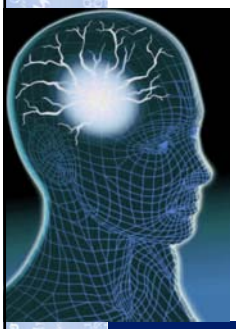

Situated Documents in Personal Information Spaces

– Final Presentation –

A. Dengel, A. Lauer, G. Buscher,
L. van Elst, M. Kiesel, S. Schwarz

SAB February 25-26th 2009

Agenda

- Mymory: Motivation & Goal
- Conceptual and Technical Results
- Evaluations
- Application, Dissemination, Summary

Motivation: In Knowledge-intensive Work, Context Means to Be in a „Specific Mindset“

- **In which context are you currently situated?**
- **How can we determine?**
- **How do we (re-)contextualize?**
- **How can we exploit context knowledge?**

Goal: Support Personal Knowledge Work

- **Represent and elicit** the user's current context
- **Exploit** current context for
  - More precise information retrieval
  - Pro-active information delivery
- **Alleviate** costs of context **switches**
  - Re-contextualization

The user's **attention towards his environment** is a key indicator for the *relevant* context aspects.

Mymory Created a Framework for Document-centered Knowledge Work Support

- Mymory focused on **attention towards text documents**
  - e.g., considering different modes of reading, annotation, …
- Context model concentrates on a **desktop environment**.
  - Many physical aspects of context are not regarded.
- Technical approach: Enrich document production and consumption with **formal annotations.**

An **extensive diary study** has been conducted at the project's beginning in order to validate underlying assumptions.

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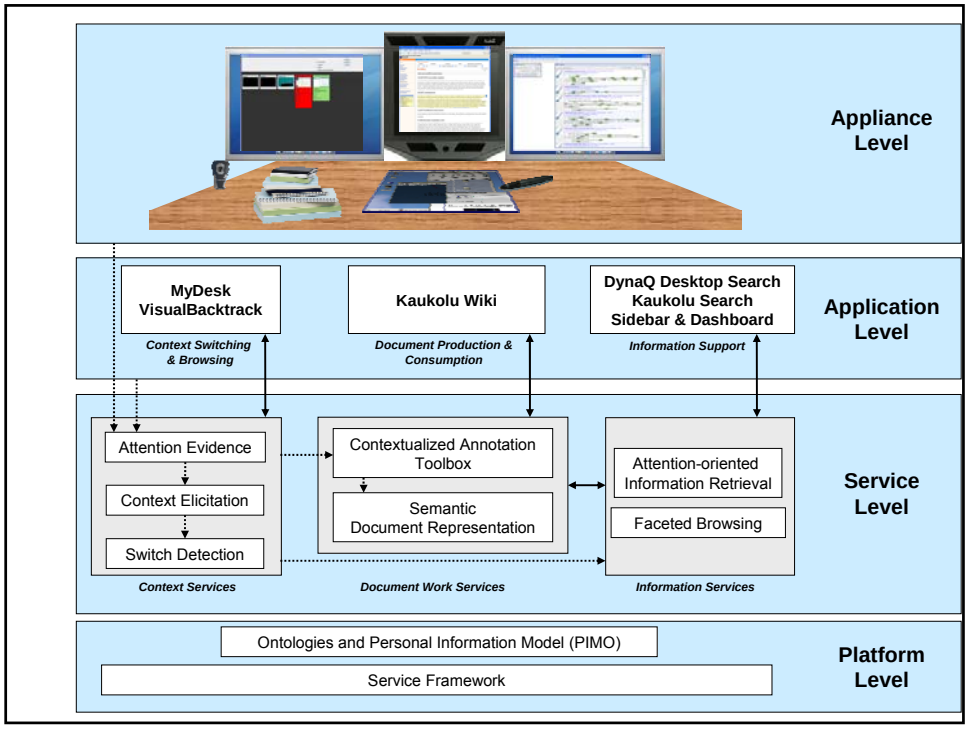
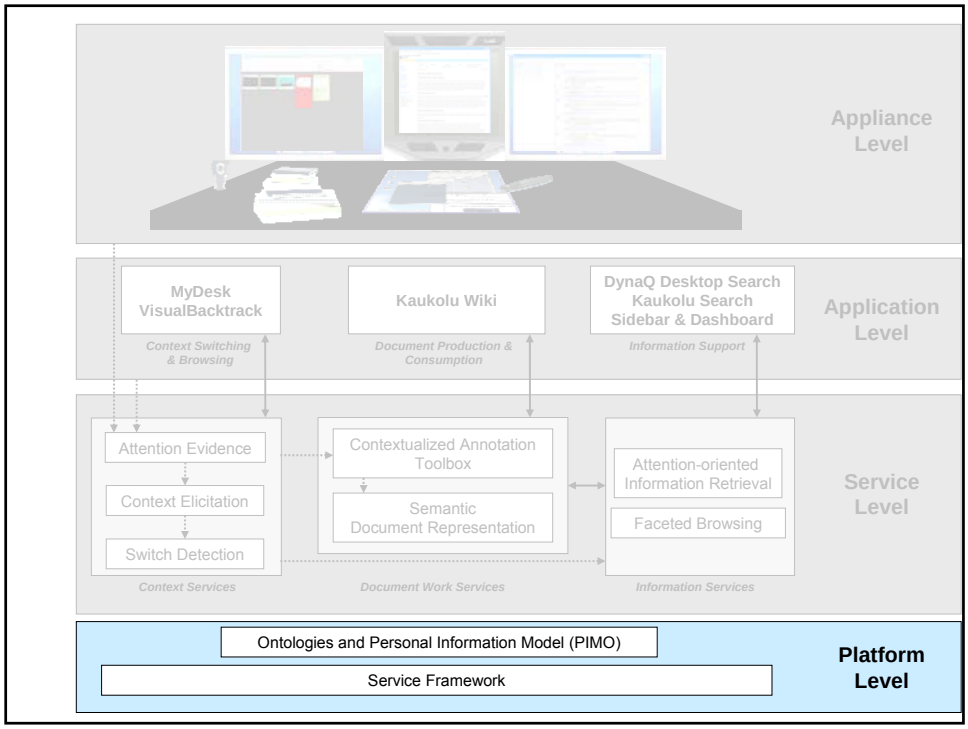

