From Personal Memories to Sharable Memories

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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 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 information*. In parallel, the huge number of websites offering forums, customer reviews, and customer-based recommendations proves the need to find *independent information*.

However people have to pay the effort to report on their experiences, which results in only a small subset of experiences being available. Given the mobile devices and instrumented environments development it is possible to capture everyday life episodes which would not have been otherwise reported but that can be useful for people facing similar situations.

In addition, most recommendation software are available on the Web and therefore are not easily accessible when people need them most, e.g. when they have to make a decision downtown about a purchase or the choice of a place to go. Most recommender systems available online are not adapted to a mobile device small display and none of them can provide proactive user support. Therefore, proposing memories sharing in a ubiquitous system may be useful. Independent information would be proactively presented to the user in relevant situations.

This raises a 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 a personal memory assistant and provide our early reflection for the extension of this assistant to 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

The dense logging of a user's actions in an intelligent environment enables the realization of memory-like structures, which can be applied to augment the user's natural memory. In the project SPECTER [Kröner *et al.*, 2006a], we researched how such *augmented personal memories* can be built and exploited for building a user model and for decision support, and how the user accesses these data and processes.

2.1 Building Personal Memories

The SPECTER system may be connected to diverse sensors in order to capture information about the user's state and context. For instance, 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 behavior 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* (cf. left part 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.

Alternatively, 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 applica-

tion – e.g., for preparing a set of "examples" based on the memories, which may then be forwarded to services implemented by the environment.

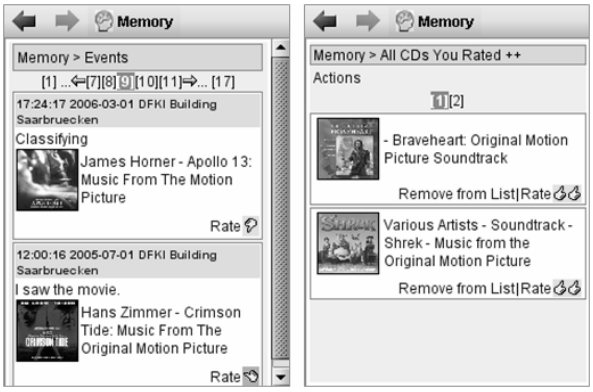

Figure 1 – On the left: event-oriented view; on the right: object-oriented view.

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 memory (e.g., allow to retrieve objects or events related to some resource) and to exploit the current environment (e.g., allow to set up a query for similar products in the current shop). All these views are interconnected; a typical dialog between user and system often involves several of them. 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 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 (cf. Figure 2).

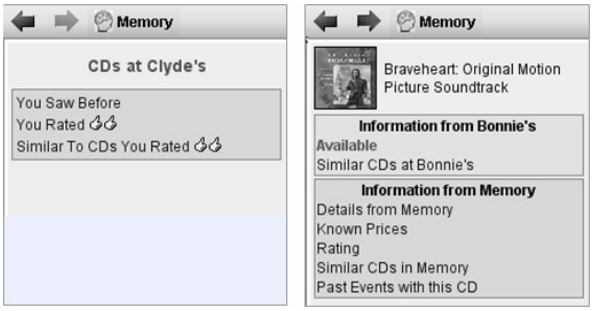

Figure 2 – On the left: proactive situated services offer, when entering a store; on the right: proactive situated services offer, when looking at a CD in a store.

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 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 from the Web).

2.5 Evaluation

We used a CD shopping scenario as setting for a summative evaluation study with users and as showcase 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].

3 Towards the Sharing of Augmented 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 "recominding" functions as time and money saving in our study, 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 Characteristics of an Application Scenario

Finding appropriate methods to discover users' needs regarding the broad and innovative memory sharing topic remains challenging. To start defining an adequate scenario, we asked participants about their potential needs in the course of our study on augmented memories. Most of the scenarios they imagined 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.". Only some participants mentioned scenarios about professional life: "I usually don't remember people's names after a meeting, which is quite annoying. Business card information could be automatically exchanged if the user requests or at least allows it.".

We are interested in keeping a shopping scenario since study participants have a positive feedback about it and we already have experience and material regarding the shopping context. However, shopping is quite limited regarding experiences sharing: it consists mainly in sharing products attributes and their associated annotations. We therefore considered moving to a "cooking for guests" scenario including 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.

