Seamless capture and discovery for corporate memory


Daniel Billsus

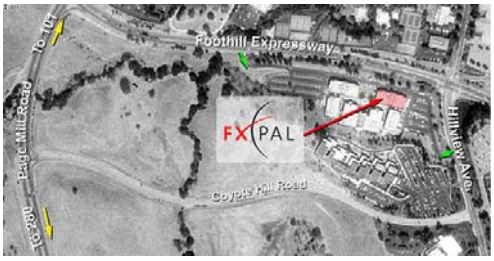

Laurent Denoue


David Hilbert

FX Palo Alto Laboratory
March 2006

FX Palo Alto Laboratory, Inc.

- Research lab for Fuji Xerox
  - ~ 25 researchers
  - Research in multimedia, teleconferencing, HCI, and information management



The "Memory Extender"

- Vannevar Bush, "As We May Think", The Atlantic Monthly, 1945
- Anticipated or inspired
  - Hypertext, Internet, World Wide Web, Wikipedia
  - MSR's MyLifeBits
- What about a corporate "Memex"?

Corporate Memory

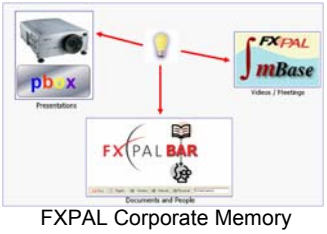
- What is it?
  - "… it allows a company to know what it knows" George Shultz, July 2004
- Without it, companies are not as efficient as they could be
  - Reuse instead of reinvention
  - Coordination instead of replication
- An important but very difficult problem

Challenges

- Information Capture
  - People won't add information if there is no immediate benefit
- Information Discovery
  - People don't search for things they don't know about
  - People can't spend all their time searching and filtering
- Multimedia Content
  - Documents alone are not enough
  - People, meetings, presentations

Vision

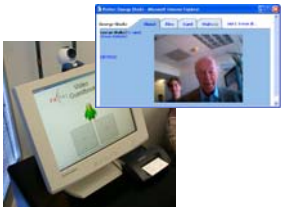
- Move *beyond* existing intranets
- Help organizations take better advantage of their intellectual capital
- Knowledge management without extra effort
- Weave capture and discovery into existing work practices



FXPAL Corporate Memory

Example Content @ FXPAL

PALWeb: Reports, Publications, Inventions



Video Guestbook: Visitor Information

PlasmaPoster: Web Pages

UbiSight: Meeting Capture

mBase: Video Database

Problems

- Useful content, but not usable as corporate memory
  - No content-based meeting retrieval
  - Users needed to manually locate relevant information

  Result: Past information often ignored

- Two new prototypes
  - ProjectorBox: autonomous presentation capture and indexing
  - PAL Bar: proactive contextual retrieval

  Result: A unified multimedia corporate memory

FXPAL Corporate Memory

- Introduction
  - Corporate Memory
- Seamless Information Capture
  - ProjectorBox
- Seamless Information Discovery
  - PAL Bar
- System Integration
  - Multimedia Corporate Memory

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ProjectorBox


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John Adcock

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Presentations

- They're everywhere
  - Business, education, government
- They're informative
  - An important communication medium
- They're nowhere
  - Pass through projectors everyday and are lost

Our Research

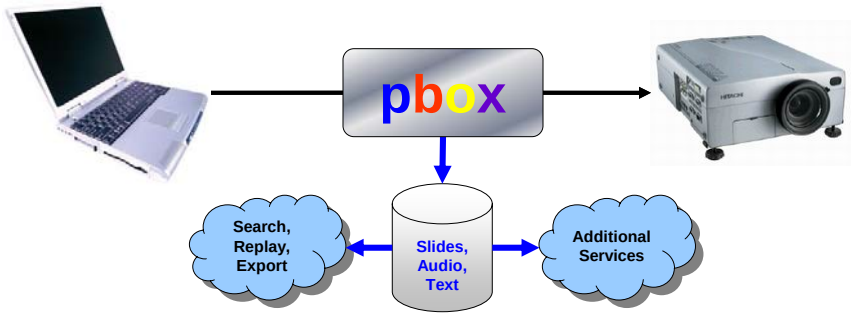
FX PAL

- Question
  - Why so few archives?
- Hypothesis
  - Cost, complexity, somebody always has to do something
- Our Research
  - What if we could create useful archives without <u>any</u> added burden on <u>anyone</u>?