Appliance Level
MyDesk VisualBacktrack
Kaukolu Wiki
DynaQ Desktop Search
Kaukolu Search
Sidebar & Dashboard
Application Level
Context Switching & Browsing
Document Production & Consumption
Information Support
Attention Evidence
Context Elicitation
Switch Detection
Contextualized Annotation Toolbox
Semantic Document Representation
Attention-oriented Information Retrieval
Faceted Browsing
Service Level
Context Services
Document Work Services
Information Services
Ontologies and Personal Information Model (PIMO)
Service Framework
Platform Level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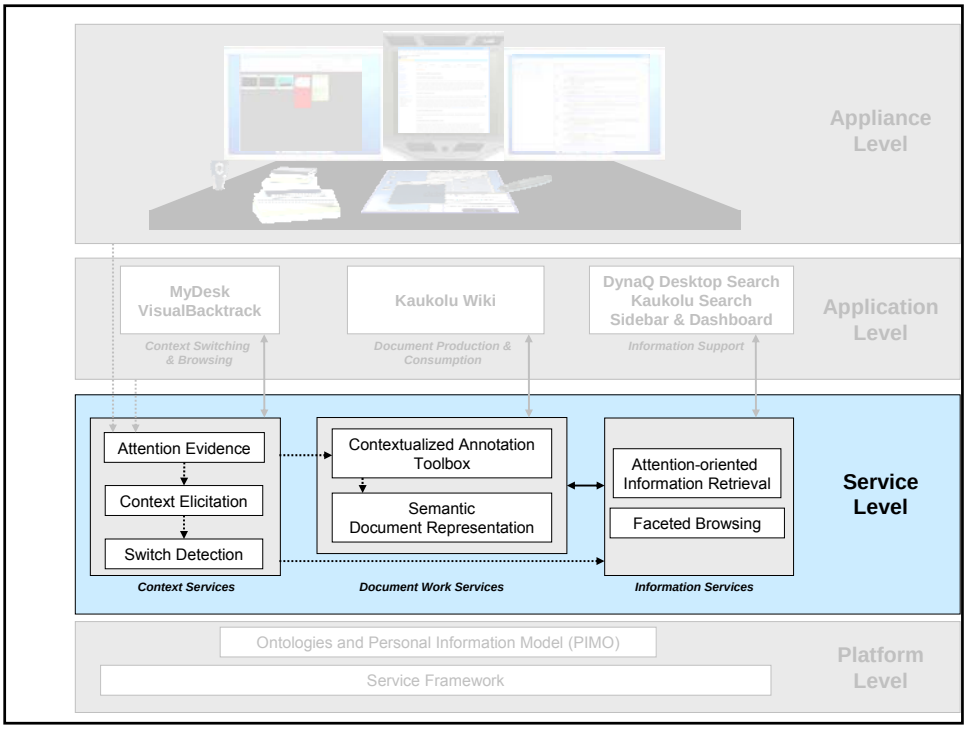
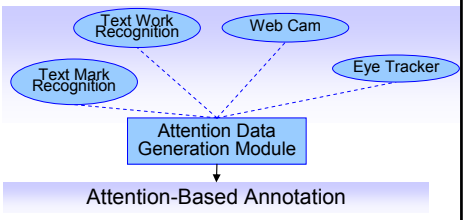
The Platform Level Facilitates Access to Semantic Desktop Components

