Situated Documents in Personal Information Spaces

- Project Report -

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SAB February 19–20th 2007

The meaning of documents is constructed in the interaction of content and comprehension

► Ontological annotation
- D, IS-A VerdictDocument
- Verdict312085/98
  PRONOUNCED 05/12/1998
- Paragraph2 DESCRIBES CaseFacts
- Paragraph3 DESCRIBES DecisiveFactors

► A lawyer's perception & annotation
In Mymory, the user’s attention is complemented by „attentive“ documents

A set of use cases has been defined as guidance for development and evaluation

- **Processes**: Generation of contract documents
- **Input**: Partly decontextualized example contracts
- **UC1a**: *Virtual abstract* of relevant example
  - based on context-mappings
  - exploit attention evidence
- **UC1b**: *Explore knowledge space* from context
  - exploit established document relations
- **UC1c**: Context-sensitive *information support*
  - exploit attention evidence for IR
- **UC1d**: *Context switch* assistant
  - exploit context detection for task-oriented workspace design
A document work study reveals more detailed insights into document-centered knowledge work

► Reading activities within real world settings are poorly understood

► Method: Diary study in the spirit of Sellen’s work
  - Questionnaire for capturing document reading & generation activities
    - document type
    - reading volume & activity
    - purpose
    - editing activities
    - medium & location
    - duration
    - sequences of activities
  - Pilot study + 26 knowledge workers in the KM lab (1 week), completed by 15 test persons (4 or 5 days of documentation)


http://www.dfki.de/mymory

First results from the study

► General characteristics
  - About 80% of work is knowledge work
  - More than 50% of knowledge work is document-centered (10-90%)
  - Test persons estimate that 80% of their document work was captured by the questionnaire

► Subgroup analysis
  - >80% of the actions have been performed online at PC
  - ~33% of paper actions led to annotations vs. 11% with PC actions
  - ~36% of actions are single/isolated; most of the chained actions contain 2-3 “atoms”, some up to 19.

Take the individual working style into consideration!
A uniform attention representation collects and integrates evidence from multiple sources:

- **Data Sources**
- **Ontologies**
  - Information Objects
  - Information Qualifiers
- **Evidence integration: Dempster-Shafer**
  - Extended by intensity intervals

**Attention Data Generation Module**

**Attention-Based Application**

*The demo provides different visualizations and interfaces according to the situation.*

Tobii 1750 eye tracker has an accuracy of around ±20 pixel

- Allows the detection of fixations and detailed eye movements

**Integration into the JAVA-based environment**

- Functionality to record and replay eyetracking sessions
- Filter chain mechanism to accumulate and process the raw gaze data and come to more abstract gaze representations

State-of-the-art eye tracking device serves as high precision source for attention evidence:

**Raw gaze data**

- Fixation Detection Filter
- Feature Detection Filter
- Reading Detection Filter

- Fixations
- Features
- Read / skimmed lines
From eye movements to document work: Detecting the reading mode

Main Question:
How can we come from raw data to "meaningful" models of cognitive processes during knowledge work?

Reading behavior consists of very characteristic eye movements:
- Fixations
- Forward saccades
- Regressions

First step: Algorithm for detecting reading vs. skimming
- Detect fixations
- Classify the transition from one fixation to another (Æ feature)
- Apply scores to the detected features
- Classify a list of successive features as "read" or "skimmed" (based on score thresholds)

A pre-study has been conducted:
- Text about software licences with 2 reading conditions
- Analysis of 11 subjects shows a strong robustness of the detection algorithm

Demonstration of reading detection

DEMO
Multi-modal context models support today’s working style

► Knowledge work requires "multi-tasking capabilities"
  - The user is embedded in a multitude of processes.
  - Many processes are emerging and changing at a rapid pace.
  - Processes are often intersecting: Tasks run in parallel.
  - The user has to keep track of and switch between processes / tasks.

► Mymory aims at assisting the user in "multi-tasking"
  - Virtual desktops as GUI metaphor for contexts.
  - MyDesk is a Java-based virtual desktop system that can handle a massive amount of desktops.

► The representation of the user context model has to incorporate this multi-tasking aspect
  - User context relies on a model of the user’s world.
  - The Mymory context model builds on symbolic representations (RDF/S) + vector representations.

An attention-based Personal Information Model plus context results in a comprehensive memory model

Sensory Level
- Multi-modal attention data generation
- Pre-processing
- Attention evidence integration

Contextual Loop
- Concepts & Attention Levels

Long-Term Personal Information Model
- Concepts & Base Activation Levels

Context Store
- Current context

Working Personal Information Model
- Concepts & Current Activation Levels

~20msec

Some seconds

Years

Minutes to hours
Attention-enhanced document retrieval requires extensions of underlying models

- Standard retrieval process offers multiple starting points for integration of attention data
  - Modified query: enrich query with recently attended text
  - Modified weighting schemas: "Attention-TFIDF"
  - Re-ranking: Attention data as relevance feedback
  - Modified documents: index virtual context-documents instead of single documents

- More powerful representation allows new types of queries
  - Local search: Find for the current task (parts of) documents, that I formerly used for a similar task.
  - Enterprise-wide search: Find for the current task (parts of) documents, that I do not know yet, but that have been used by some colleague for a similar task.

An experimental environment for attention-based informational retrieval has been established as a Matlab-based toolkit.

A Wiki system narrows the gap between document consumption and generation

- Multi-context scenario imposes additional challenges:
  - The semantic Wiki system Kaukolu (based on JSPWiki) allows for massive document annotation.

- Templates vs. flexible granularity:
  - Arbitrary annotations can be added to any wiki page, paragraph, or individual words.
  - Context- and attention-oriented annotations need flexibility!

- Storage questions arise:
  - Annotations are stored separately from the text as the amount of expected data (eyetracker, context) is expected to make in-document storage impractical.
  - Annotations consist of a starting and ending character position and the annotation data itself.
  - Challenge: Keeping annotation data in sync with documents.

A running prototype for semantically enriched document work is available as open source software.
Example: Text work with a semantic Wiki

A Wiki allows for integrated reading and editing.

Kaukolu facilitates annotation with formal concepts on all levels of granularity

GNU Lesser General Public License 2.1

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...
Annotations can serve as starting point for knowledge exploration

Annotations can be exploited when a text receives attention

The "License Wiki" serves as a comprehensive and surveyable test scenario

- **Licence agreements** as experimental domain
  - Domain of increasing importance
  - Manageable text corpus with high overlap and relevant level of detail
  - Attention interpretation complex enough

- 72 open source **software license texts** have been imported into Kaukolou.

- An **ontology** that allows to formalize "license knowledge" has been created.

- First licenses have been annotated (e.g., knowledge base facts have been linked to the text parts they correspond to).
Main focuses for Mymory's second year

- Exploitation of explicit attention data sources
- Attention-based document management and retrieval algorithms
- Management of multiple contexts
- Building the physical workplace

Thank you for your attention!

Questions and Suggestions