ProjectorBox

FX PAL

A smart appliance for capturing, indexing, and managing presentation media



- Intercepts video between PCs and projectors
- Extracts text (OCR) and records audio (microphone)
- Automatically archives slides, text, and audio
- Simple UIs and APIs for accessing media

ProjectorBox

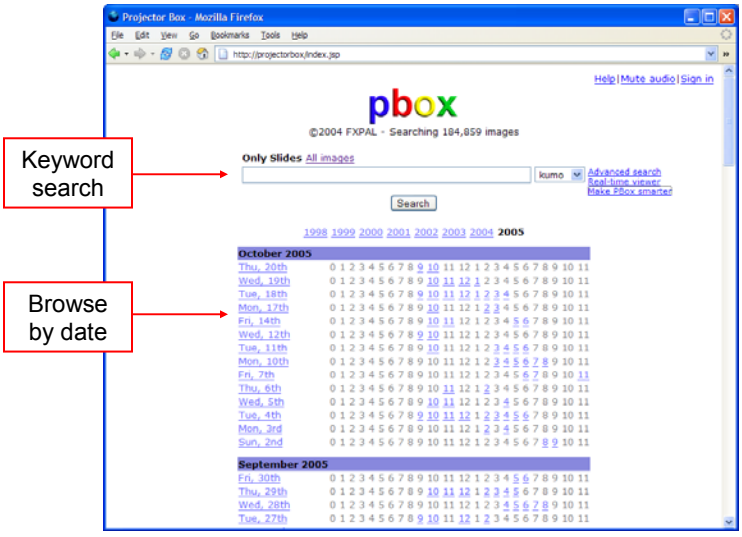
- Small PC-based appliance
  - Video capture card + splitter
  - Microphone
  - Web server

- Key features
  - Starts / stops recordings automatically
  - Easy search, skim, and export
  - No change to presentation practice
  - Works with any projector, PC, software

