MultiMatch - Providing Multilingual/Multimedia Access to Cultural Heritage Content

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Overview

Introduction
User requirements
Prototype system
User interface
Evaluation
Summary
The initial idea

Problem (back in 2005!)

The Web contains a wealth of cultural heritage (CH) information

- Web pages (e.g. Wikipedia)
- Digital Libraries managed by cultural institutions

But it’s hard to access this information

- dispersed and fragmented
- multiple formats and languages
- not all information publicly-accessible (e.g. archives)

Users are left to discover, interpret, and aggregate it
MultiMatch project (http://www.multimatch.org)

- enable users to explore and interact with online accessible cultural heritage content, across media types and language boundaries

European Union research project (FP6)

- Technology-enhanced Learning and Access to Cultural Heritage
- approx budget of 3.2 million Euros
- 11 European partners
- ran May 2006 – October 2008
Objectives

Develop a (vertical) search engine to provide targeted, enriched access to heterogeneous “cultural objects”

• across all media types and language boundaries
• supporting various user classes
• with aggregate views on complex task scenarios

Assist cultural heritage institutions in raising the visibility of their content (online)

• link from their content to related material online
Users and intended functionality

Target audience

- cultural heritage professionals (archivists, researchers, etc.)
- educational users (students, professors)
- general users (tourism, etc.)

Provide functionalities that allow users to

- search across languages (query translation)
- search for web pages, audio, video, and images simultaneously
- explore connections and relationships between creators, creations, time and place
The consortium

Academia
- Istituto di Scienza e Tecnologie dell’Informazione (ISTI-CNR)
- University of Sheffield (USFD)
- Dublin City University (DCU)
- University of Amsterdam (UvA)
- University of Geneva (UniGE)
- Universidad Nacional de Educación a Distancia (UNED)

Industry
- OCLC (Sheffield, UK)
- WIND Telecomunicazioni S.p.A. (WIND)

Cultural heritage providers
- Fratelli Alinari Istituto Edizioni Artistiche SpA (Alinari)
- Netherlands Institute for Sound and Vision (Sound and Vision)
- Biblioteca Virtual Miguel de Cervantes (UA)
Project activities

User-oriented activities
  • e.g. requirements gathering, interface design

Component development
  • multilingual indexing and retrieval
  • multimedia indexing and retrieval
  • information extraction and classification
  • user interface components

System architecture and component integration

Evaluation and field trials

Dissemination and exploitation
MultiMatch design process

Multi-technique “task-driven” design process
• developed to meet the needs of users carrying out prototypical tasks in the cultural heritage domain (scenarios)

Iterative design involving two main cycles (prototypes) with five stages
• needs assessment and task analysis
• preliminary design using low-fidelity prototypes
• design and development of interactive prototype
• heuristic evaluation and re-design
• user evaluation
Requirements gathering

Important aspect of user-centered design

- identify potential users and their information needs

Sources of input

- literature and past research
- analysis of related sites
- log file analysis
- user studies and interviews
  - cultural heritage professionals/experts
  - general users (e.g. tourism)

## Competitor analysis (56 sites)

<table>
<thead>
<tr>
<th>Functionality</th>
<th>Percent</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free text search</td>
<td>91%</td>
<td></td>
</tr>
<tr>
<td>Browse by category</td>
<td>71%</td>
<td><a href="http://www.archinform.net">www.archinform.net</a></td>
</tr>
<tr>
<td>Advanced search</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>News/Calendar</td>
<td>61%</td>
<td><a href="http://www.tate.org.uk">www.tate.org.uk</a></td>
</tr>
<tr>
<td>Registration/login</td>
<td>45%</td>
<td></td>
</tr>
<tr>
<td>Multilingual</td>
<td>34%</td>
<td><a href="http://www.louvre.fr">www.louvre.fr</a></td>
</tr>
<tr>
<td>Geographical search / Map</td>
<td>29%</td>
<td><a href="http://whc.unesco.org/en/map">http://whc.unesco.org/en/map</a></td>
</tr>
<tr>
<td>Shopping</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>Search within results / See &quot;more like this&quot;</td>
<td>29%</td>
<td><a href="http://www.fotolia.com">www.fotolia.com</a></td>
</tr>
<tr>
<td>Ability to segregate multimedia results by type (if applicable)</td>
<td>29%</td>
<td><a href="http://www.archive.org">www.archive.org</a></td>
</tr>
<tr>
<td>Timeline / Search by time</td>
<td>21%</td>
<td><a href="http://www.birth-of-tv.org">www.birth-of-tv.org</a></td>
</tr>
<tr>
<td>Change results layout (order by..)</td>
<td>21%</td>
<td><a href="http://www.artandarchitecture.co.uk">www.artandarchitecture.co.uk</a></td>
</tr>
<tr>
<td>Hierarchical browse</td>
<td>20%</td>
<td><a href="http://www.staffspasttrack.org.uk/">http://www.staffspasttrack.org.uk/</a></td>
</tr>
<tr>
<td>Sitemap</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Controlled vocabulary</td>
<td>9%</td>
<td><a href="http://www.tate.org.uk">www.tate.org.uk</a></td>
</tr>
<tr>
<td>Colour/layout search</td>
<td>7%</td>
<td><a href="http://www.hermitagemuseum.org">www.hermitagemuseum.org</a></td>
</tr>
<tr>
<td>Query translation</td>
<td>5%</td>
<td><a href="http://www.fotolia.com">www.fotolia.com</a></td>
</tr>
<tr>
<td>Faceted browsing</td>
<td>3%</td>
<td><a href="http://orange.sims.berkeley.edu/">http://orange.sims.berkeley.edu/</a></td>
</tr>
</tbody>
</table>