- **Light-weight basis for a service-oriented organization of Mymory components**
  - Supervises the services' life-cycles (deployment, start, stop)
  - Provides communication facilities for synchronous as well as asynchronous information exchange between services
  - Supports distributions among desktops
- **Provides endpoints for external applications (e.g., Thunderbird, Firefox) to deliver information**
- **Management of ontologies is done by services built on top of the platform**
  - Ontologies can be added at runtime, including SPARQL and inferencing support
  - High-level operations on the personal information model (PIMO)

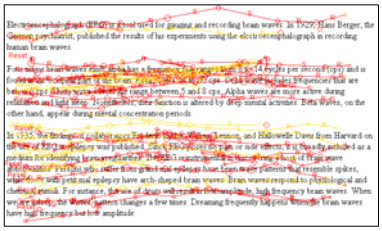


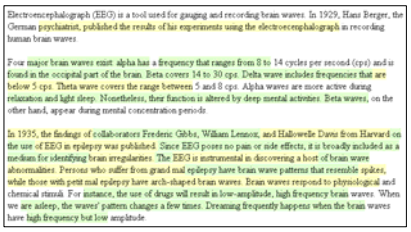
The Service Level Realizes the Core Functionalities of a Personal Memory: (1) User Attention

- Attention evidence can be acquired from multiple sources and be uniformly represented.



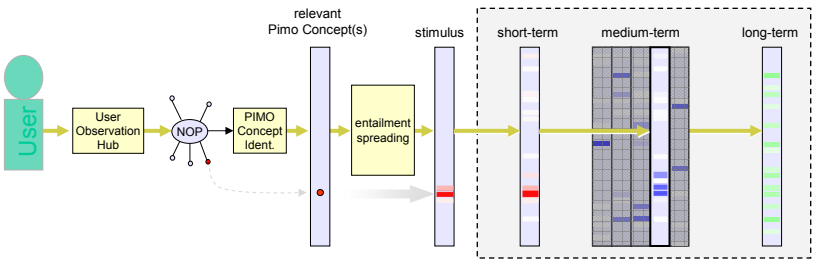
- From eye movements to document work:
  A robust algorithm for *detecting the reading mode* has been developed.