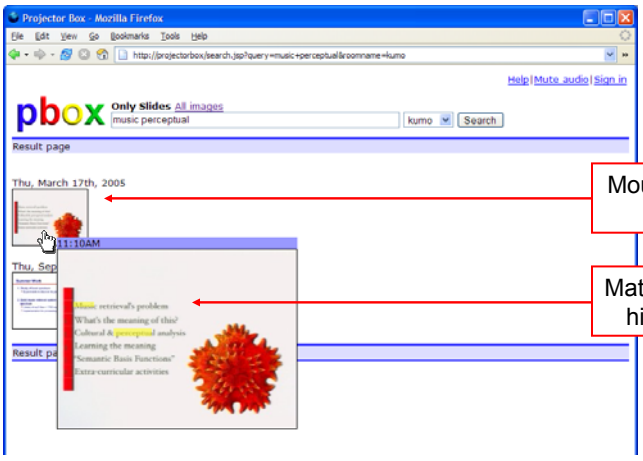
25¢

Demo

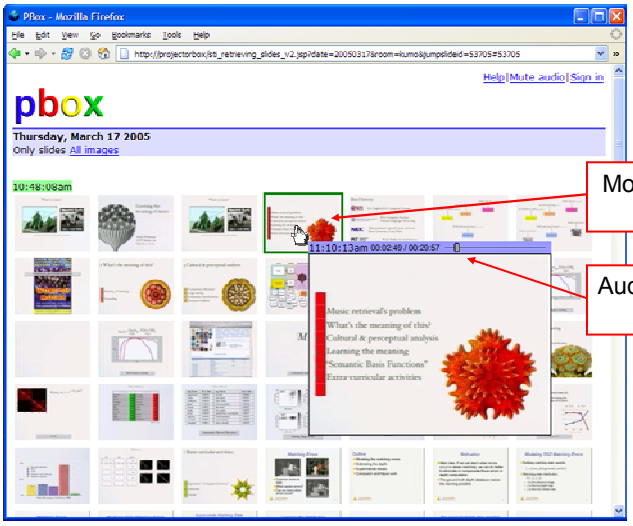
Search and Browse



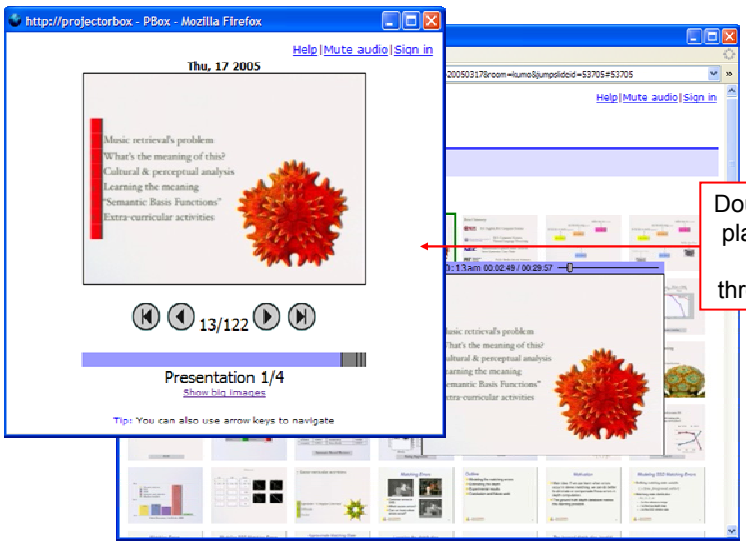
Search Results



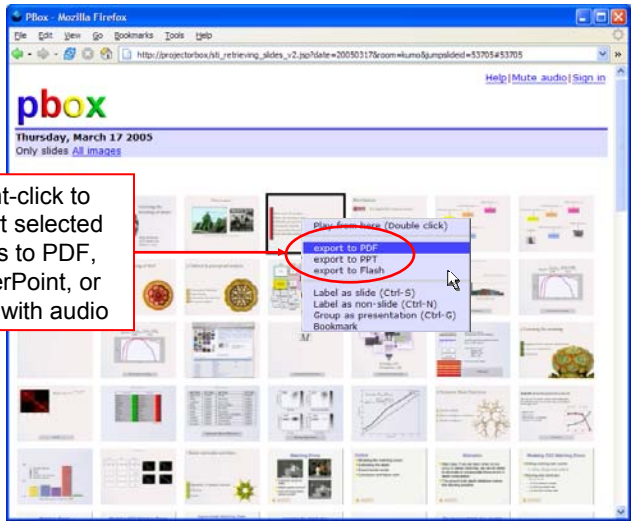
Skimming



Playback



Export



Right-click to export selected slides to PDF, PowerPoint, or Flash with audio

Real-time Slide Enhancement

Enriching presentations by **overlaying** additional information

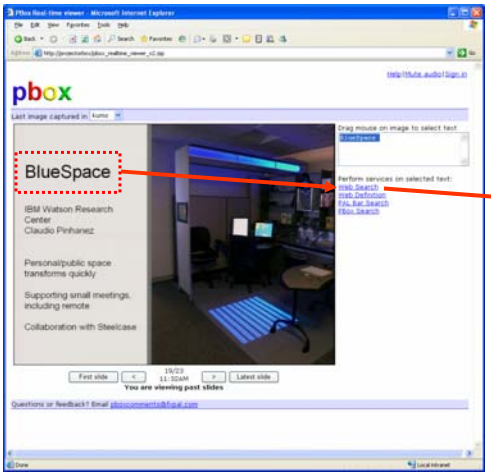
Users can mouse-over text for more information

