

InformaticaUmanistica

Introduzione alle Biblioteche Digitali



UNIVERSITÀ DI PISA

Sommario [1/2]

◆ Cenni storici

- Vannevar Bush
- Dalle Biblioteche ai Cataloghi Automatizzati
- Gli OPAC accessibili via Web
- Le Biblioteche Digitali

◆ Cos'è una Biblioteca Digitale

- Definizione
- Confronto tra BD e database, sistemi IR, WWW, biblioteca tradizionale
- Vantaggi delle BD
- Alcuni esempi di Biblioteche Digitali

Sommario [2/2]

- ◆ **Cosa ha permesso la nascita delle Biblioteche Digitali**
 - Evoluzioni tecnologiche
- ◆ **Tipologie di Biblioteche Digitali**
 - Biblioteche Pubbliche e Biblioteche Specializzate
 - Tipi di documenti trattati
 - Libri
 - Documenti testuali
 - Immagini
 - Audio/video
 -

Gestione del video

- ◆ **Perchè è importante poter gestire biblioteche digitali di audiovisivi**
- ◆ **Caratteristiche specifiche dell'audio/video**
- ◆ **Applicazioni delle biblioteche digitali audio/video**
- ◆ **Alcuni esempi di biblioteche digitali audio/video**

The importance of video

- ◆ **Video can be considered today the primary information and communication channel, due to**
 - Richness in information contained
 - Appeal

- ◆ **Video libraries will become essential in many application fields**
 - Personal information
 - Distance learning
 - Telemedicine
 -

Video characteristics

◆ High video production vs print production

- TV stations produce 50 Million hours of video per year (25,000 TB)
- Newspapers and periodicals produce less than 200 TB of data per year

◆ Storage and transmission problems

- Video is usually compressed

◆ Richness in content

- Difficulties in automatic extraction of content description

Services of A/V Digital Libraries

- ◆ **Digital Video Libraries are more complex than traditional DLs; they require the integration of several specialized technologies**
- ◆ **They offer the same services of text digital libraries**
- ◆ **Specific characteristics of Indexing and retrieval services**
 - Indexing based on the integration of different technologies for the automatic feature extraction
 - Integration of manual and automatic indexing
 - Retrieval based on different video features

Characteristics of an Audio/Video DL

The need of A/V DLs

- ◆ **Nowadays, video is present in many situations**
 - TV broadcasting
 - Professional applications, such as medicine, journalism, advertising, education, training, surveillance, etc.
 - Movies
 - Historical videos
 - Personal videos
- ◆ **The combination of audio and video is a very powerful communication channel**
 - approximately 50% of what is seen and heard simultaneously is retained

Advantages of A/V DLs

- ◆ **Most of the video material produced is used only once, due to the difficulty to archive it, to protect and to retrieve.**
- ◆ **A large video library of distributed and network searchable videos would enable**
 - Preservation of precious and expensive material
 - Reduction of production costs for new videos, through the reuse of existing material
 - Diffusion of knowledge

In general, it will enable the access to information that could have been lost.

A/V vs traditional DLs [1/2]

◆ Library creation

- Traditional DLs, contain text documents
 - ➔ Library creation requires automatic acquisition of text, extraction of document content, and indexing
 - ➔ This process is well known and many different techniques have been developed
- Video is extremely rich in “content” but
 - ➔ the indexing of video content is difficult, expensive, and extremely dependent from the user and the application
 - ➔ A possible approach consists in an appropriate integration of automatic content extraction (e.g. speech recognition, image analysis, etc.) and manual indexing

A/V vs traditional DLs [2/2]

◆ Library exploration

- Traditional DLs, contain text documents
 - ➔ **Library exploration requires simple interfaces to formulate queries on free text and document metadata.**
- Video libraries should permit
 - ➔ **To formulate queries on many different “dimensions”**
 - **Text, as extracted from speech and captions**
 - **Images extracted as key frames**
 - **Motion information**
 - **Other features automatically extracted**
 - **Metadata provided manually**

Applications of Audio/Video DL

Who may use A/V DLs?