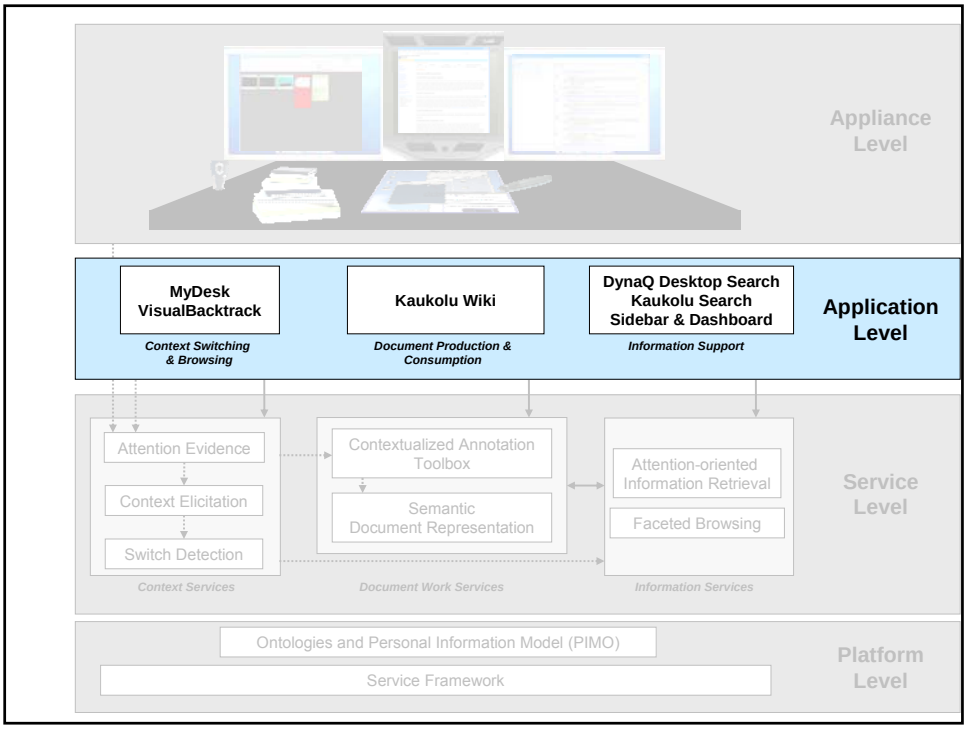
Core Functionalities of a Personal Memory (2): Multi-Context Tracking

- The user's work context can be **formally represented**:
  - The Personal Information Model (PIMO) provides the basic vocabulary for the context model.
  - Weighting the concepts according to their relevance for the specific context leads to a vector representation.
- Efficient **basic operations** on contexts are defined:
  - The *current* context can be identified from user observation.
  - Context *switches* can be detected.



Core Functionalities of a Context-oriented Personal Memory (3): Document & Information Services

- **Semantic Wiki document backend**
  - Enriching documents with semantic, context- and attention-oriented annotations
  - Manually and automatically generated annotations
- **Exploitation of context and attention data**
  - Attention-oriented information retrieval engine
    - Desktop and web search
  - Faceted search:
    - Page filters
    - Annotation filters
    - Context filters
    - Combination of simple filters with AND, OR



Visual Backtracking with the Context-sensitive Dashboard Application

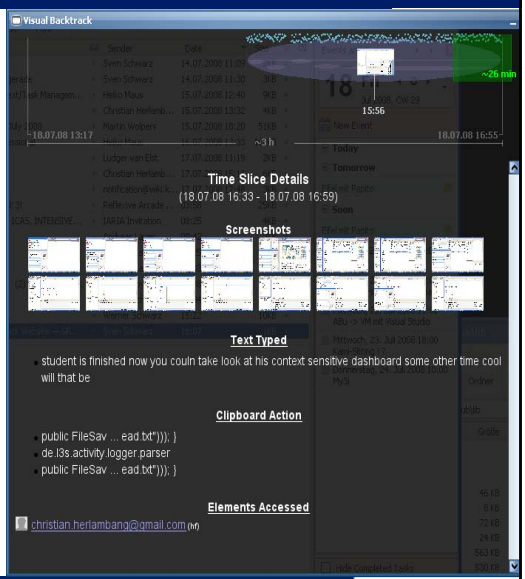
- **Dashboard metaphor a la Mac OS X**
  - *context-sensitive* behavior of widgets
    - E.g., TODO list, information provision, …
- **Assist context *transitions***
  - Addresses main problem with context switches: remember + resume old, abandoned goals and tasks
  - Visual Backtrack widget allows looking into the past (of a context)
- **Experiment**: Simulate resuming of *old* tasks by introducing *new* clerks
  - New participants were asked to continue the work of other participants
  - No task description was given: Use Dashboard and the Visual Backtrack!
  - After 96 seconds (avg.), the new user's had a close description of 50% of the tasks to resume.
  - The max. time needed to resume a task was 7:28 minutes.

