From Personal Memories to Sharable Memories

Nathalie Basselin and Alexander Kröner
German Research Center for Artificial Intelligence
Stuhlsatzenhausweg 3, 66123 Saarbrücken
{firstname}.{lastname}@dfki.de

Abstract

The exchange of personal experiences is a way of supporting decision making and interpersonal communication. In this article, we discuss how augmented personal memories could be exploited in order to support such a sharing. We start with a brief summary of a system implementing an augmented memory for a single user. Then, we exploit results from interviews to define an example scenario involving sharable memories. This scenario serves as background for a discussion of various questions related to sharing memories—and potential approaches to their solution. We especially focus on the selection of relevant experiences and sharing partners, sharing methods, and the configuration of those sharing methods by means of reflection.

1 Introduction

The tremendous growth of social software and associated concepts (from blogs to collaborative tagging and recommendation to reputation systems) demonstrates that people are willing to share *personal experiences*. In parallel, the huge number of websites offering forums, customer reviews, and customer-based recommendations proves the need to find *independent information*.

However, these technologies require people to spend efforts on reporting experiences, which is (beneath other issues such as privacy) one of the reasons why only a selected subset of experiences is shared this way. Another drawback of these common approaches to sharing is the lack of availability and context-awareness, which prevents their application for proactive and situated user support

These issues could be addressed by a mobile assistant, which supports the user in sharing personal information and in retrieving independent and relevant information. However, this raises lot of related research issues, for instance, the access and presentation of others' memories, or privacy issues. Our experience and a large-scale user study with a personal memory assistant offer some hints regarding these questions. In this paper we describe this assistant and report about our early reflection on how to extend this assistant for memory sharing: beneath an application scenario proposal for memories sharing, we describe our approach to solve issues such as the retrieval of relevant experiences in other people's memories, the selection of sharing partners, the handling of sharing occasions, and their exploitation for improving the system behavior.

2 Augmented Personal Memories

In SPECTER (cf. [Kröner et al., 2006a]) we conducted research on how augmented personal memories can be exploited for user modeling and decision support. The memories are created from a dense log of user experiences captured by an intelligent environment. Here, we think of an experience as an action, the context where this action took place, and annotations attached by user and system.

2.1 Building Personal Memories

The experience log is the result of an abstraction process, which begins on the level of sensor data. SPECTER may be connected to diverse sensors in order to capture information about the user's state and context. We experimented with a combination of GPS, IR (location tracking), biosensors (user feedback), web services (product-related services), and RFID (location tracking, smart objects). For a limited time, perceptions provided by these physical and virtual sensors are held in SPECTER's *short-term memory*, where inference processes and plan recognition are used to create a model of the user's current context.

In addition, all information gathered by the system is stored in a *long-term memory*, where machine-learning is applied in order to build a user model from behavioral patterns. The long-term memory provides beneath a plain record of perceptions an event-based organization, which combines each observed user action with its context. This so-called personal journal serves in the first place as "experience record" for the user, and is therefore an integral part of the user interface.

2.2 Accessing Personal Memories

The captured information about the user's activities is accessible to the user via diverse types of memory views.

The *chronological event list* (see the left-hand side of Figure 1) displays each observed user action in its context (e.g., place and time). The user can annotate each event with a written comment or adjust ratings (e.g., about quality) assigned by the system based on the user model.

An *object-oriented view* focuses on the recorded information without its context. It is typically applied to display query results about resources (e.g., products, places) and to exploit these for further application—e.g., for preparing a set of "examples" based on the memories, which may then be forwarded to services implemented by the environment (see the right-hand side of Figure 1).

Finally, a *function-oriented view* offers contextual functions for resources such as persons, objects, and locations stored in the memory. These functions make use of the

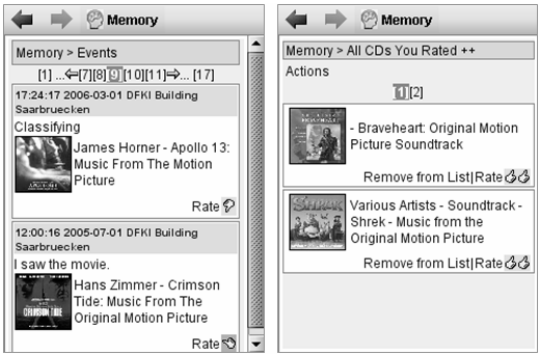

Figure 1: On the left-hand side: event-oriented view; on the right-hand side: object-oriented view.

memory (e.g., allow to retrieve objects or events related to some resource) and allow the user to exploit the current environment (e.g., allow to set up a query for similar products in the current shop). A typical dialog between user and system often involves several of these views. For instance, the event view grants access to the function view for objects involved in events, which allows setting up object selections displayed in the object view.