◆ We consider four main categories

- Large companies
 - Large corporations that may use Digital Video for their internal business, for advertising, promotion, etc.
- Media and entertainment
 - The most traditional area. Video is one of the key assets.
- Education
 - Video recording of courses
 - Video used as course material
- Others
 - Health and medicine
 - Government
 - Surveillance
 - Etc.

Large companies

- ◆ **Audio/video digital libraries are used for**
 - Sales
 - Product launches
 - Marketing
 - Relation with investors
 - Product design (acquisition and analysis of customer's needs)
 - Support for online sales
 - Video archives for internal use
 - Special services for customers, such as web access to specialized video archives, e.g.
 - ➔ **News**
 - ➔ **Economic information**
 - ➔ **Products**
 - ➔ **Materials**
 - ➔ **Etc.**

Media & Entertainment [1/3]

◆ Broadcasting companies

- Many broadcasters are creating and distributing video programs on the web. A video archive is very helpful to them to add a new service for accessing old video material.

- Examples:

- **ABC News**

- **Mediaset**

- **RAI**

- Archive of old programs
- Archive of daily programs
- Additional material w.r.t. tv programs

Media & Entertainment [2/3]

◆ Video archives

- Many national and private organizations own old video material. The digitalization and archiving of this material is beneficial for content owners (for example, they can promote the use of their material) and for users belonging to different categories: e.g. professional users (that need the material to produce their video programs) or researchers or general public.
- Examples:
 - [Istituto Luce](#)

Media & Entertainment [3/3]

◆ **Movie production companies**

- Many large movie production companies own a large amount of video material, composed of the films and of related material, such as cuts not used in the final film version, interview, video trials, etc. This material is very helpful for many purposes, from the production of DVD version of the film up to the critical study of the video. Providing access to the general public of this material is also a powerful promotion and advertising channel.
- Examples:
 - [MGM](#)
 - [20th Century Fox](#)

Education

◆ Digital video used for different purposes

- Promotion and advertising
 - ➔ Online preview of training content
- Store and distribute the video courses
 - ➔ Remote access of the courses
 - ➔ Keep track of classroom discussion
- Used as course material
 - ➔ Delivery of video clips to students, either online or in the classroom
 - ➔ From remote sites provide students and teachers with on-demand, searchable access to whole programs and video clips
 - ➔ Free search and access to the video library can be used by students to find answers to specific questions, to study in depth some topics, etc.
- Production of new courses
 - ➔ Improve the course production procedures, allowing teachers and producers to remotely access the video library
- Examples:
 - ➔ Princeton University
 - ➔ Harvard Business School
 - ➔ University of Arizona

Other Applications [1/2]

◆ Health and medicine

- Health and social care info to the general public
- Information to physicians for special purpose medical procedures
- Training

Other Applications [2/2]

◆ Government

- Enhancement of the governmental decision making process, by recording and archiving of public meetings and discussion.

◆ Surveillance

- A large amount of video is produced for surveillance purposes.
 - ➔ **Required automatic video analysis**
 - ➔ **Archiving for successive search**

The characteristics of Digital video

Types of data managed

- ◆ **A digital video is composed of a sequence of frames plus possibly an audio track.**
- ◆ **In general, it is possible to view an audio/video document from different perspectives**
 - The audio part can be separated into
 - ➔ **Speech**
 - ➔ **Sound**
 - Sequence of frames (video shot and sequence)
 - Single frames as images
- ◆ **From all of them is possible to extract information that can be used for indexing and retrieval purposes**

Digital video characteristics

- ◆ **Sequence of frames with a certain frame rate**
 - NTSC 30 frames/sec, PAL 25 f/s, HDTV 60 f/s
 - Minimal change between frames
- ◆ **Single frames resolution**
 - 768 x 576 PAL, 720 x 480 NTSC
- ◆ **Uncompressed video requires high storage space and bandwidth**
 - For example, one second of uncompressed PAL video requires
 $768 \times 576 \times 16 \times 25 \sim 172$ MByte