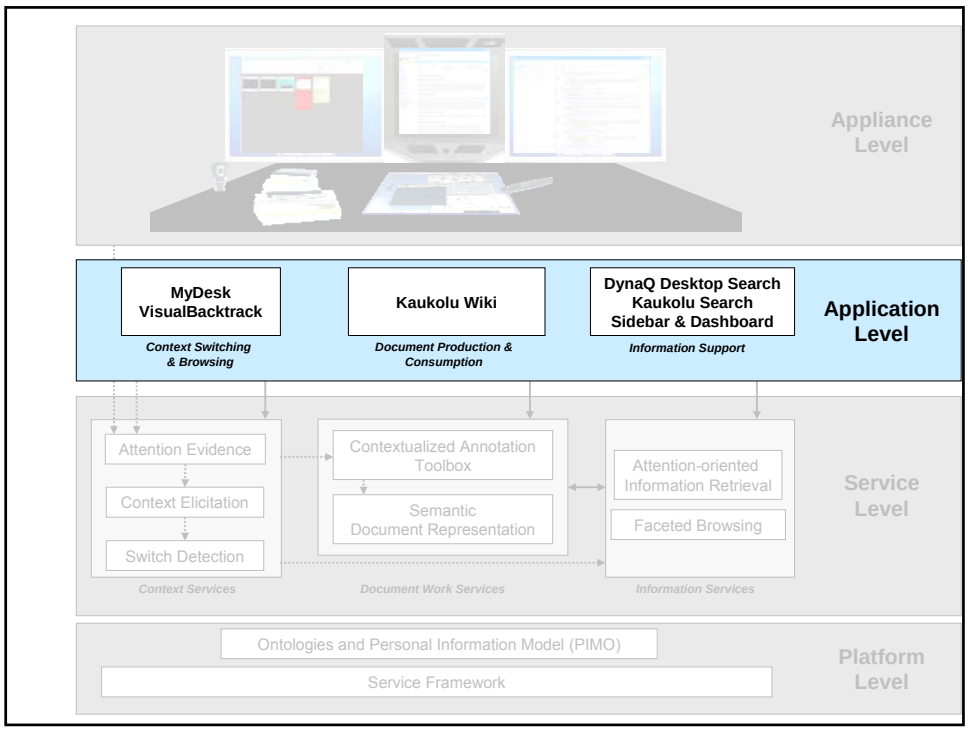
Visual Backtrack Widget Supports Reminding Old Context

Timeline view

Recorded behavior

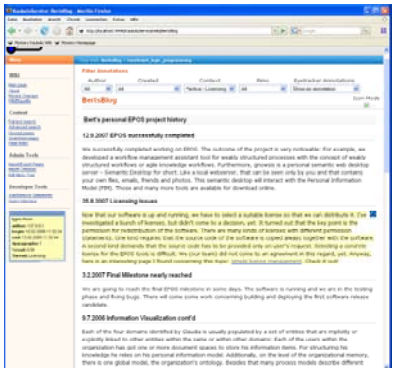
- Screenshots of desktop
- Typed text
- Clipboard actions
- Accessed resources (e.g., documents, person contacts)





A Set of Exemplary Applications Exploit the *Mymory* Services

- **MyDesk** supports navigation in large context sets
  - Context ↔ Desktop
- **VisualBacktrack** supports re-contextualization
- **Kaukolu** as main place for document-centric work
  - Wiki for text production and consumption
  - Situated views based on attention and context
- **Kaukolu Search** extends standard wiki search with semantic search.
- Coupling of **DynaQ desktop search** with attention services
- **Sidebar & Dashboard** for (pro-active) information delivery



Appliance level resembles this grouping of applications.