Or overlays can be shown on multiple screens

Real-time Slide Enhancement

FX PAL

Enriching presentations by **linking to** additional information



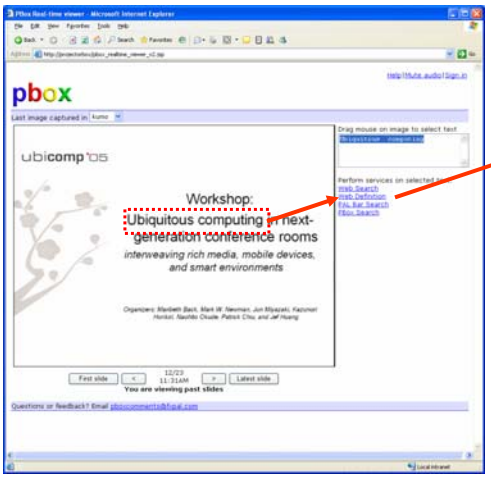
Users can drag mouse over image to select slide text and submit it to services (e.g., web search, definitions, translations)

Related links may also be proactively recommended

Real-time Slide Enhancement

FX PAL

Enriching presentations by **linking to** additional information



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Media Analysis Overview

- Image change detection
- Slide classification
  - Average font height from OCR
- Presentation segmentation
  - Time-based
- Storage cost
  - ~30 MB/hour (300 KB/slide, 350 KB/minute MP3 audio)
  - ~20 GB for all presentations at FXPAL in 2005
  - 10+ times lower than current MPEG4 video encoding at 1024x768

Deployments

- Corporate settings
  - FX Palo Alto Laboratory
    - Main conference room
    - Fixed room appliance
  - (Also @ Fuji Xerox)

- Educational settings
  - Naval Postgraduate School (NPS)
    - Multiple classrooms
    - Portable appliance, laptop capture client
  - (Also @ SFSU)

Study Summary

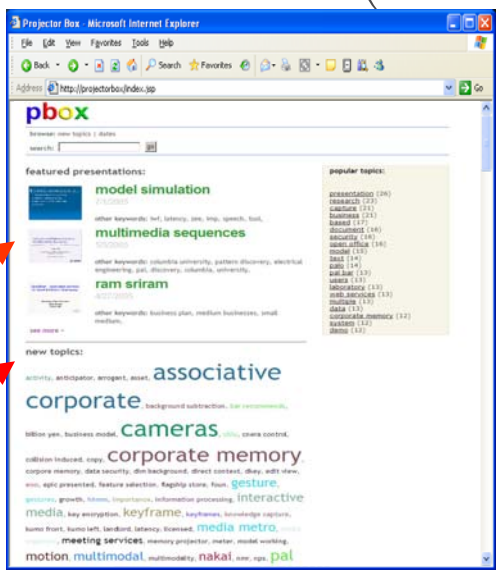
- Worked well across diverse settings
  - Primarily for viewing missed presentations
  - More attention, less notes
- Usage differences
  - Education: “Study aid”
  - Corporate: “What’s going on?”
- What’s missing?
  - Dynamic content (e.g., videos clips and demos)
  - Students missed whiteboard, not video
  - Search on audio
- Validated design
  - Searching important (in corporate setting)
  - Skimming important (both settings)
- New directions for corporate use
  - New content access interfaces
  - Privacy and security

New Directions

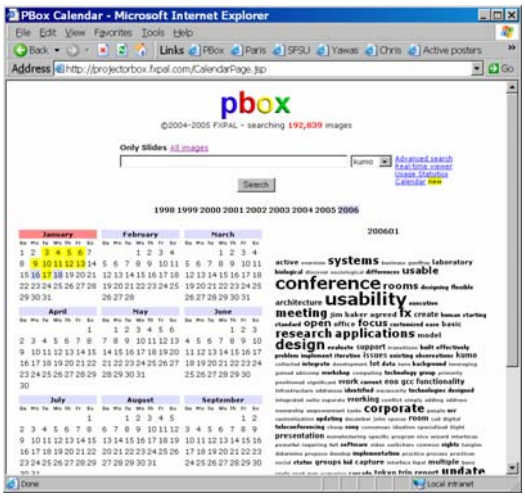
- New content access interfaces
- Privacy and security

Awareness and Discovery

- Users can easily search, browse, and skim to find what they are looking for
- But how can they stay aware of what's new and discover what's "interesting"?
  - E.g., recent talks by external visitors
  - E.g., "hot topics" that have increased in popularity recently



Exploration



Privacy and Security

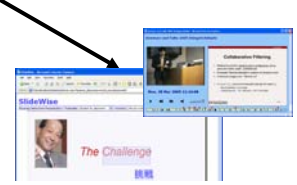
- Recording awareness and control
  - Interactive projection overlay
  - RGB cable interface
- Usable access control
  - Smart cards, biometrics?
- Alternative form factors
  - Next generation IC recorder?