Digital video storage and transmission [1/3]

- ◆ **The high storage requirements of video imposes the adoption of compression techniques.**
- ◆ **High compression rates are possible with video signals, due to the following reasons:**
 - Spatial correlation: correlation among neighboring pixels
 - Temporal correlation: correlation among pixels in different frames
 - A significant part of video data is not perceived

Digital video storage and transmission [2/3]

- ◆ **Compression can be divided in two broad categories**
 - **Lossless compression**, that allows one to compress decompress video without any degradation
 - **Lossless compression provides low compression factors**
 - **An example of lossless compression is MJPEG, where each frame is compressed using the JPEG format**
 - **Examples of lossless coding techniques are run-length coding, Huffman coding**

Digital video storage and transmission [3/3]

- **Lossy compression**, where the complete cycle of compression and decompression introduces some degradation of the original video
 - **Lossy compression allows to obtain high compression factors**
 - **Examples are the MPEG compression family (MPEG1, MPEG2)**
 - **Example of lossy coding is DPCM**
 - **DPCM compares adjacent pixels and stores only their difference**

MPEG

◆ MPEG (Moving Pictures Experts Groups)

- MPEG1 has a bit-rate up to 1.5Mb/sec
 - Designed for storage and retrieval of VHS quality video on CD-ROM
- MPEG2 Designed for broadcast video quality
 - Bit rate: 2Mbps or higher
 - Used for DVD, cable TV, etc.
- MPEG4 is object-based, multi stream
 - Variable bit-rates, from <64 kbps, up to 4Mbps and more (in the future)

MPEG-1 [1/2]

◆ Compression based on intra-frame and inter-frame encoding

◆ Intra-frame coding

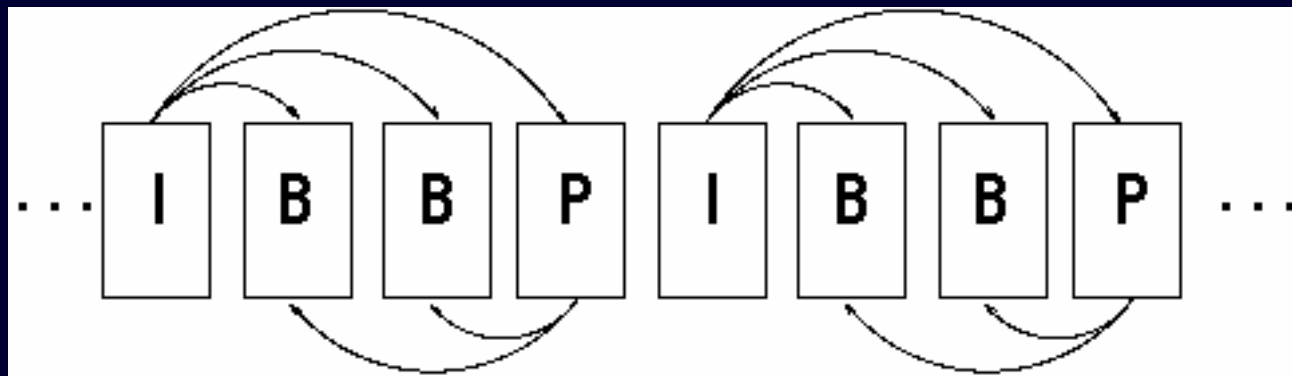
- Each frame is subject to compression
- Uses DCT compression schema

◆ Inter-frame coding

- Exploits temporal redundancy
- Predictive coding
 - current picture is modeled as a transformation of picture at some previous time
- Interpolative coding
 - Uses past and future pictures for reference

MPEG-1 [2/2]

- ◆ **MPEG uses three types of frame coding**
 - I frames: intra-frame coding
 - Moderate compression
 - Access points for random access
 - P frames: predictive-coded frames
 - Coded with reference to I or P frames
 - B frames: bi-directionally predictive coded
 - Coded using previous/next I and P frames
 - High compression