Appliance Level: The Physical Workplace Reflects the Logical Structure

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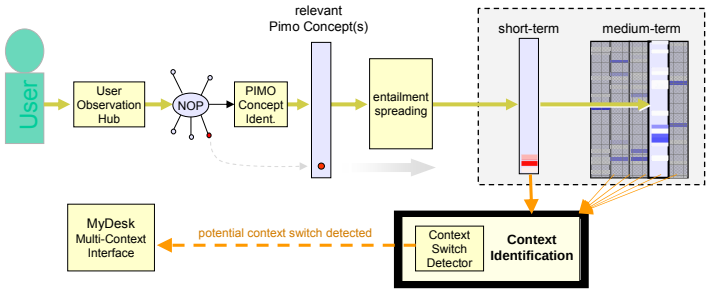
Context Identification Is a Cornerstone of Multi-Context Knowledge Work Support



- Ground truth: Recorded user's actions during several work days (1-2 weeks)
  - Done with our user observation framework "UserObservationHub"
  - Parallel to the user working, absolutely no user interference
- Each user action is mapped to one context thread (task)
  - Manual assignment is done offline with specialized GUI
- Context identification has been analyzed on the basis of 10-fold cross validation on ground truth.

Context Identification Using a Cross Validation on Ground Truth Data

- Automatic context identification works well for many contexts
  - **Correct** identifications (true positives): 69%
  - **False** identifications (false negatives): 9%
  - Unidentified cases: 13%
- High amount of not observable actions makes some threads hardly identifiable
- False identifications can not be completely eliminated for similar context threads

identified contexts (computed)

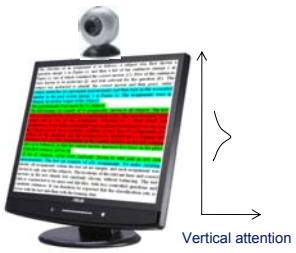
actual contexts \ ident	c0	c1	c2	c3	c4	c5	c6	c7	c8	c9	c10	unident.
c0	109	0	0	0	0	0	0	1	0	0	0	0%
c1	6	25	0	0	0	1	0	0	0	0	0	36%
c2	22	0	931	4	6	0	0	0	0	2	1	4%
c3	1	1	0	59	0	3	0	15	2	1	0	25%
c4	5	0	0	0	50	0	2	0	0	1	2	40%
c5	0	2	1	0	0	34	0	0	0	0	0	26%
c6	22	0	0	0	1	0	57	0	0	1	0	10%
c7	1	0	7	22	2	0	0	61	0	1	0	37%
c8	14	0	0	0	0	3	0	0	206	32	1	12%
c9	8	0	0	0	0	0	0	0	0	25	0	34%
c10	0	0	0	0	0	0	0	1	0	0	57	3%

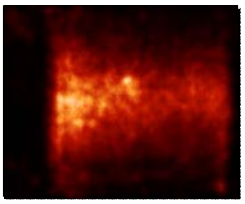
Exploitation of Gaze Data Has Been Investigated in Various Retrieval Settings

- Estimation of explicit **relevance feedback**. Prediction whether a document is individually perceived relevant or irrelevant based on eye movement measures:
  - 21% improvement in positive prediction value and
  - 200% improvement in sensitivity over the best test reported in the literature
- **Query expansion** and **re-ranking** based on gaze feedback on the paragraph level of viewed documents:
  - 32% improvement in Mean Average Precision over relevance feedback on the document level.
- Work published in:
  G. Buscher, A. Dengel, L. van Elst. Query expansion using gaze-based feedback on the subdocument level, In: *SIGIR '08: Proceedings of the 31st annual international ACM SIGIR conference on Research and development in information retrieval*, Singapore, pp. 387-394, 2008.

