiquitous access to additional data, such as dynamic information from the web, during the shopping planning process. Nurmi at al. [9] introduce a grocery retrieval system that maps shopping lists written in natural language into actual products in a grocery store. They have developed the system using nine months of shopping basket data from a large Finnish super-market. A prototype for creating shopping lists using multiple input devices such as desktop, smart phones, landline or cell phones and in multimodal formats such as structured text, audio, still images, video, unstructured text and annotated media was introduced by Jain et al. [7]. Wu et al. designed a new architecture enabling efficient integration between mobile phone applications and Web Services. Using this architecture, they have implemented a mobile shopping assistant [13].

Interestingly, none of the existing mobile applications has considered pen and paper as input modalities, although *Pen-and-Paper User Interfaces* (PPUI) have been used by others, e.g., in Butterflynet [14] and NICEBook [4]. These approaches, however, do not offer insights into the design of PPUIs for the shopping task and only limited insights for PPUI design for everyday task in general.

3. FIELD STUDY

In a first step, we conducted a field study to understand the creation and usage of paper-based shopping lists. The study was conducted during 2 weeks in March 2010 at different times of the day (morning, noon, afternoon, in the evening shortly before the shop was closed) in the *Globus* store, a German retail store. The customers were asked if they want to take part in our study, directly after they had paid their goods at the cashiers. 270 customers agreed to participate in the study.

Our interviewers asked them about their age, gender, income, shopping experiences and shopping frequency. The overall background of the study sample is as follows: $2/3$ of the participants are women and $1/3$ are men. More than 90% of participants are familiar with the market since more than 3 years. The mean age of all participants is 38.2 years. The monthly incomes are around 1800-2000 EUR. 50% of the participants visit the store 1-2 times a week. 20% of the participants visit the store 3-4 times a week and another 14% just a couple of times in a month.

47% of the participants had shopping lists with them but only 3% used electronic shopping lists, e.g., smartphone applications. This is a strong indication that the majority of people still uses paper-based shopping lists. Three examples of different shopping lists are presented in figure 1. The shopping lists contained 13.3 (mean) items (Median 11, Min. 2, Max. 47). The lists often contained very little detail: just 10% of the lists showed an amount or unit label for the product. Often the participants used generic terms on their lists (about 2/3 of all items on a list). Instead of specifying products by their proper name, they used generic terms such as "beer", "fruits" or "some sweets for the kids". In contrast to that, people often had specific items from promotions on their lists (often with a lot of detail, e.g. location of the market, price, discount rate). In addition the lists often contained "pointers" to family members such as: "marmalade for Eva", "food for Mietze" (colloquial for cat). In some cases, different scripts indicated that different people had collaborated in writing the list together.

4. DESIGN IMPLICATIONS

From the findings in retail research and different scripts on the studied shopping lists we derive that shopping planing and creation of shopping lists is often done collaboratively, involving multiple members of a household. Thus, applications supporting the grocery shopping task should be designed to support *collaborative creation and editing* of shopping lists. Furthermore, the shopping list serves as communication medium in the context of shopping: instructions what to buy are communicated to the household member actually performing the shopping trip. *Accessing* the list *to inform* the shopping process in the store should be supported by an application.

Our study revealed that users add additional information to the items ("for Eva"). We believe that these hints are highly personal markers for product details, e.g., "marmalade for Eva" means marmalade from a specific brand that Eva likes. The vocabulary used for specifying items on the list is also highly heterogeneous: users tend to use acronyms, colloquial expressions and textual clarifications, as can be seen in Fig. 1. Therefore we conclude the user should be able to specify shopping list items with arbitrary, individually chosen names. Thus, the system should support a *household vocabulary* for list items. Here, we see a benefit of pen and paper input: keying in such item names is very tedious on mobile devices, while it is easily done with pen and paper. The application supporting the grocery shopping task should be *hybrid*, i.e., combine a mobile GUI and a PPUI.

Regarding the handwritten creation of shopping lists, it can be observed that people use heterogeneous types of paper artifacts as writing media, ranging from notepads to old paper envelopes (see again Fig. 1). As a result, hybrid shopping list applications need

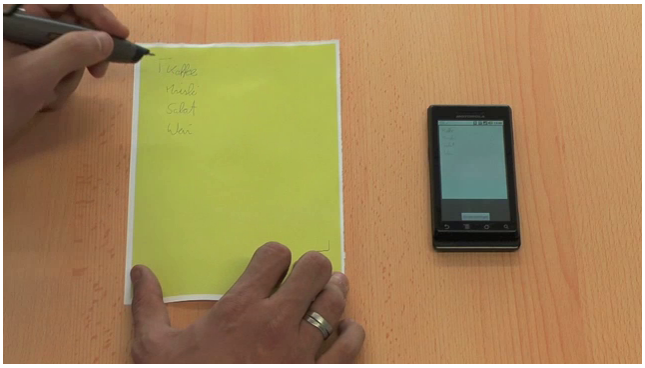

Figure 2: Integrating handwritten list items using a digital pen.