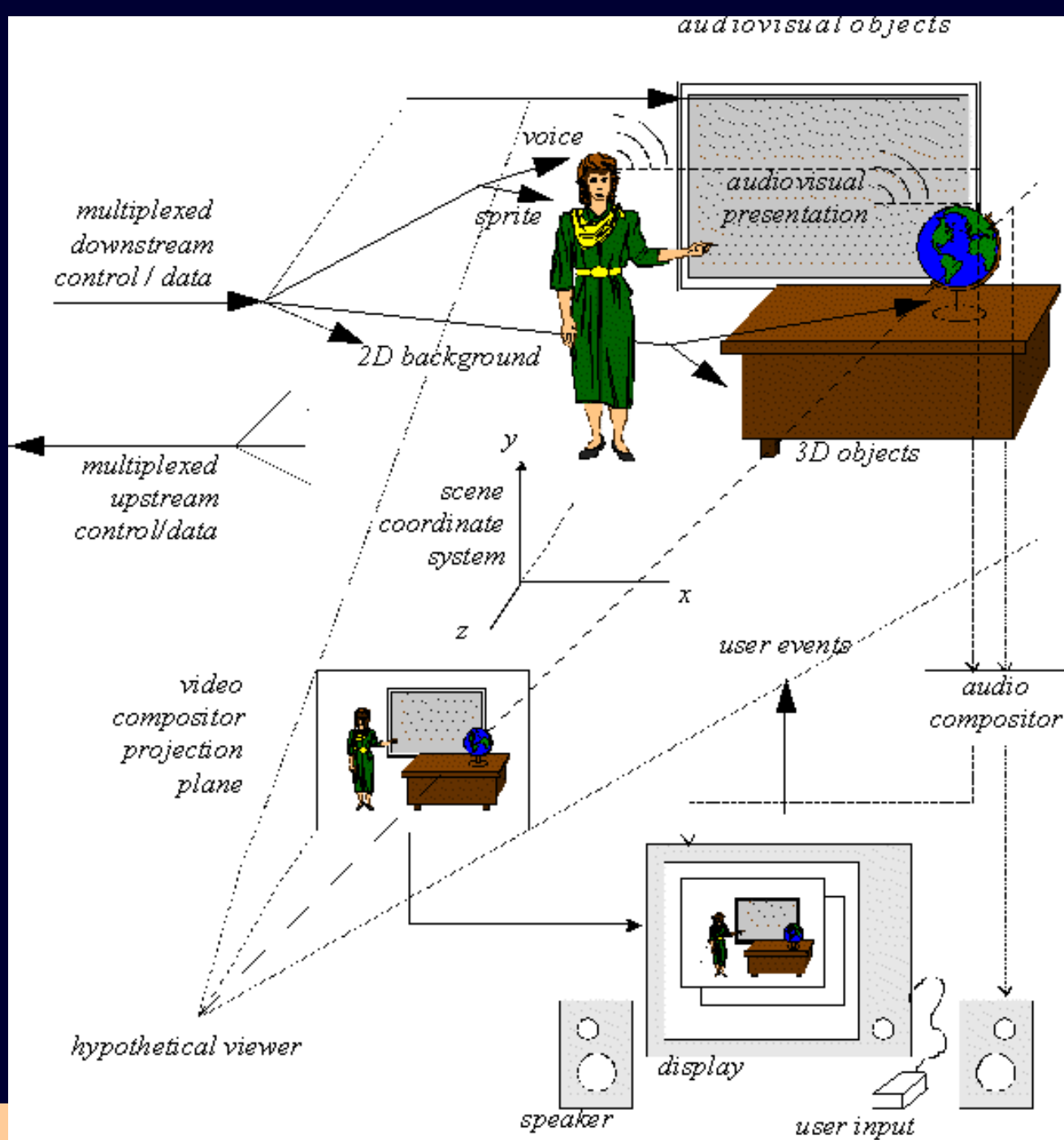
MPEG-4 [1/4]