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11. [http://orange.sims.berkeley.edu](http://orange.sims.berkeley.edu)
# Log file analysis

## Categorisation of top 100 most frequent queries

<table>
<thead>
<tr>
<th>Category</th>
<th>Site</th>
<th>Named Entities</th>
<th>Subject</th>
<th>Place</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art</td>
<td>Tate Online</td>
<td>63</td>
<td>36</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>General CH</td>
<td>WIND</td>
<td>66</td>
<td>24</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Literature</td>
<td>Cervantes</td>
<td>73</td>
<td>24</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Photography</td>
<td>Alinari</td>
<td>33</td>
<td>29</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>Photography</td>
<td>St Andrews</td>
<td>10</td>
<td>25</td>
<td>64</td>
<td>0</td>
</tr>
</tbody>
</table>

**Example Queries:** Van Gogh, Surrealism, Florence, Middle Ages

Useful in design, component testing and user task-based user evaluation
User studies and interviews

100 interviews carried out with ‘expert’ users
Also carried out more in-depth studies
• focus groups and interviews (15 people)
• with educational users, video professionals and image professionals

Information gained about
• tasks that users perform (typical and challenging)
• multilingual and multimedia requirements
• examples of use and suggestions for improvement

Also carried out studies with ‘general’ users
Main findings

Reliance on Internet search for everyday work
  • depend largely on general-purpose search engines (although often unsatisfied with results)

Work includes
  • finding material for presentations/clients, fact-checking details, background research

Multiple sources searched
  • internal databases and archives
  • external sites on the Web
Search characteristics

Reinforced previous findings in CH domain

- names, places, dates, titles, subjects

<table>
<thead>
<tr>
<th>Percentage of users Interacting with media type</th>
<th>Text</th>
<th>Images</th>
<th>Video</th>
<th>Audio</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>100%</td>
<td>87%</td>
<td>47%</td>
<td>7%</td>
</tr>
</tbody>
</table>
### Example scenarios

<table>
<thead>
<tr>
<th>User type</th>
<th>Typical task</th>
<th>Media and languages involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH professional</td>
<td>Searching for video footage on Pier Paolo Pasolini, needs to gather background information on who he was</td>
<td>Text, Images, Video English, Dutch</td>
</tr>
<tr>
<td>CH professional</td>
<td>Looking for images of (non-famous) people drinking coffee – images that capture a certain emotion</td>
<td>Images English, Italian</td>
</tr>
<tr>
<td>Academic</td>
<td>Preparing a presentation on Don Quixote and how it has influenced the arts</td>
<td>Text, Images, Video, Audio (?) English only</td>
</tr>
<tr>
<td>Cultural tourist/ general user</td>
<td>Planning a visit to Turin, wants to know about museums to visit, what can see whilst there</td>
<td>Text, Images, Audio (podcasts) English, Italian</td>
</tr>
</tbody>
</table>
Design requirements

Classification and aggregation of content
- enrich the associated metadata (for creators and creations)
- enable cross-document and cross-collection linking

Enhanced multilingual support
- query translation (MT and dictionary-based translation)
- document translation (e.g. translated snippets and key terms)