Summary

Automatic archives
Completely unattended recording, indexing, and organization



Easy retrieval and reuse
Convenient search, skim, and export features

Services
Corporate memory, real-time slide enhancement

ProjectorBox team


Laurent Denoue


David Hilbert


John Adcock

Contributors


Daniel Billsus


Matt Cooper


Hanning Zhou


Jim Vaughan

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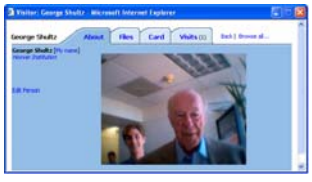
Corporate Memory Content @ FXPAL

Documents, web pages, bookmarks

ProjectorBox: Slide Capture

UbiSight: Video Capture

mBase: Video Database



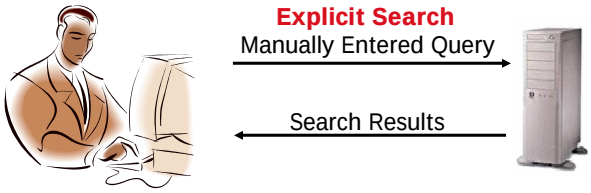
Guestbook: Visitor Information

PlasmaPoster: Web Pages

PAL Bar: Seamless Information Discovery

- **Seamless Information Discovery**
  - PAL Bar automatically finds corporate resources based on currently displayed web page or email
  - Proactive recommendations
  - No added effort

Explicit Search vs. Proactive Recommendations



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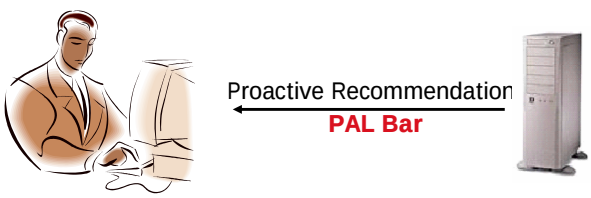

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PAL Bar Architecture

Server

- Database: Users, Content
- Server converts text to query
- Full-text search

Documents

Slides

Videos / Meetings

Visitors

PAL Bar Architecture

Text

Server

- Database: Users, Content
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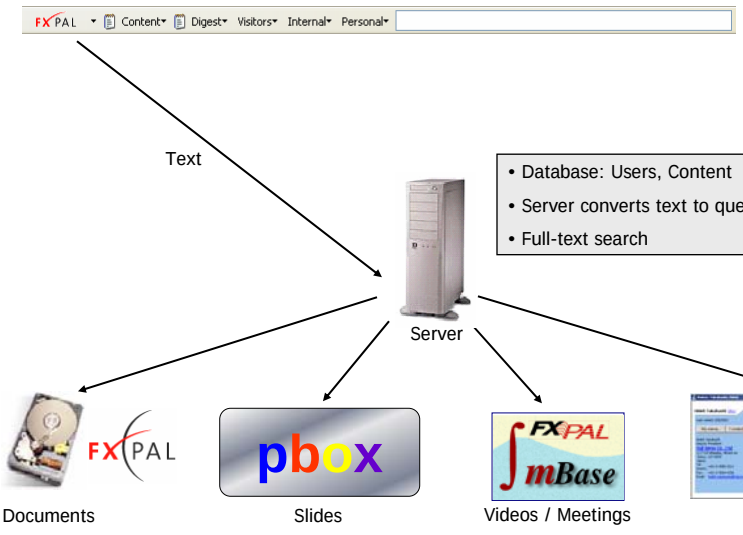
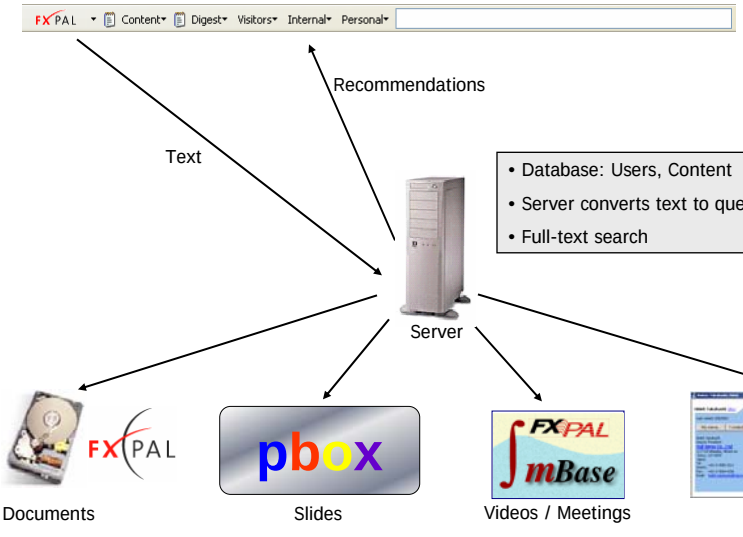
PAL Bar Architecture