2.3 Decision Support

In order to describe the specific decision support provided by SPECTER, we coined the notion "Recomindation". This new paradigm for the exploitation of augmented memories blends "recommendation" and "reminder". "Recomindation" functions make use of the user's past experiences, of the current context, and of similarity algorithms to provide recommendations whose relevance is explained by the user's personal past experiences. For instance, when the user enters a CD store, the system offers among others the list of CDs she likes that are available in the store. Also when the user is looking at a CD, she can get a list of similar CDs that she knows. That way, she can remember similar CDs that she would have forgotten or learn more about an unknown CD (see Figure 2).

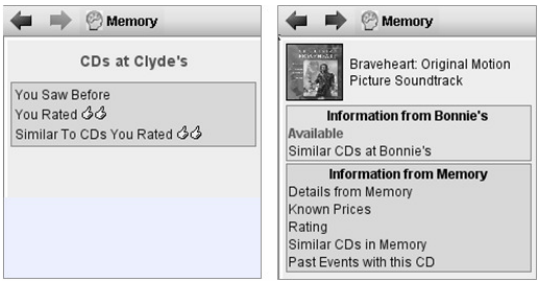

Figure 2: On the left: proactive situated services offer, when entering a store; on the right: proactive situated services offer, when looking at a CD in a store.

2.4 Reflection

Reflection on events recorded in the long-term memory allows the user to review past experiences, e.g., in order to prepare herself and/or the system for future actions. Guided by the system, the user adapts the system's decision support functions, for instance by customizing situational service triggers, or by correcting assumptions made by the system in the user model. In addition, the system offers automatically generated summaries of past actions. This aims at bringing elements (e.g., objects, locations) referenced by these events back into the user's mind and at assisting in their exploitation by offering services available on the Web (e.g., acquisition of extensive product reviews).

2.5 Evaluation

We used a CD shopping scenario for a summative evaluation study of the main aspects of our personal memory assistant: capture, storage and data presentation, exploitation, and control. We conducted the study with 20 participants in mock-up CD stores. Overall, participants were satisfied with the tested prototype and with the functions based on augmented memories; for a detailed description of the results, see [Plate *et al*., 2006].

Since the scenario of the study addressed a specific domain, we wanted to know if memory support was improving the user experience in this domain, and which other activities of the everyday life could benefit from augmented memories. Therefore, we asked participants to imagine scenarios where they would appreciate the functions of augmented memories; in addition, we asked for ideas and opinions regarding the sharing of information maintained by a SPECTER-like system. Most of the scenarios they imagined regarding sharing were shopping or tourism-oriented: "I am entering a bookstore. I would like to know the bestsellers as well as some people's opinions if I am interested in a given product. If I hesitate to buy a book, I might ask a friend who has tastes similar to mine."; "I would like to know if a given product is cheaper elsewhere."; "I would like to be warned when I'm about to buy a product which dissatisfied most people."; "I'm sightseeing but I don't know which places I should visit, whether this museum is worth its 25 euros entry fee, or how this hotel is.".

A shopping scenario is indeed a domain where experiences sharing functions are promising: the number of online customer reviews and forums about products proves that people are willing to learn about other people's opinions and experiences. In the scenarios they described, participants mentioned also several times that they are willing to know friends' opinions ("I might ask a friend who has tastes similar to mine."). Such functions could be provided by the sharing of user models and experiences of known people. However, shopping is quite limited regarding the kind of content shared: it consists mainly in sharing products attributes and their associated annotations. We therefore considered moving to a "shopping and cooking for guests" scenario including both grocery shopping and cooking in an instrumented kitchen. Since cooking involves recipes, i.e. processes, the sharing mechanisms will be more complex, as episodes, and not only perceptions, will have to be shared.