- ◆ **Scalability of bit rate vs quality**
- ◆ **Better Audio/Video compression than MPEG-1**
- ◆ **Content based coding**
- ◆ **Support for efficient streaming**

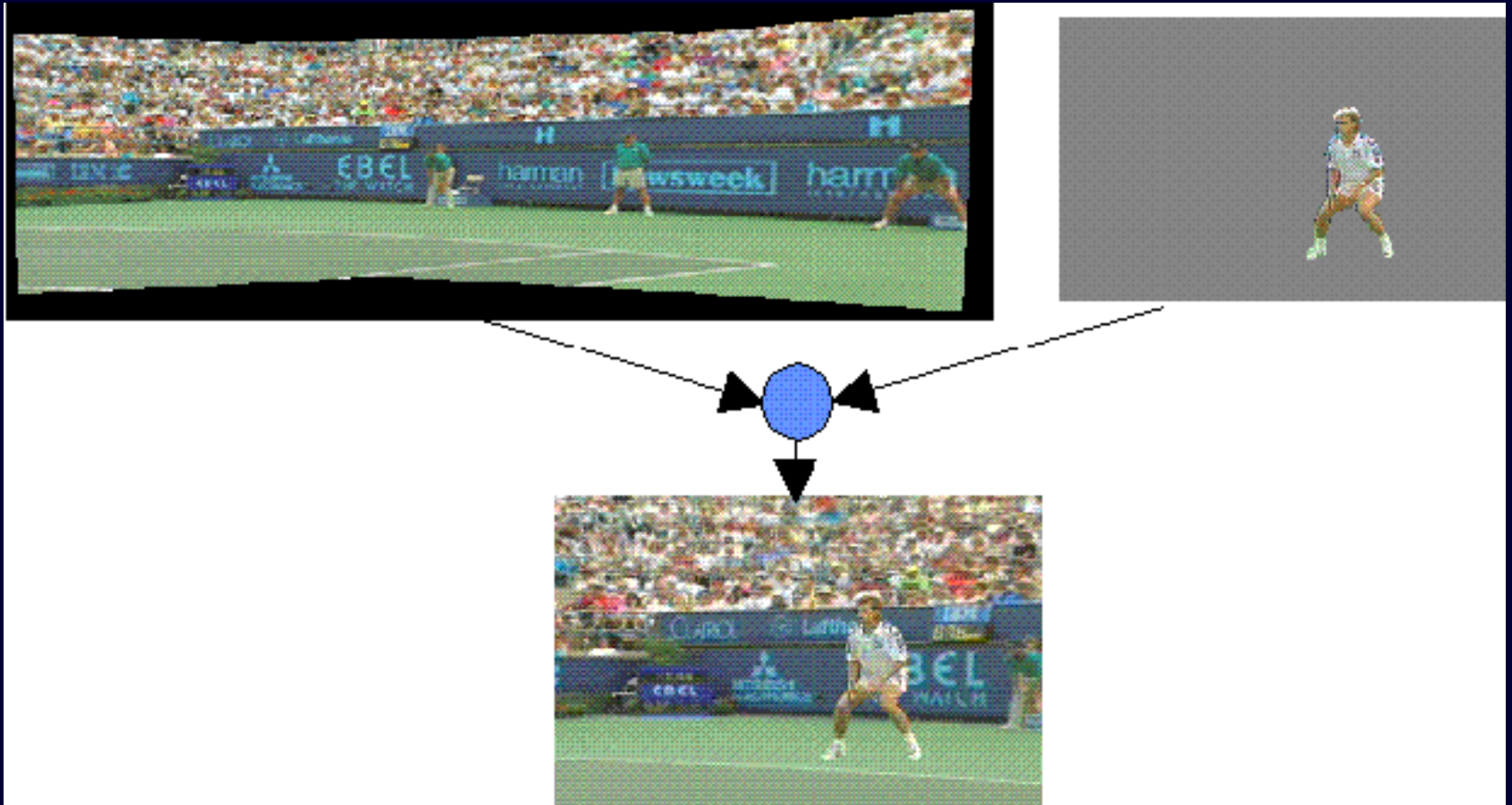
MPEG-4 [2/4]