Enhanced multimedia retrieval
- still images based on fusing visual features and text
- audio content based on speech transcripts and metadata
- video content based on text and visual queries and keyframe-based video browsing

Faceted search/browse (semantic navigation)
- facets related to creators and creations (e.g. date, place)
- presentation of creator/creation in context (e.g. timeline, map)
Prototype system

Two prototype systems developed during project
- Service Orientated Architecture (SOA)
- Four independent but co-operating sub-systems
Prototype

**GUls**
- Overview
- Images
- Video
- Audio
- Creators
- Text (web and archives)
- RSS

**APIs (clients)**
- General Search
- Specialized search (images, video, text, RSS creators)
- Translation
- Query Expansion
- Query Suggestion
- Faceted Browser

**Web Services**
- Search
- Translation
- Query Expansion
- Faceted browser
- Query Suggestion
Content indexed

Selected content used for prototype systems

- cultural heritage sites
- educational sites related to CH
- encyclopaedic sources
- IPR-protected CH material
- OAI compliant resources (e.g. TEL)
- dynamic content (RSS feeds)

Representative cross-section of CH information

- multimodal, multilingual, dynamic and static, multiple sources
Metadata modeling and interoperability

Defined a conceptual reference framework suitable for cultural heritage content

- metadata schema and data model
- thesauri for artists names and descriptions, geospatial information (Getty)
- mapping between CH providers and common data model

Simple to use (interoperability)
Suitable for automatic population

First Analysis of Metadata in the Cultural Heritage Domain, Deliverable D2.1
Data model

Metadata Schema and Mapping Evaluation and Revision, Deliverable D2.2.2
http://www.multimatch.org/docs/publicdels/D2.2.2.pdf
Ingesting content

act Metadata + Digital Artifact

Native Metadata + Digital Object

Metadata Transformation

Metadata + Digital Object

Translation

Metadata + Digital Object

Classification

Metadata + Digital Object

Summarisation

Metadata + Digital Object

Term Cloud Generation

Metadata + Digital Object

MultiMatch Object for Storage

Metadata + Digital Object

Metadata + Digital Object

Metadata + Digital Object

Metadata + Digital Object
Information extraction

Topical Web crawling
- selection of content *within* specific sites (e.g. CH in Wikipedia)
- dynamic data (e.g. RSS feeds)

Automatic extraction of indexing features for all media (text, speech, images, video) and crawled data

Development of algorithms for classification and information extraction
- creators, type/genre, subject, place/time, art objects/works

Automatic linking of documents
- link related documents by content (inter-doc linking)
- detect terms that should be marked as anchor tags within a text and identifying target pages the terms should be linked to (intra-doc)
Example – B&G videos
Multilingual support

Provide system with monolingual and multilingual search functionalities

- English, Dutch, Italian, Spanish, German and Polish

Provide effective translation strategies

- multilingual dictionaries
- machine translation
- combined hybrid translation methods
- translation uses domain-specific dictionaries

Provide expansion services

- relevance and pseudo relevance feedback

Multilingual IR – query translation

Original Query

Query translation Service

English Query
German Query
Spanish Query
Italian Query
Dutch Query
Polish Query

Separated Index

English Index
German Index
Spanish Index
Italian Index
Dutch Index
Polish Index

Separated Result

English Result
German Result
Spanish Result
Italian Result
Dutch Result
Polish Result

Collection

English Collection
German Collection
Spanish Collection
Italian Collection
Dutch Collection
Polish Collection

Translation Service

Final Ranked List

Result Merging
Multilingual IR – document translation

- Original Query
  - Query translation Service
  - English Query
  - Translated Query

- English Collection
- German Collection
- Spanish Collection
- Italian Collection
- Dutch Collection
- Polish Collection

- Document translation Service
  - Translated Collection
    - English Collection
    - English Collection
    - English Collection
    - English Collection
    - English Collection

- English Index
  - One Joint Index

- English IR
- Final Ranked List
Data to manage is varied, including different formats plain text, XML documents, colour histograms, etc.