3 Towards Sharing Personal Memories

In the study, the information about the CDs' availability in the current mock-up store was provided by the CD store database; the similarity mechanism required for the "recomindation" functions consisted in calling the Amazon Web service corresponding to the function "Customers who bought this album also bought…". However, such information could be provided independently by a memory sharing mechanism. Someone looking at a product could access others' experiences to compare prices, to get customer opinions, or suggestions of alternative products.

Information provided by memory sharing is independent and not limited to the existing Web services. In addition, if subjects considered "recomindation" functions as time and money saving in our study, then we can expect users to find added value in querying others' past experiences since memory sharing has the potential to offer services like the ones mentioned above.

In other words, memory sharing has the potential to become a new medium for information exchange, which may complement traditional forums and online customer reviews. One advantage over those media could be the easiness to publish experiences. In addition the memory sharing principle used in a mobile and context-sensitive application would make the offered services accessible on site, either requested explicitly or provided proactively.

3.1 Field Study

We conducted a contextual inquiry with four participants who cooked for guests. They have been interviewed about their menu selection, observed while shopping and cooking, and interviewed.

Even if participants are equally either enthusiastic or skeptical regarding the application scenario, the observation proves that for each participant it is rich in sharing occasions. Some of the main sharing occasions that occurred are the following:

- Asking guests (or friends with same food habits and culture) about their tastes and constraints (religion, medical restrictions, vegetarianism),
- Asking friends/mother about menu suggestions, as well as recipe ingredients and directions,
- Asking the guests whether they may like the menu, whether there are ingredients that they do not eat,
- Getting specialized stores recommendations (Muslim or Asian grocery stores, for instance),
- Finding alternative solutions when ingredients are not available in a store,
- Estimating food and spices / salt quantities.

3.2 Example Scenario

According to our studies results, a scenario for memory sharing in the everyday life could be sketched as follows:

Barbara is at home, thinking about a menu that might please Jessica, her colleague, whom she has invited for dinner. She only knows that she likes chocolate a lot. She checks if Jessica has any food constraints, and indeed she is vegetarian. To find recipe suggestions, she queries the memories of unknown vegetarian people, paying more attention to vegetarians she trusts since she already followed their recommendations. She selects a starter and a main dish. She is not sure that Jessica will like the mushrooms in the main dish, so she queries Jessica's memory about mushrooms and finds out that she liked a lot most of the dishes with mushrooms. She now searches for deserts with chocolate. The system remembers Barbara of a given user who helped her a lot the last time she was looking for recipes with chocolate. She browses through the recipes with chocolate of this person and decides to prepare one of her new recipes: a chocolate fondue.

Barbara is not sure to find in her usual supermarket the specific spices which are used in the main dish recipe. She checks whether one ever bought such spices at her supermarket. Since no recent result is returned, she finds with the system where the person offering the recipe bought them. She buys the spices there and the other ingredients at her usual supermarket. There, she takes mozzarella for the starter. The system informs her that users complained about the awful quality of this mozzarella brand. So, she chooses another brand.

While she is cooking, Barbara gets a request from a friend, Paul, who would like to know if she likes sushi. She gives him access to her experiences with sushi. Later, someone asks her where she buys coffee. She does not reply since she's in a critical step of her recipe. Jessica arrives and Barbara finishes preparing the main dish: she takes the spices from the shelf and is informed that Jessica does not stand spices in high quantities. She thus uses less spice and asks Jessica to taste to know if the spice quantity is appropriate.

The next day, Barbara and Jessica review recently captured events. Jessica and Barbara rate the diner episode and Barbara decides to set it public, so that her friends can learn about her tastes for their next invitations and also to recommend the recipes she used. She also gives trust points to people whose experiences helped her for the diner preparation in order to use those people's memories in priority in the future. She also reviews missed sharing occasions and authorizes all SHAREDLIFE users to access her experiences with coffee in the future.

4 Approach

The above scenario illustrates actions relevant for sharing, including issuing sharing requests, handling sharing requests, and handling sharing responses. In the following, we will explain how these might be addressed by means of augmented personal memories.

4.1 Issuing Sharing Requests

"She checks if Jessica has any food constraints..."