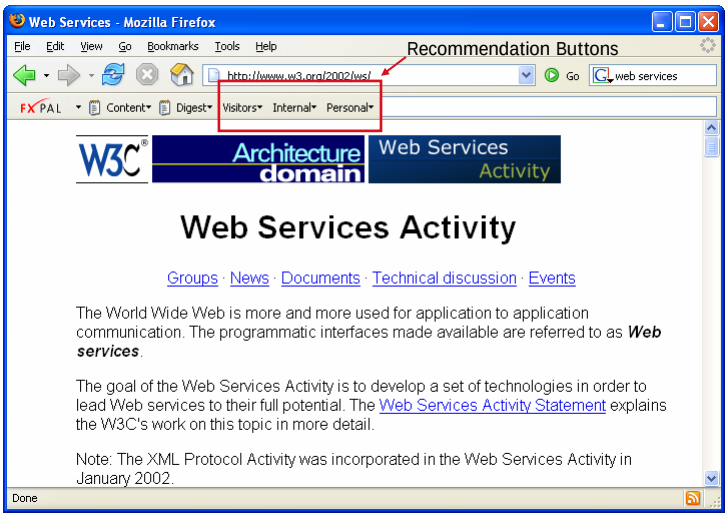


PAL Bar Architecture

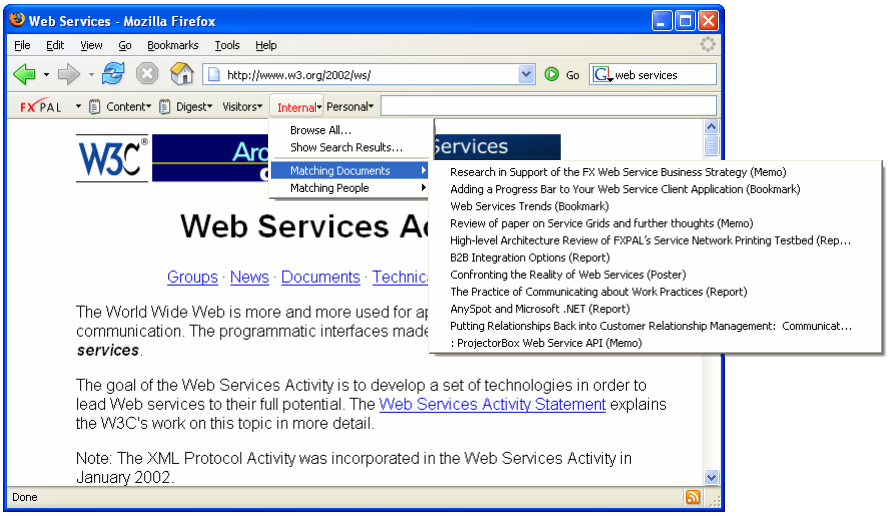


PAL Bar Recommendations

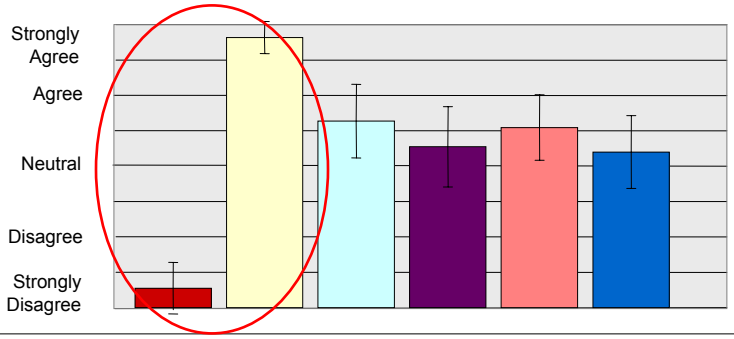
PAL Bar Recommendations



PAL Bar Recommendations



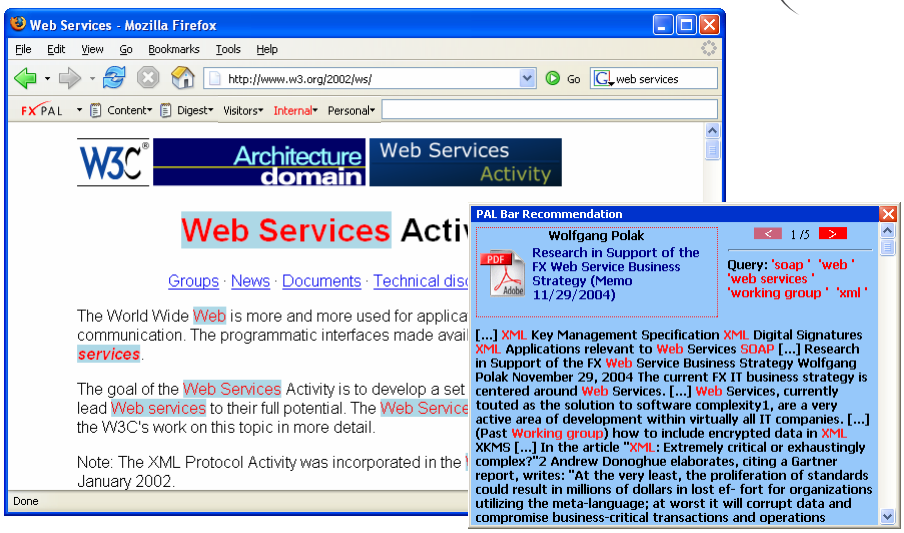
Initial User Study



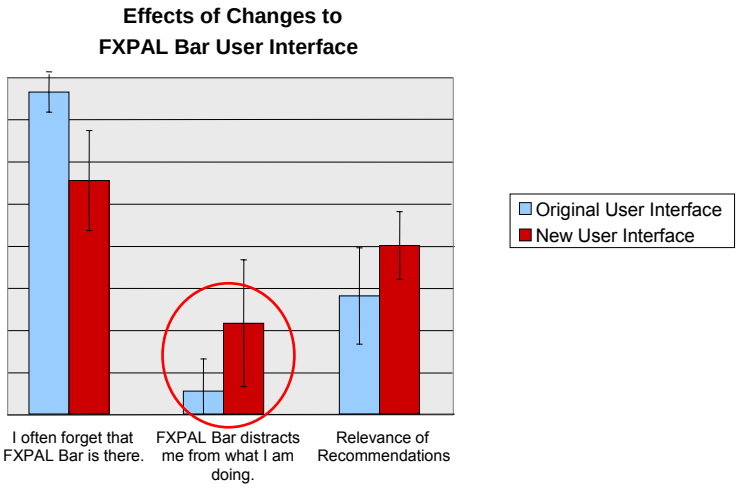
- PAL Bar distracts me from what I am doing.
- I often forget that PAL Bar is there.
- I would use PAL Bar more often if I could easily see why it had recommended certain things to me.
- I would use PAL Bar more often if it showed me a preview of recommended documents before I clicked on them.
- I would use PAL Bar more often if the recommendations were sorted into topic categories.
- I would provide feedback on the quality of my recommendations if it helped improve future recommendations.