- ◆ **Content based coding**
 - Reusability of object coding
 - Adaptation (different coding for different objects)
 - High quality for interesting parts
 - Possibility of scene composition
 - ➔ **Integration of natural and synthetic content**
 - ➔ **Tele-presence**

MPEG-4 [3/4]



MPEG-4 [4/4]



Digital Video representation

- ◆ Video is composed of a sequence of **frames**
- ◆ Video is separated into **shots**
 - A shot is a sequence of frames separated by a transition
 - Transitions between shots are given by
 - Camera break
 - Dissolve
 - Wipe
 - Fade-in, fade-out
- ◆ A video can be separated into **sequences**, that are **semantically meaningful groups of shots, possibly non consecutive**

Operations of an A/V Digital Library

- ◆ **Video archiving and indexing**
- ◆ **Video storage**
- ◆ **Content-based search**
- ◆ **Video access (visualization and copy)**

Summary of all phases & operations

Library Creation

Offline



Digital Compression

Speech Recognition
Image Extraction
Object/face detection and recognition

Segmentation

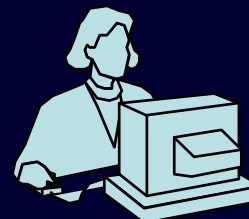
Insertion of video metadata

Indexed Database

Indexed Transcript
Segmented Video
Compressed Audio/Video
Metadata

Library Exploration

Online



Free text query

Metadata Fields query

Retrieved video segments

Requested Video Segment

Indexed Database

Indexed Transcript
Segmented Video
Compressed Audio/Video
Metadata

DISTRIBUTION TO USERS

Biblioteche Digitali

Informedia – an example

The screenshot displays the CMU Informedia Video Library interface. The search bar contains the query "fires floods earthquakes hurricanes tornadoes". The search results section shows "9 of 287 results: any of *fires floods earthquakes hurri... tornadoes.*" with a note to "Click on a word to highlight it in yellow." Below this, there are navigation buttons and a grid of video thumbnails.

The visualization window, titled "Visualization of search results set containing 287 documents", shows a scatter plot of documents. The plot is divided into four quadrants by the words "fires", "floods", "hur...", and "earth...". The plot is currently displaying 287 visible documents, with lines toggled on. The visualization is controlled by a panel on the right with the following settings:

- Color Code By: Minimum Value Average Value Maximum Value
- Relevance (All: 0 - 100) Size-Code Color-Code
- Within: [dropdown]
- Date (All: 07/01/99 - 09/30/99) Size-Code Color-Code
- Size (All: 0.02 - 30.30) Size-Code Color-Code
- Map Hits (All: 1 - 125) Size-Code Color-Code
- Topic Hits (All: 1 - 253) Size-Code Color-Code

Additional controls include "Ellipse", "Re-Plot", "Connect words", "Show Doc. Info", and "Show Details..." buttons.

Informedia – an example

The screenshot displays the CMU Informedia Video Library interface. The main window is titled "CMU Informedia Video Library" and contains several sections:

- Search for ANY of:** A search bar containing the text "fires floods earthquakes hurricanes tornadoes".
- Search Options / Results Options:** A section showing "9 of 287 results: any of *fires floods earthquakes hurr tornadoes.*" with a note "Click on a word to highlight it in yellow." and navigation buttons like "Prev. Page", "Next Page", "Go to Page...", and "Visualize All..".
- Search Results (Page 1 of 32):** A grid of video thumbnails, each with a small "****" rating.
- Visualization of search results set containing 287 documents:** A world map showing search results. A tooltip over Turkey indicates "TURKEY: 46/48 hits active".
- Map Controls:** Includes tabs for "VIBE", "Timeline", "Map", and "Topics", along with navigation icons and radio buttons for "Countries" and "States".
- Document List:** A list of visible documents with tabs for "Visible", "Invisible", and "Inactive". The list includes "CHINA", "MEXICO", "TAIWAN", and "TURKEY".
- Filtering and Visualization Options:** A section titled "58 visible documents; 4 of 5 words ignored; 25 of 55 locations ignored." with various filters and visualization options. The "Color Code By" section includes "Minimum Value", "Average Value", and "Maximum Value". The "Relevance" filter is checked, and the "Date" filter is also checked. The "Map Hits" filter is checked, and the "Color-Code" checkbox is checked. The "Topic Hits" filter is also checked.

ECHO Retrieval Interface

The screenshot shows the ECHO Retrieval Web Service interface in Microsoft Internet Explorer. The interface is divided into several sections:

- Search Form:** Located on the left, it includes fields for Label (In Titles, In Content, In Dates, Collocation-ID), Value (*, 1933), and a Submit button. There are also checkboxes for Work, Expression, and Manifestation, and a field for 'in archive: IL' with a 'show 500 hits' option.
- List of Retrieved Items:** A list of items is shown, including 'Francoforte sul Meno (Germania). I primi lavori stradali della progettata rete tedesca', 'Nella sede provvisoria del Reichstag il cancelliere Hitler espone il suo programma di governo.', and 'Studi sulla popolazione mondiale'. Each item has a duration and a date.
- Detailed View:** A detailed view of the selected item is shown on the right, including fields for Title, Series Title, Series Number, Genre, English Abstract, Themes, Description Language, Producer Name, Production Date, Producer Nationality, Kind, Silent, Color, Audio Language, Collocation, and Provider.

Red circles and arrows highlight specific features:

- Red circles around the search form, the list of items, and the detailed view.
- Red arrows pointing from the search form to the detailed view, and from the list of items to the detailed view.
- Red circles around the navigation buttons (Browsing Player, Cataloging, Metadata Edit, Transcript, Export, Delete) and the ECHO logo.

Integration of Clients and Services in GUI

Views on the material

Attribute Search Retrieval interface

Search for category level of material (Work, Expression, Manifestation, Item)

Detailed view on an item corresponding to the full ECHO data model (structures, links, ...)

List of retrieved items

ECHO Prototype 3 Web Service - Microsoft Internet Explorer

Adressleiste: <http://cms.289.8080/MediaArchive/servlet/startView>

Suchen:

Navigation: Zurück, Vorwärts, Abbrechen, Aktualisieren, Startseite, Suchen, Favoriten, Verlauf, E-Mail, Drucken, Bearbeiten, Diskussion, Real.com

Werkzeuge: Browsing, Metadata Editor, Export, Import, Delete

ML ES CO

Kind of Search: Nearest Neighbours Range

Strategy:

Tune Parameter:

Hits:

hits: 10

Suchergebnisse:

	DMGGuid: 444C4755494400DF3A88C2F7B10F009518EE810C Timecode: 00384960 Distance Value: 0.492198
	DMGGuid: 444C4755494400B4499179D81E300054F49CE503 Timecode: 00067280 Distance Value: 0.63827
	DMGGuid: 444C4755494400897DA0F56A9052001782671B03 Timecode: 00061280 Distance Value: 0.638392
	DMGGuid: 444C4755494400897DA0F56A9052001782671B03 Timecode: 00004240 Distance Value: 0.676915
	DMGGuid: 444C47554944000779CB40F7B10F002E6F2A5403 Timecode: 00051960 Distance Value: 0.680515

Work Title: [Nozze principesche a Monaco](#)

Duration: 00:08:20.19

Date of Ingest: 21.08.2002-14:38:46

Material: video

ECHO Model Entity

```

graph TD
    AV[AV-Document] --> V[Version]
    V --> M[Media]
    M --> S[Storage]
    V --> Video[Video]
    V --> Audio[Audio]
    V --> Transcript[Transcript]
    Video --> Audio
    Audio --> Transcript
  