A single user's augmented memory is a rich source of situations and artifacts. We developed in the SPECTER prototype a combination of different approaches, which provides the user with manual and proactive means of retrieving and browsing augmented memories. Extending these means for a sharing scenario is partly straightforward. Thus, it is easy to imagine how the various views on memories could be enriched in order to exploit such personal information as starting point for manual sharing actions—e.g., by adding functions for sharing via a ubiquitous user model (cf. [Heckmann, 2005]) or by attaching retrieval functions to objects (see Figure 3).

However, the quality of the selected experiences is directly related to the adequateness of the selected sharing partners: according to our application scenario, users might be willing to view experiences of a given kind of individuals or of given known people or of people similar to themselves or to their guests.

Thus, the user needs ways to select sharing partners relevant for the current situation. The system could automatically select people according to the current situation characteristics (all users having experiences with the mozzarella Barbara is looking at), however there are cases where the user knows better than the system whose memories she wishes to explore, for instance, because of information available in the user's natural memory, but not in the augmented memory: in the coffee aisle, the user does not know which coffee to buy, but she remembers

Figure 4: Possible design. The first screen would proactively appear when the user looks at a product in a store, offering annotation possibility and services involving other users' memories. The second screen shows other users' annotations about the product in a shopping context.

that her mother makes excellent coffee and she would like to explore her memories to know which brand she buys.

We therefore need an interface which supports the user in the selection of sharing partners. Since the number of individuals can be high, the interface should provide ways to express constraints on the available sharing partners, e.g., on food habits, tastes, health problems, religion, or homeland—information which can be offered (and protected with respect to the partner's privacy constraints) by a ubiquitous user modeling server.

While some constraints refer to Boolean variables (vegetarian: yes/no), other constraints address variables which can take different numeric values, which imposes additional requirements on the user interface—e.g., the option to sort sharing partners in order to identify interesting groups. Here, we believe that trust is an indispensable dimension when it comes to communities and recommendations. Physical proximity is also important for such a mobile and ubiquitous application. Additional dimensions like the number of experiences exchanged in both directions, the social distance (direct contact, friend of a friend, etc.), the profile similarity, the quantity and average quality of the experiences could also be taken into account. Potential sharing partners could not only be sorted according to those dimensions, but could also be restricted to people in a certain range of values of these dimensions. For instance, a student in Germany who invites a Chinese student from his campus could select Chinese people far away (in China) to get authentic Chinese recipes and then Chinese people two kilometers away to learn where these buy the required ingredients.

Distributing people in various *people categories* can also simplify search of relevant sharing partners: we consider categories such as buddies (a common approach used in chat applications, Movielens, and other social software), "familiar strangers" (unknown people with a trust level assigned by the user with time) and other unknown people. Each category could be shown or hidden.

We designed four prototypes for the selection of sharing partners. They all respect the principles described above but differ in the visualization of the community and the number of dimensions used at a time in the visualization. Two of our prototypes are shown in Figure 4: in the basic prototype on the top, the number of selected buddies, familiar strangers and unknown people can be reduced by Boolean constraints and sliders for interval selection for each numeric constraint. On the prototype at the bottom, sharing partners are distributed in a 2D graph