All content in Multimatch is enriched with metadata (and unique identifier) and stored in repository allows these documents to be optimally searched

Supported by MILOS
  • Multimedia Content Management System for Digital Library Applications (http://milos.isti.cnr.it/)

  Lucene plug-in for full-text searches
  fusion plug-in for multi-modal searches
  entity disambiguator
  MPEG-7 index plug-in
Multimedia support

Audio streams (e.g. podcasts)
- automatic speech recognition to generate transcript (searchable)
- segmented (based on theme not just energy levels)

Video streams
- metadata is translated and searchable
- videos are segmented (shot boundary detection)
- keyframes extracted from segments
- used Real Helix streaming video server for playback

Still images
- low-level visual features extracted and indexed
- accompanying text also indexed allowing multimodal search and browse
User interface (UI)

Default/overview search
• no assumptions made about user and their query
• access to general interactive features

Set of specialised search interfaces
• allow users to query specific search services
• provide access to advanced features

Search levels
• default and advanced modes

Allow users to customise interface
• e.g. specify interface language
Architecture

Interface implemented using the GWT (UNED)

- common protocol developed (based on URL messaging) to communicate between GUIs
- provided a library of core components (widgets)
- templates provided for writing new applications

Additional work involved in creating the interface

- creating APIs (client services) which interact with MultiMatch web services and the GUI
- dynamic parsing of metadata structures to extract required information for individual interfaces

Interfaces developed as standalone applications (GUIs)
Overview UI

Common entry point for (mainly) general users
  • starting point for specialised interfaces
  • results aggregated across sources and media types

Users can add/remove results windows
  • Web, Archives, Video, Image, Audio, Creators, RSS
  • use of “infinite” scrolling bar
  • links to metadata, term clouds, snippets and related terms

Users can filter language of results

New functionality for cross-language support
  • use of combined MT and dictionary service
  • ability to select/de-select alternative translations
  • search all languages (English interlingua)
  • localisation (Dutch, Spanish and German)
Simple functionality to access visual material
  • assume that users begin with verbalised query
Results include
  • image (thumbnail), title and URN
Users can also view
  • metadata, term cloud, snippet, related terms, similar images
Find similar images (“more like this”) function
  • images with similar visual content
  • images with similar visual content and semantic content matching the query (uses fusion service)
Audio UI

Generic playback for any web browser

- JavaScript-based wrapper provided playback controls independent of audio file type

Segments in transcribed audio which match query terms

Two approaches for presenting transcripts
Transcript presentation

Transcript browse
- Clickable audio segments
- Transcript viewable

Term cloud browse
- Clickable audio segments
- Term cloud items can be arranged alphabetically or by time
Results of audio evaluation

General users (12) asked to perform 4 search tasks to evaluate presentation techniques

Main findings
• slight preference for transcript browse (terms sometimes deemed as not relevant in term clouds)
• no preference given to how terms ordered in term cloud browse (alphabetically or temporally)
• many users interacted directly with the progress bar

User’s comments
• could only jump to first occurrence of term in term cloud browser
• ideal speech data presentation technique would be combination of verbatim transcript display together with query-sensitive term clouds
Video UI

Similar look-and-feel to audio UI
- view metadata, term clouds, snippets and related terms

Initial search queries video metadata
- also provided a search within results (inter-video search) function based on transcripts (requested by video experts)

For selected video users can
- playback video from various starting points
- view keyframes and associated transcript text
- search for (and playback) specific keyframe segments containing keywords

# Inter-video search

**Inter-document text search for the 10 videos on this page**

<table>
<thead>
<tr>
<th>Frequency of occurrence for the query item: &quot;schilderen&quot;</th>
<th>Document 1: Picture STORM &quot;1 times</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Document 2: IN FORMER DAYS &amp; THIS WAY &quot;1 times</td>
</tr>
<tr>
<td></td>
<td>Document 3: CLOSE - UP &quot;1 times</td>
</tr>
<tr>
<td></td>
<td>Document 4: Picture STORM &quot;0 times</td>
</tr>
<tr>
<td></td>
<td>Document 5: WHY DO I HAVE READ THIS &quot;0 times</td>
</tr>
<tr>
<td></td>
<td>Document 6: WIM QUIST, ARCHITECT &quot;0 times</td>
</tr>
<tr>
<td></td>
<td>Document 7: Picture STORM &quot;2 times</td>
</tr>
</tbody>
</table>

Select video from drop-down list to display its transcript.