Query Expansion and Re-ranking Based on Display-time-based Feedback on the Paragraph Level

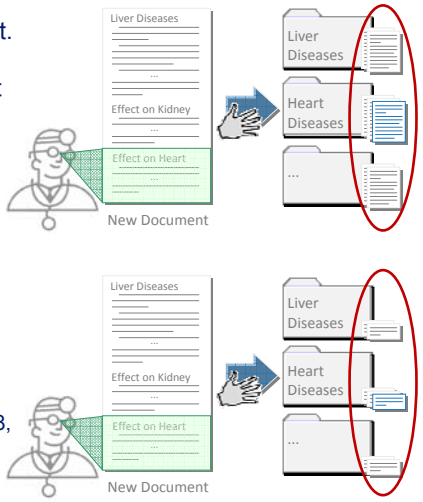
- **Motivation**:
  Eye tracking is a very expensive technique.
  Approximation by less expensive methods?
- **Idea**:
  - Observation of scrolling behavior
  - Observation of mouse movements
  - Face tracking
- **First study**: common scrolling and mouse movement behaviors
  - Gaze positions during reading are individually different
- **Second study**: How can display time be used to approximate eye-tracking-based feedback in information retrieval scenarios
  - Display-time-based methods can be tuned to work as well as eye-tracking-based methods.
- → SIGIR'09 paper submitted





Mymory Approach Can be Extended to Further Information Services: Attention-Based Document Classification

- Before assigning a document to a specific class, the user examines it.
- Assumption: Only these document parts can have led to the user's classification decision that have been paid attention to.
- Only these parts are used for training an appropriate document classifier.
- Work published in:
  Buscher, G. & Dengel, A.: Attention-Based Document Classifier Learning. Proceedings of the Eighth IAPR Workshop on Document Analysis Systems, IEEE computer society, 2008, pp. 87-94.
  Best paper award.



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Industrial Case Studies Show Real-World Applicability of the *My*mory Approach

- Service Center Scenario (...)
  - Partly very long documents (e.g., handbooks)
  - Various types of document consumers with different use profiles
  - Combination of current process, user role, and specific information needs sets context for most useful view
- Engineering Scenario
  - Combination of structured (product) data and textual information
  - Flexible navigation is needed
  - Semantic annotation on the sub-document level

(...): Diagnostics Scenario

Publication and Dissemination Activities

- ~20 Papers published (book chapters, conference & workshops, journals)
- 2 Best paper awards:
  - Buscher, G. & Dengel, A.: Attention-Based Document Classifier Learning. Proceedings of the Eighth IAPR Workshop on Document Analysis Systems, IEEE computer society, 2008, pp. 87-94.
  - G. Buscher. Attention-Based Information Retrieval , Abstract in *SIGIR '07: Proceedings of the 30th annual international ACM SIGIR conference on research and development in information retrieval (doctoral consortium). Best paper award of the doctoral consortium*.
- 9 Diploma & project theses
- Several tutorials and lectures (at conferences and universities)
- Scientific exchange
  - Georg Buscher worked at Microsoft Research, Seattle on prediction of visual attention on web pages
- Workshop (co-)organizations in the area of context awareness
- Several program committee memberships
- Co-operations with Semantic Desktop and Semantic Search projects
  - (...)Virtual Office of the Future, (...), iDocument, THESEUS, NEPOMUK, Aloe, DynaQ

Summary: Main results of Mymory

- **Concepts and tools for document-centered knowledge work have been developed.**
  - Flexible semantic annotations in an integrated document production and consumption environment are the basis for a personal memory system.
  - Context elicitation by unobtrusive attention tracking.
  - Context switches can be technically supported.
  - Attention data can be exploited for Information Retrieval tasks.
- **Experiments supported the claimed benefits.**
- **Perspectives for further exploitation are promising.**
  - Attention-based approach will be elaborated in Perspecting (long-term history, utilization for information extraction).
  - EyEducator will transfer eye tracking-based attention and reading technology to learning application.
  - Expert network in iGreen is planned to build on the Semantic Wiki.
  - For Siemens use case, a follow-up project is planned.

Thank you for your attention!

Questions?