Figure 3: Adding items directly in the leaflet with a digital pen.

to support the usage of *arbitrary paper artifacts*. In addition, only 5% of the collected shopping lists bear marks of active editing in the market, e.g., check marks or crossed out items. So we assume that handwritten lists primarily serve the planning phase, and conclude that not the handwritten list itself but rather its content is used during the actual shopping (c.f. access to inform described above). So a hybrid shopping list application should allow *handwritten creation* of lists, yet the usage of this handwritten list in the market can be neglected with regard to other design considerations.

As reported by Block and Morwitz, additional paper artifacts play a role in the planning phase, e.g., leaflets, special offers and coupons [3]. So a hybrid application should incorporate *additional resources* too. Furthermore, people often require additional information regarding items on their list, e.g. for price comparison. So a shopping support application should integrate *additional information* about list items as well.

In summary, the design implications are the following:

- collaborative creation and editing
- access to inform
- household vocabulary
- hybrid paper-digital design / handwritten creation
- arbitrary paper artifacts
- additional resources and information

5. THE DGL APPLICATION

The *Digital Grocery List* (DGL) application integrates handwritten shopping lists, paper leaflets distributed by the supermarket and a GUI on a mobile device into one coherent system for supporting the everyday task of grocery shopping. The prototype has been designed according to the design guidelines above.

5.1 Design of the DGL Application

The DGL application supports collaboration of multiple users editing a shared grocery list using either a PPUI, a GUI, or a combination thereof.

Collaborative Shopping Planning.

The DGL application is designed for collaboration: Using a smartphone, everybody can manage items in a shared list stored on a home-server. This satifies the need for collaborative shopping planing as outlined above. Additionally, the same home-server hosts the shared household vocabulary for items to be purchased. When the user starts to enter an item into a list an incremental search provides a selection of matching items. The user than can either select one of these or continue entering a new item. New items are automatically stored in the shared vocabulary. Changes to the list are forwarded to all connected mobile devices. This lets all household members access the shopping list to inform their buying process. The shopper can immediately see all changes in the shared list, even while in the supermarket. Items in the list are displayed by their name and a small iconographic representation. Additionally it is possible to mark items in the list with a checkmark to indicate that these items have been purchased and are no longer needs of the household (as opposed to deleting unwanted items). Marking items is also communicated instantly allowing household members to track the buying process performed by the shopper.

Integration of Paper Artifacts.

Items can also be added using PPI: the user writes items on a sheet of paper (augmented with the Anoto[1] dot pattern) just as with traditional, paper-only grocery lists.

Relying on the Anoto technology, of course, contradicts the desire to integrate arbitrary paper artifacts. Given the current state of technology for PPUIs, it is, however, the only viable option. In order to come as close to using arbitrary paper artifacts as possible, the DGL application does not require to introduce the paper artifact beforehand. To use a sheet of Anoto paper with the DGL application, the user draws two corners spanning a rectangle on any paper containing the Anoto dot pattern, similar to the hotspot association gesture described by Yeh et al. [14]. The DGL application will recognize any items written into the region specified thereby.

After writing items on paper a facsimile UI shows the items in the list, as shown in figure 2. Instantly visualizing the written ink helps users to understand the input they are providing to the system. Subsequently, the written items are attached to the grocery list on the home-server buy pressing a button on the mobile device.

However, as discussed above, there are more paper documents involved in the grocery shopping planning process. Users browse leaflets and commercial brochures, etc. for preparing shopping trips. These documents essentially satisfy information needs, e.g. tell the user which items are available as bargain offer. Therefore, DGL integrates these paper documents directly into the planning process: leaflets are also augmented with the Anoto dot pattern. Using a digital pen the user can add or remove items depictured in the leaflet to the list by drawing a plus or minus sign on them. This allows the user to keep track of the items selected for a shopping list even while working with the paper leaflet only.

[1] `http://www.anoto.com`

Additional Information.

In addition the DGL application offers different additional "digital" functionality. In order to obtain pricing information, the user can choose a store for the shopping trip. By issuing a long click (> 3s) on top of any item in the list the application displays additional information regarding this item: it matches the current item with the wares offered in that store and allows the user to review a selection of matching products, along with their pricing, availability and packing size. By providing a loose coupling to the store, the user can compare different stores by reviewing the same shopping list for all of the stores. Additionally, users can further benefit from digital functionality offered by their smartphones, e.g. derive the route to the next store via a map application (if available).