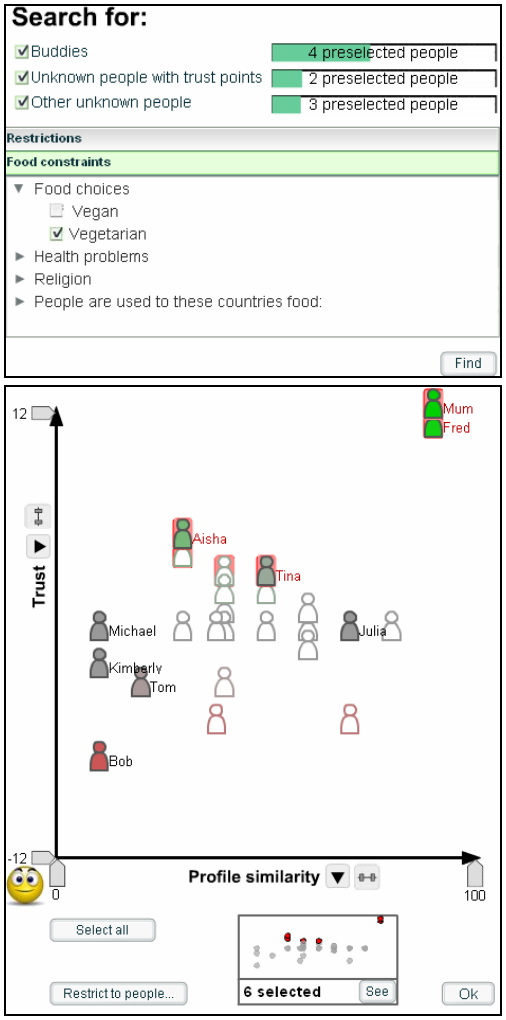

Figure 3: Two interfaces for selecting sharing partners.

according to the graph axes representing chosen dimensions. The results of an early study—whose extensive discussion would exceed the scope of this paper—indicate that the user might benefit from a combination of the two prototypes described here. We are currently working on the different possibilities of combination.

4.2 Handling Sharing Requests

"While she is cooking, Barbara gets a request…"

Our scenario includes many opportunities for sharing. Some are relevant for the user's current context (e.g., for Jessica, Barbara's request regarding her food constraints), some not (e.g., for Barbara, the request about where she buys coffee)—but probably these turn out to be relevant for future contexts. All these occasions will result in a large number of incoming sharing requests, which can hardly be handled by the user on his or her own.

Thus a straightforward approach which presents requests directly to the user is little promising—while it allows immediate reaction in urgent requests, the user might not be able (or willing) to verify all of them. In order to free the user from this burden, one could serve all incoming requests automatically based on a sharing policy specified in advance for the whole augmented memory. However, beside issues of privacy and trust in such

automatism, the unsupervised exchange of information might "overcrowd" the user's augmented memory with information never actually used.

An alternative way of handling sharing requests can be achieved by means of a mediator for user models. Thus, we explored in a prototype built upon SPECTER, how the user may exploit the facilities of an augmented memory to select explicitly data for sharing, attach situated access constraints, and then store these data on a ubiquitous user modeling server (cf. [Kröner *et al.*, 2006b]). There, default reasoning can be applied in order to infer additional privacy constraints. This way, the efforts required for specifying privacy constraints can be reduced since only a subset of information from the memory needs to be protected. And in addition, there is no need for the user to deal with reoccurring requests on data stored at the mediator. However, the whole process might turn out to be cumbersome if diverse requests enforce the user to submit again and again small pieces from the memories to the server, or unhandy if immediate response to a request on information not available at the mediator is required.

Therefore we propose to exploit the episodic nature of SPECTER's augmented memories for handling sharing requests. Following that model, the short-term memory enables an immediate analysis of and reaction on occasions of special relevance. In the case that an occasion is not relevant or ignored by the user, it is stored in the long-term memory, which enables the user to reflect later on these "missed" opportunities.

Reflection on Sharing

"Barbara and Jessica review recently captured events."

As discussed in Section 2.4, reflection on past events is a powerful means of exploiting augmented memories. This also holds for the reflection on sharing occasions, as illustrated by the following application examples.

Building a community: By evaluating recorded sharing occasions and actually shared experiences, the user may provide the system with feedback related to sharing partners (e.g., regarding privacy, trust, or expertise). Here, a trust level could be assigned with time: the user would give one trust point for each helpful experience or opinion which matches hers, or a negative trust point when one has an opinion opposite to hers.

Adding retrieval keys: By reflecting on experiences exchanged with others, the user may decide to add retrieval keys to her personal memory: comments, event ratings and retrieval helpers such as landmarks (cf. [Horvitz et al., 2004]) and collaborative tagging.[1]

Pending requests: A sharing request is not necessarily bound to a small time interval. For instance, a sharing partner might express a general interest in certain information. Therefore, reflection on such requests should allow the user to react to a request as long as the preconditions of the particular request are still valid.

Setting up sharing rules: Due to the sheer amount of requests there is always a risk that the user misses interesting occasions. To avoid such situations in the future, the recorded occasions can be exploited in order to configure the system's sharing behavior. If Barbara notices in her records requests about her (public) preferred coffee strength, she can set up a rule which lets the system reply on such requests automatically. Other rules might include situational elements; for instance, the user might want to trigger an anonymous sharing mode once a sharing partner is less the 50 meters away. Therefore, we want to assist the user in extracting from the records the characteristic features of the sharing occasion of interest and to bind these to services provided by the system. In order to achieve this goal, we will exploit (and extend, if required) an approach discussed in [Bauer *et al.*, 2005].