- Document 1: Picture STORM
- Document 2: IN FORMER DAYS & THIS WAY
- Document 3: CLOSE - UP
- Document 4: Picture STORM
- Document 5: WHY DO I HAVE READ THIS?
- Document 6: WIM QUIST, ARCHITECT
- Document 7: Picture STORM
- Document 8: Picture STORM
- Document 9: SKY CONCERNING THE NETHERLANDS
- Document 10: ZEMBLA

The frequency of occurrence for the query item "schilderen" is as follows:

- Document 1: Picture STORM - 1 time
- Document 2: IN FORMER DAYS & THIS WAY - 1 time
- Document 3: CLOSE - UP - 1 time
- Document 4: Picture STORM - 0 times
- Document 5: WHY DO I HAVE READ THIS? - 0 times
- Document 6: WIM QUIST, ARCHITECT - 0 times
- Document 7: Picture STORM - 2 times

The video player is displayed with a realPlayer logo and a RealPlayer icon.
Video playback and transcript search

Click on any key frame to play video from that point. If playback stalls, note the timestamp information provided (text box above). Stop playback via manual controls and then jump to selected point by pressing "Play" button and then adjusting slider on progress bar.
Results of Video Evaluation

User study at B&G in May 2008 (10 users)
  • examine usability and efficiency of video UI with professional users
  • reported in D7.3 (Evaluation of second prototype)

Overall positive quantitative results and qualitative feedback
  • task of selecting relevant clips from video document aided by shot-aligned speech and keyframes

Highlighted problems with ASR accuracy and multilingual speech
Creators UI

Utilisation of MultiMatch metadata schema and annotation
• provides biographical information and cross-referencing

Provides users with access to biographical information related to particular artist
• birth/death places/dates, nationality, alternative names, description
• query suggestions (names of artists)
• list of creations by selected artist

Link to page for selected artist displaying
• related creations (images and videos)
• related web pages
• “More like this” for images (derived from image UI)
New MultiMatch object which is indexed

1 - Picasso, Pablo (1881–1973)

Birth Place: Málaga (Málaga province, Andalusia, Spain)

Death Place: Mougins (Alpes-Maritimes, Provence-Alpes-Côte d'Azur, France)

Nationality: Spanish;

Brief Description: Creator decorative artist ceramicist painter artist writer sculptor draftsman printmaker

Alternative names: Picasso, Pablo; Ruiz Picasso, Pablo; Picasso, Pablo Ruiz; Picasso, Pablo Ruíz; Picasso, Pablo Ruiz; Picasso, Pablo; Ruiz Picasso, Pablo; Picasso, Pablo Ruiz; Picasso, Pablo; Picasso, Pablo Ruyis; Pablo Picasso, Pablo; Picasso, Pablo; Diego José Francisco de Paula Juan Nepomuceno Crispín Crispiniano de la Santísima Trinidad Ruiz Blasco; Ruys Picasso, Pablo; Pablo Picasso; Picasso, Pablo; Picasso, Pablo Ruiz;

Source: Allinari;

Related Creations: 8

Related Webpages: 10

show description - 9

Painting by Pablo Picasso entitled 'Girl on the Ball', in the Pushkin Museum in Moscow. A man with powerful limbs is seated before a young Acrobat shown balancing on a ball. In the background, a woman with an infant in her arms and a child at her side can be seen. "I Amal Description" Painting by Pablo Picasso entitled 'Girl on the Ball', in the Pushkin Museum in Moscow. A man with powerful limbs is seated before a young Acrobat shown balancing on a ball. In the background, a woman with an infant in her arms and a child at her side can be seen. "I Amal Description" Painting by Pablo Picasso entitled 'Girl on the Ball', in the Pushkin Museum in Moscow. A man with powerful limbs is seated before a young Acrobat shown balancing on a ball. In the background, a woman with an infant in her arms and a child at her side can be seen. "I Amal Description" Painting by Pablo Picasso entitled 'Girl on the Ball', in the Pushkin Museum in Moscow. 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Evaluation

Internal testing carried out during development
• held a number of “evaluation days”

Some components evaluated individually
• audio UI and video UI
• faceted browsing and focused browsing

Overall prototype tested in user evaluation and field trials
• task-based evaluation with 55 users (3 user groups)
• low satisfaction with video interface
  high satisfaction for multilingual functionalities

Further user evaluations are planned
User evaluation

Comparison with other tools
Cultural Heritage Users

Would use MM in your work
MM is more valuable than tools you are using
Are metadata provided detailed

Not at all (1)
2
3
4
5
6
Very likely (7)

0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0
Field trials
Example research

Summary

Specialised search engine focused on cultural heritage domain
  • higher quality (and authoritativeness) of results compared to general Web search engine
  • include content from cultural heritage institutions

Reduces time and effort spent searching
  • users don’t have to perform same search on multiple sites (i.e. like metasearch)

Ability to broaden search
  • search across languages, sources and media types
You want to find out more ….