3.2 Contextual Inquiry

In order to check the validity and the potential in sharing occasions of the "cooking for guests" scenario, we conducted a contextual inquiry with 4 participants who cooked for guests. They have been interviewed about their menu selection, observed while shopping and cooking and interviewed about the occurred sharing occasions, about the memory sharing principles, and the cooking scenario.

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.

3.3 Example

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 in Jessica's memory if she is vegetarian, which is indeed the case. 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. 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.

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 recent captured past 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 trusts points to people whose experiences helped her for the diner preparation in order to use those people's memories in priority in the future.

4 Approach

Some of the concepts underlying the above scenario include unobtrusive building of personal memories, views on others' memories according to constraints such as context and sharing preferences, ways to access functions based on other people's memory, which can be requested explicitly or performed proactively, community building to address issues related to trust in others' recommendations, and a posteriori reflection which allows to configure the system proactive behavior and also to annotate the past events for later personal use or sharing purposes. This section presents different approaches addressing these topics.

4.1 Accessing Memories

A single user's augmented memory is already a rich source of situations and artifacts. In a multi-user scenario where sharing applies, the available information set becomes even larger. Therefore, the user requires means of selecting other people's experiences relevant to the current situation. Although some automatic means of relevant information retrieval can be offered, we cannot expect the system to automatically guess for each situation all information relevant to the user. Additional manual mechanisms are required to look up interesting information in the personal and others' memories. In SPECTER we experimented with combinable approaches to query a personal memory. Those solutions are applicable or extendable to query others' memories. We believe from our study with the SPECTER prototype that a combination of different tools is a good means for enabling users to access the needed information in any situation. Below are listed automatic means of information retrieval:

- Situated filtering: omitting events and events' parts irrelevant to the user's context.
- Situated organization: organizing events to facilitate access to the past (e.g., by clustering).
- Proactive offer of services / information of interest for the current situation (see left part of Figure 3): this is illustrated in our example scenario: "The system informs Barbara that users complained about the awful quality of this mozzarella brand".
- Situated view selection: offer of different view types according to the situation: function-, event-, resource-, or annotation-oriented views (see Figure 3).
- Recomindation in the sharing context: recomindation of other people's experiences (selecting an event in a personal or others' memory and asking for similar experiences in others' memories), recomindation of resources (selecting a resource – object or place – in the environment or in a personal or others' memory and asking for similar recommended resources) and recomindation of sharing partners: people who had helpful memories in a past situation are recommended when the user is in a similar situation again.

Figure 3 – 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. Filtering and sorting about the users, stores, dates or evaluations could be available.

Manual means for information retrieval are also necessary to allow the user to access information that the system would not have automatically brought due to unexpected situations or non-situated queries which may also arise. Manual access means could *initiate* an automatic selection of data (e.g. selection of an element in the personal memory used as a retrieval key in the others' memories) or could *refine* a result set provided by the system (e.g. selection of the most interesting results to refine the query).

We also plan to extend the principle of event annotation which was used in SPECTER to help the user to remember and access her personal events later. Annotations were also supporting "recomindation" mechanisms (proactive offer of CDs in the store similar to the ones the user rated as "Excellent"). Annotations could be extended and used as retrieval keys facilitating search in other people's memories: comments and event ratings could be complemented by ratings on sharing experiences which would report on the sharing partner and the quality of the shared content and by retrieval helpers such as landmarks (cf. [Horvitz et al., 2004]) and collaborative tagging[1].

5 Selecting Sharing Partners

We expect that 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, however there are cases where the user knows better than the system which memories she wishes to explore: in the coffee aisle, the user does not know which coffee to buy, but she remembers that her mother makes excellent coffee and she would like to explore her memories to know which brand she buys. In our scenario, Barbara is at home and wishes to explore memories of vegetarian people.

We therefore need an interface enabling to select sharing partners satisfying given constraints. Since the resulting number of individuals can be high, the interface should provide ways to determine who the most relevant people are, for instance, according to additional dimensions that the user could choose.