These applications of experience records are all affected by a specific problem: since recording sharing occasions will not reduce their mass, we have to provide the user with powerful means to filter and rank such records. In part, this issue can be addressed by regular GUI features (e.g., filters based on the user's buddy list); in addition we intend to introduce a measure for the value of sharing occasions, a work which has recently started.

4.3 Handling Sharing Responses

"Barbara finds out that she liked a lot most of the dishes with mushrooms."

Our goal is to respond in sharing requests not only with a snapshot-like excerpt of the user model, but also with related experiences. Sending experiences instead of user models serves several purposes. Thus, we expect that user models of sharing partners will often be incomplete or partially protected, which may prevent a system from inferring information of interest for the requesting user. Here, experience records allow the user to make assumptions about the course of events on his or her own. Similarly, the user is not forced to trust inferences drawn by a sharing partner's SHAREDLIFE since retrieved experiences allow for a re-interpretation by user and system.

The exchange of experiences allows also addressing the variety issue known from recommender systems (cf. [Jameson, 2006]): if people query their guest's memory to learn about her favorite dishes, she can get the same dishes at each invitation. Accompanying each dish recommendation by the guest's episodic memory involving it could address this issue: the frequency and dates when the guest ate the recommended dish are visible as well as the evolution of the dish rating over time.

Of course it may happen that no experiences are returned to a request—for instance, because the person never experienced for some reasons something matching the request or because the relevant experiences are protected by privacy constraints. In this case, the user can explore her guest's network to find people similar to her (see Section 4.1), or who have experiences related to cooking for this guest, or whom the guest trusts.

5 Related Work

Popular approaches related to our research are forum, Wiki, and in particular blogs. While these also provide means of sharing experiences, our work extends these in populating the experience base automatically, in assisting the user with proactive retrieval methods, and in allowing the specification of constraints on privacy and trust.

Thus, our work is also related to research on extending the blogging idea. For instance, FeedMap[2] allows for connecting blogs to locations and thus realizes a location-centered sharing approach, however, affected by the same

[1] A good example of applying collaborative tagging can be found at http://movielens.umn.edu/

[2] http://www.feedmap.net/

limitations regarding privacy and trust which apply for regular blogging. This issue is addressed by Moleskiing, which introduces trust on expertise to blog-like mechanisms. In addition, this work exploits reflection on past events in order to prepare experiences for (non-situated) sharing. [Avesani *et. al.*, 2005]

A well-known system related to augmented memories and sharing of memories is MyLifeBits. It assists its user in creating presentations from documents (e.g., photos, text files) collected over an individual's life; the documents may have attached automatically captured meta data (e.g., GPS). [Gemmell *et al.*, 2005]

Other related research addresses the unobtrusive capturing of meeting or classroom activities. These approaches often focus on creating a memory common to all participants in contrast to personal sharable memories. Studies showed that students in such settings were missing means to personalize the captured data and to retrieve it easily (cf. [Abowd *et al.*, 2000]). Another attractive scenario for research on sharing experience records are conference visits. Thus, such records can be exploited for initiating communication between participants (cf. [Müller *et al.*, 2004]), or, in combination with blogging, for sharing selected experiences (cf. [Numa *et al.*, 2006]).

Close to our research are the goals of a project started in 2006 by Nokia: SharMe[3] aims at recording input from mobile devices such as cell phones and at supporting the user in sharing that information with others.

6 Conclusion and Future Work

In this paper we tried to provide some answers to questions raised by memory sharing: we described combinable ways to provide access to others' experiences relevant to the user in the current situation. We described principles enabling to manually select relevant sharing partners. We also described how incoming sharing requests could be handled both automatically when sharing policies apply or manually if necessary and how missed sharing opportunities can be used to specify sharing rules. However, those concepts need to be designed and tested with users to find principles which will ensure the acceptance of memory sharing in context-sensitive software. Our field study and the user study about the community browser will be followed by other iterative sessions of design and evaluation with users. Because of the project's focus on sharing experiences collected over time, we will need to conduct the final evaluation over a long period with a consequent group of users made of known and unknown people.