Recommendation Windows

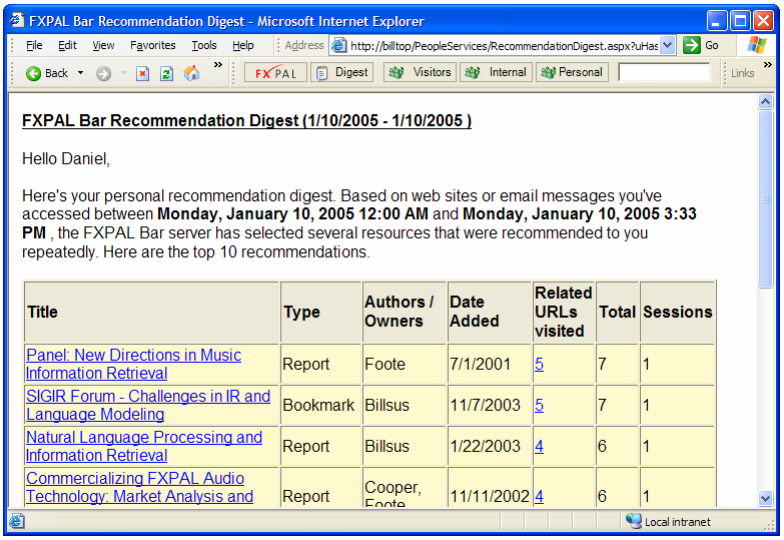
Recommendation Windows



Effects of UI Changes



Recommendation Digests



Demo

- Multimedia Content
  - PAL Bar can recommend presentations and show slides
  - Users can access corresponding UbiSight videos

Algorithm Overview

- Contact Information Matching
  - Heuristic name, address and email matching

- Document and Context Representation
  - tf-idf (term frequency – inverse document frequency)
  - Vector-Space representation
- Query Generation
  - Sorting terms by term weights to find weighted query terms
- Full-Text Search
  - Relational database with integrated full-text indexing (e.g. MS SQL Server or MySQL).
- Similarity Threshold
  - Retrieve candidate documents
  - Recommend to user if cosine similarity exceeds threshold

Query Generation

- Goal
  - Convert current document to query that retrieves relevant documents
- Corporate Memory Bias
  - Query should reflect current context **and** document collection
- Algorithm
  - Find set of words and word pairs that are frequently informative in document collection: *corporate topics*
  - Convert context to two term vectors: unigram and bigram term weights
  - Use term vectors and set of frequently informative words to construct weighted query

Query Generation

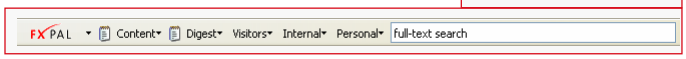
- Example
  - ISABOUT ("junk mail" weight (0.512), "mail filters" weight (0.439), "junk" weight (0.753), "filters" weight (0.424), "mail" weight (0.396))

Future Work

- Email integration
- Usable access control
- Mobile device capture and access
- Enterprise knowledge portal
- Text mining, e.g. trend discovery
- Visualizing corporate memory (topic clouds, etc)

Corporate Memory for Sales Support

Research Tool at FXPAL



Sales Support Tool at Kanagawa Xerox

Customization, configuration, minimal development

Summary

Documents

pbox

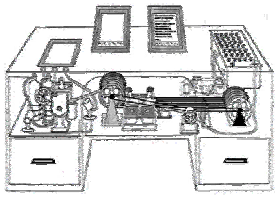
Slides

FXPAL mBase

Videos / Meetings

Visitors

One step closer to a "Corporate Memex"



Thank You

Daniel Billsus, Laurent Denoue, David Hilbert

{billsus, denoue, hilbert}@fxpal.com
http://www.fxpal.com/