Constraints could come from a user profile filled in by the users or by the system with inferences made from the collected experiences. Information contained in the user profile could be as general as gender or profession, or application-oriented such as health problems, religion, or country of origin which influence food habits. This obviously raises privacy issues, but these could be addressed by allowing users to mark certain information as private so that they would not be returned by any query about information they consider as too personal.

While constraints are binary information (vegetarian: yes/no), *dimensions* are variables which can take different numeric values enabling to sort available sharing partners and thus to identify interesting groups. We believe that trust is an indispensable dimension when it comes to communities and recommendations. A trust level could be assigned to users with time: the user would give one trust point for each helpful experience or opinion which matches hers. She could give also a negative trust point when one has an opinion opposite to hers. With time, trusted unknown users would become "familiar strangers": in our scenario, to get vegetarian recipes suggestions, Barbara prefers recipes from unknown vegetarian users she trusts because she has already successfully tried their recipes. Regarding other possible dimensions for the selection of people, we believe that 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

[1] A good example of use of collaborative tagging applied to movies recommendation can be found at http://movielens.umn.edu/login

range of values of these dimensions. For instance, a student in Germany who invites a Chinese student from his campus could select only Chinese people far away (in China) to get authentic Chinese recipes and then only Chinese people two kilometers away to know where Chinese buy Chinese ingredients in the city where he lives.

According to our opinion, people should be also distributed in various *people categories*, such as buddies (a quite common approach used in chat applications, Movielens, and other social software), familiar strangers (unknown people with a trust level) and other unknown people. Each category could be shown or hidden.

Currently, we are conducting a study addressing the particular benefits of various approaches to visualize and select people with an interesting sharing potential.

5.1 Handling Sharing Requests

Having discussed how users may specify and explore potential sharing partners, we are now in a position to analyze the next step: how incoming sharing requests could be treated by user and system.

Our scenario includes many opportunities in which experiences could be shared. Some will be relevant for the user's current context (e.g., in our scenario, Jessica receives a request from Barbara regarding her food constraints), some not (e.g., while shopping, Barbara might receive a special offer not related to the planned dish). The number of relevant sharing requests alone might be huge, and requests which are not relevant in the user's current situation might turn out to be important for a future context.

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. However, beside issues of privacy and trust in such automatism, the unsupervised exchange of information might "overcrowd" the user's augmented personal memory with information never actually used.

An alternative way of handling sharing requests can be achieved by means of ubiquitous user modeling [Heckmann, 2005]. We have explored how the user may exploit the facilities of an augmented personal memory in order to choose 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; however, the whole process might turn out to be cumbersome if requests are diverse, or unhandy if immediate response is required.

Therefore we propose to exploit augmented memories themselves for handling sharing requests. Following the model of short-term memory and long-term memory applied in SPECTER, 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.

5.2 Reflection on Sharing

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 opportunities, as illustrated by the following application examples.

Adjusting sharing policy: 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). This feedback can be exploited by the system to adapt the user's sharing policy with respect to the context where these events have been captured.
Adding retrieval keys: By reflecting on experiences exchanged with others, the user may decide to add retrieval keys to the personal memory – for herself, or for others.
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 data, e.g., all future experiences in cooking. 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: Some sharing occasions will require immediate treatment. However, due to the sheer amount of requests there is always a risk that the user misses even important occasions. While their recording can not actually remove that problem, we think that it could provide the user with a means of avoiding such situations in the future. Here, an approach explored in SPECTER might turn out to be of special value [Bauer *et al.*, 2005], and can be exploited to trigger specific sharing behavior – for instance, to automatically inform the user if a certain expert is nearby, or to activate means of anonymization if a distrusted party is physically near.

These applications are promising but are all affected by the following problem: since recording sharing opportunities 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 opportunities, a work which has recently started.

6 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 diverse ways: we want to populate the experience base (the memory) automatically, to assist the user with proactive retrieval methods, and to allow for 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 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

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

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. [Abowd *et al.*, 2000]

An 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.

7 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. The contextual inquiry and the user test we are conducting will be followed by other iterative sessions of design and evaluation with users. This enables a user-oriented conception, moving progressively from low level prototypes to an implemented application used in an instrumented environment. Because of the project topic (sharing of 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.

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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* (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.

[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* (New York, New York, USA, October 15 - 15, 2004). CARPE'04. ACM Press, New York, NY, 93-98, 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