```

Title: [Nozze principesche a Monaco](#)

Has Version: [\(To Version object\)](#)

Has Audio: [\(To Audio object\)](#)

Has Transcript: [\(To Transcript object\)](#)

Unit Indication: Whole

Silent: Sound

Color: BW

Person: [Kelly, Grace; Ranieri III di Monaco](#)

Locations: [Principato di Monaco; New York; Statua della libert ](#)

Fertig

Lokales Intranet

ECHO Prototype 2 Web Service - Microsoft Internet Explorer

Adresse <http://cms289.8080/MediaArchive/servlet/startView>

Video Segmentation

Find: * Submit

as of: unlimited show: 10 hits of type:

in archive: * sorted by: Relevance in: ascending order

Hits: 10

- [Zuckerfabrik Frauenfeld](#)
- [Zirkus Pilatus](#)
- [Zirkus Knie: Training im Winterquartier](#)
- [Zibelemärit](#)
- [Zentrum des schönen Buches in Ascona](#)
- [Zeltlager im Schnee](#)
- [Zeitmessung und Uhrenindustrie](#)
- [ZEVENDE NEDERLANDSE KATHOLIEKENDAG](#)
- [Yoga](#)

00:06:59.19...00:06:59.21 (00:00:00.02)

00:06:59.22...00:07:02.09 (00:00:02.12)

00:07:02.10...00:07:04.05 (00:00:01.20)

00:07:04.07...00:07:06.06 (00:00:01.24)

00:07:06.07...00:07:07.13 (00:00:01.06)

00:07:07.15...00:07:08.21 (00:00:01.06)

00:07:08.24...00:07:12.10 (00:00:03.11)

00:07:12.13...00:07:15.02 (00:00:02.14)

Fertig Lokales Intranet

ECHO Prototype 3 Web Service - Microsoft Internet Explorer

Filei Bearbeiten Ansicht Favoriten Extras ?

Zurück Vorwärts Abbrechen Aktualisieren Startseite Suchen Favoriten Verlauf E-Mail Drucken Bearbeiten Diskussion Real.com Links

Adresse <http://cms289:8080/MediaArchive/servlet/startView> Wechseln zu

Browsing Metadata Editor Export Import Delete

ES CO Video Segmentation

Find: Submit

Archive:

Themes:

show hits

Hits:

- [mec001](#)
- [mec001](#)
- [RAMSIS I](#)
- [Vw Käfer](#)
- [Zuckerfabrik Frauenfeld](#)
- [Zirkus Pilatus](#)
- [Zirkus Knie: Training im Winterquartier](#)
- [Zibelemärit](#)
- [Zentrum des schönen Buches in Ascona](#)
- [Zelllager im Schnee](#)

Fertig Lokales Intranet

ECHO Prototype 3 Web Service - Microsoft Internet Explorer

File Edit View Favorites Extras ?

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Adresse <http://cms289.8080/MediaArchive/servlet/startView> Wechseln zu

Browsing Metadata Editor Export Import Delete

ES CO Video Segmentation


Find worker Submit


as of unlimited show 100 hits of type


in archive * sorted by Relevance


in ascending order


Hits:

- 


DMGid: 444C4755494400B4499179D81E300054F49CE503
 Timecode: 00069680
 Distance Value: 0.811999
- 

DMGid: 444C4755494400897DA0F56A9052001782671B03
 Timecode: 00074480
 Distance Value: 0.870983
- 

DMGid: 444C4755494400897DA0F56A9052001782671B03
 Timecode: 00239920
 Distance Value: 0.874066
- 

DMGid: 444C4755494400BD2E9CCC65CE0E00C65F457CC
 Timecode: 02318000
 Distance Value: 0.904751
- 

DMGid: 444C4755494400897DA0F56A9052001782671B03
 Timecode: 00025800
 Distance Value: 0.811999



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