5.2 Implementation of the DGL Application

The DGL Application uses a client/server based architecture. The grocery list shared by all members of a household is stored on a home-server and accessed by several client applications. On the same home-server, the explicit household vocabulary used for searches in the GUI is hosted, although it is possible to deploy this functionality in a different location. Client applications employ a user interface, consisting of a GUI and an optional PPUI. Each of the client applications contains a local list for offline use, so that the system can deal with loss of connection. Additionally, the store hosts a set of *products* on another server, which can be mapped to items in the vocabulary, e.g., "milk" in the household vocabulary can be mapped to a specific brand and packing size.

The DGL application is written in Java using the MundoCore [1] middleware. The mobile client application has been developed on the Android[2] platform, using API version 2.1. The PPUI part bases on Letras [5], a flexible framework for ubiquitous PPI. In our implementation, we used the Nokia SU-1B digital pen and its android driver in combination with the first two processing stages of Letras, all deployed locally on the android phone. We tested the application on a Motorola Milestone and a Samsung Galaxy S smartphone.

6. CONCLUSION & FUTURE WORK

In this paper we have investigated the usage of physical and digital media within the shopping list creation process. In a field study we investigated the current usage and properties of physical shopping lists and derived design implications for our own application. We think that these guidelines can improve the usability of the current bulk of shopping list applications for various platforms. In addition we showed how the combination of physical and digital tools can enrich the process of creating a shopping list. In this work we tried to combine the advantages of both worlds, pen and paper and mobile GUIs, in a single application to meet the user's needs. In future work we aim to focus on the interaction schemes that arise from using digital pens in combination with mobile devices. Additionally, we plan to investigate how other modalities than pen and paper can be facilitated in the shopping list creation process, e.g. speech.

[2] `http://www.android.com`

7. ACKNOWLEDGMENTS

Part of this research was conducted within the ADiWa project funded by the German Federal Ministry of Education and Research (BMBF) under grant number 01IA08006.

8. REFERENCES

[1] E. Aitenbichler, J. Kangasharju, and M. Mühlhäuser. Mundocore: A light-weight infrastructure for pervasive computing. *Pervasive and Mobile Computing*, 3(4):332 – 361, 2007. Middleware for Pervasive Computing.

[2] R. Bassett, B. Beagan, and G. E. Chapman. Grocery lists: connecting family, household and grocery store. *British Food Journal*, 110(2):206 – 217, 2008.

[3] L. G. Block and V. G. Morwitz. Shopping lists as an external memory aid for grocery shopping: Influences on list writing and list fulfillment. *J. of Consumer Psychology*, 8(4):343 – 375, 1999.

[4] P. Brandl, C. Richter, and M. Haller. Nicebook: supporting natural note taking. In *Proc. CHI '10*, pages 599–608, New York, NY, USA, 2010. ACM.

[5] F. Heinrichs, J. Steimle, D. Schreiber, and M. Mühlhäuser. Letras: An architecture and framework for ubiquitous pen-and-paper interaction. In *Proc. EICS '10*, pages 193–198, New York, NY, USA, 2010. ACM.

[6] A. Inc. Apple app store. `http://www.apple.com/iphone/apps-for-iphone/`, February 2011.

[7] J. Jain, R. Ghosh, and M. Dekhil. Multimodal shopping lists. In *Proc. HCI '09*, pages 39–47, Berlin, Heidelberg, 2009. Springer-Verlag.

[8] E. Newcomb, T. Pashley, and J. Stasko. Mobile computing in the retail arena. In *Proc. CHI '03*, pages 337–344, 2003.

[9] P. Nurmi, E. Lagerspetz, W. Buntine, P. Floréen, and J. Kukkonen. Product retrieval for grocery stores. In *Proc. SIGIR '08*, pages 781–782. ACM, 2008.

[10] N. M. Puccinelli, R. C. Goodstein, D. Grewal, R. Price, P. Raghubir, and D. Stewart. Customer experience management in retailing: Understanding the buying process. *J. of Retailing*, 85(1):15 – 30, 2009.

[11] S. Shekar, P. Nair, and A. S. Helal. igrocer: a ubiquitous and pervasive smart grocery shopping system. In *Proc. SAC '03*, pages 645–652, 2003.

[12] A. Thomas and R. Garland. Grocery shopping: list and non-list usage. *Marketing Intelligence & Planning*, 22(6):623 – 635, 2004.

[13] H. Wu and Y. Natchetoi. Mobile shopping assistant: integration of mobile applications and web services. In *Proc. WWW '07*, page 1260. ACM, 2007.

[14] R. Yeh, C. Liao, S. Klemmer, F. Guimbretière, B. Lee, B. Kakaradov, J. Stamberger, and A. Paepcke. Butterflynet: a mobile capture and access system for field biology research. In *Proc. CHI '06*, pages 571–580, New York, NY, USA, 2006. ACM.