Acknowledgments

This research is supported by the German Ministry of Education and Research respectively under grant 524-40001-01 IW C03 (project SPECTER) and 01 IW F03 (project SHAREDLIFE). Thanks to all projects members.

References

[Abowd *et al.*, 2000] Gregory D. Abowd and Elizabeth D. Mynatt. Charting past, present, and future research in ubiquitous computing. ACM Transactions on Computer-Human Interaction, 7(1):29–58, 2000.

[Avesani *et al.*, 2005] Paolo Avesani, Paolo Massa, and Roberto Tiella. A trust-enhanced recommender system application: Moleskiing. In SAC '05: *Proceedings of the 2005 ACM symposium on Applied computing*, pp. 1589–1593, Santa Fe, New Mexico. ACM Press, 2005.

[Bauer *et al.*, 2005] Mathias Bauer and Stephan Baldes. An Ontology-Based Interface for Machine Learning. In J. Riedl, A. Jameson, D. Billsus, and T. Lau (eds.), *Proceedings of the 2005 International Conference on Intelligent User Interfaces* (IUI 2005), pp. 314–316. New York: ACM, 2005.

[Gemmell *et al.*, 2005] Jim Gemmell, Aleks Aris, and Roger Lueder. Telling stories with MyLifeBits. In *Proceedings of the IEEE International Conference on Multimedia & Expo (ICME 2005)*, Amsterdam, The Netherlands, July 2005.

[Heckmann, 2005] Dominik Heckmann. Ubiquitous User Modeling. Ph.D. thesis, Saarland University, Department. of Computer Science, Germany, 2005.

[Horvitz *et al.*, 2004] Eric Horvitz, Susan Dumais, and Paul Koch. Learning Predictive Models of Memory Landmarks. In *Proceedings of the CogSci 2004: 26th Annual Meeting of the Cognitive Science Society*, Chicago, August 2004.

[Jameson, 2006] Anthony Jameson. Adaptive Interfaces and Agents. In J. Jacko & A. Sears (eds.), *Human-Computer Interaction Handbook,* Lawrence Erlbaum Associates, New Jersey, 2006.

[Kröner *et al.*, 2006a] Alexander Kröner, Dominik Heckmann, and Wolfgang Wahlster. SPECTER: Building, Exploiting, and Sharing Augmented Memories. In K. Kogure (ed.), *Proceedings of the Workshop on Knowledge Sharing for Everyday Life* (KSEL 2006). Kyoto, Japan, February 9–10, 2006.

[Kröner *et al.*, 2006b] Alexander Kröner, Dominik Heckmann, and Michael Schneider. Exploiting the Link Between Personal, Augmented Memories and Ubiquitous User Modeling. In: *Proceedings of the ECAI 2006 Workshop on Ubiquitous User Modeling* (UbiqUM 2006), Riva del Garda, Italy, 2006.

[Müller *et al.*, 2004] Christof E. Müller, Yasuyuki Sumi, Kenji Mase, and Megumu Tsuchikawa, Experience sharing by retrieving captured conversations using non-verbal features. In *Proceedings of the 1st ACM Workshop on Continuous Archival and Retrieval of Personal Experiences* (CARPE 2004), pp. 93–98. New York: ACM, 2004.

[Numa *et al.*, 2006] Kosuke Numa, Toshiyuki Hirata, Ikki Ohmukai, Ryutaro Ichise and Hideaki Takeda: Action-oriented Weblog to Support Academic Conference Participants. In *Proceedings of the IADIS International Conference on Web Based Communities (WBC2006)*, San Sebastian, Spain, 26–28, February 2006.

[Plate *et al.*, 2006] Carolin Plate, Nathalie Basselin, Alexander Kröner, Michael Schneider, Stephan Baldes, Vania Dimitrova, and Anthony Jameson. Recomindation: New Functions for Augmented Memories. In V. Wade & H. Ashman (eds.), *Adaptive hypermedia and adaptive web-based systems: Proceedings of AH 2006*. Berlin: Springer, 2006.

[3] http://research.nokia.com/research/projects/sharme