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 con 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**
    - ➔ **Harward 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 x 576 x 16 x25 ~ 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 MJEPG, 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

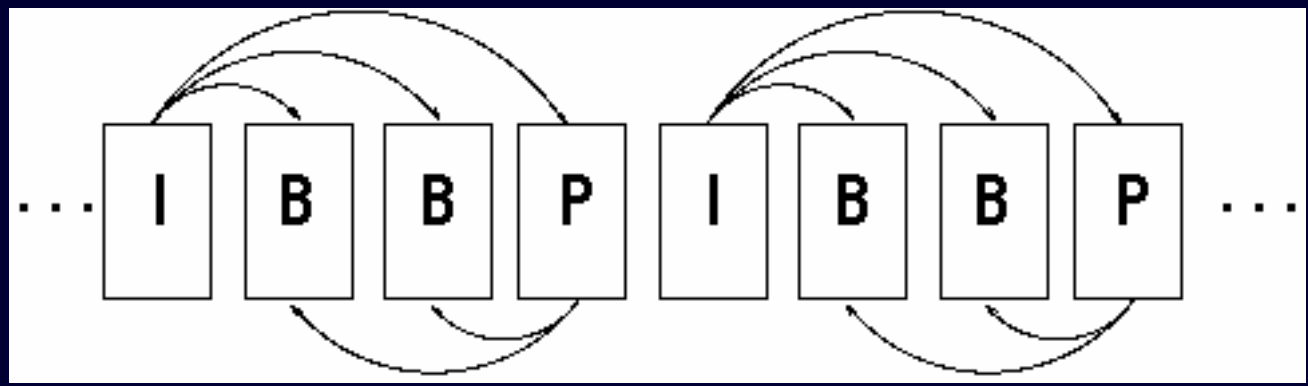
- **MPEG (Moving Pictures Experts Groups)**
  - MPEG1 has a bit-rate up to 1.5Mb/sec
    - ➔ **Designed for storage and retrieval of VHS quality video on CD-ROM**
  - MPEG2 Designed for broadcast video quality
    - ➔ **Bit rate: 2Mbps or higher**
    - ➔ **Used for DVD, cable TV, etc.**
  - MPEG4 is 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**



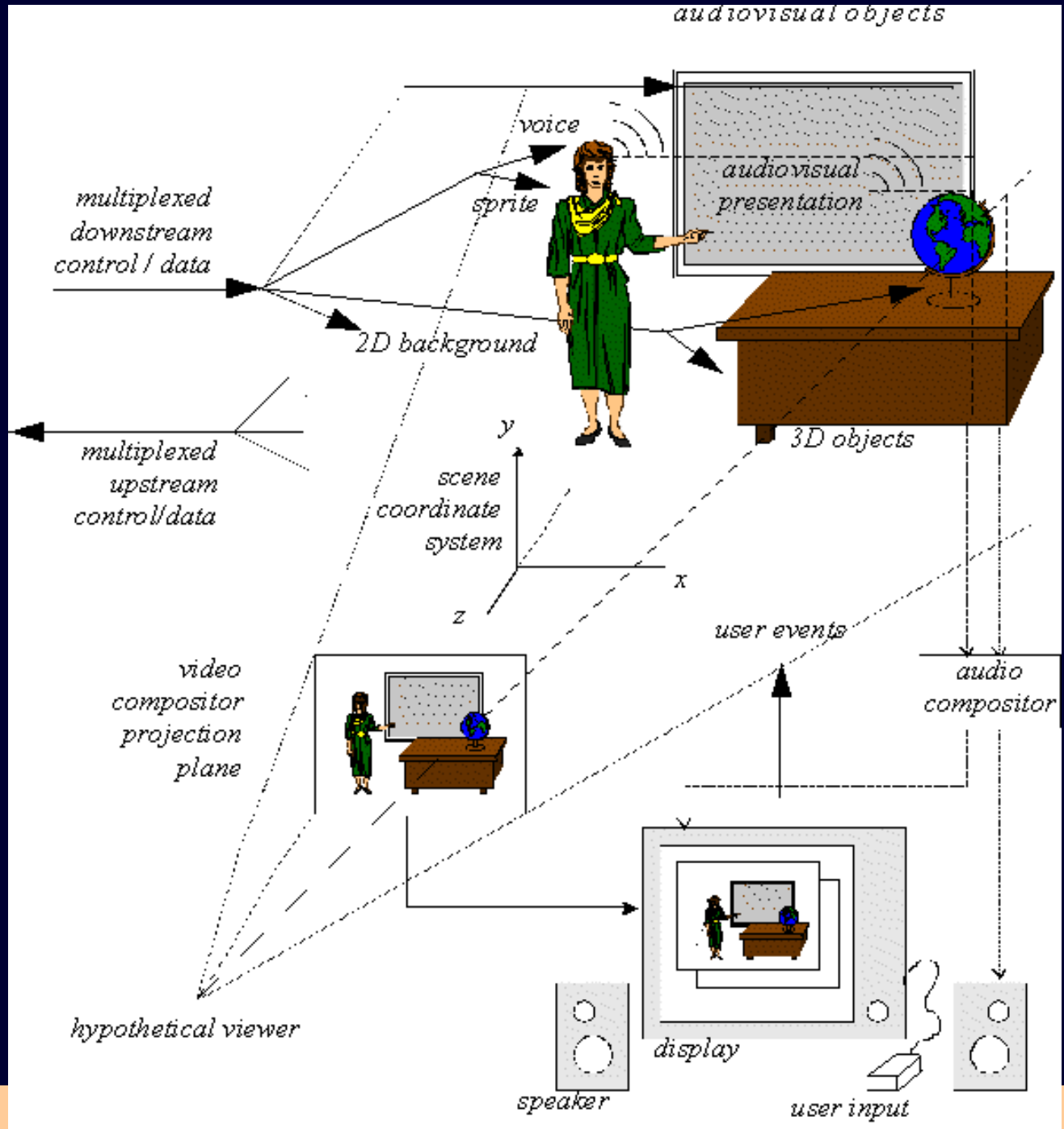
MPEG-4 [1/4]

- 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]


audiovisual objects
voice
sprite
audiovisual presentation
multiplexed downstream control / data
2D background
3D objects
multiplexed upstream control/data
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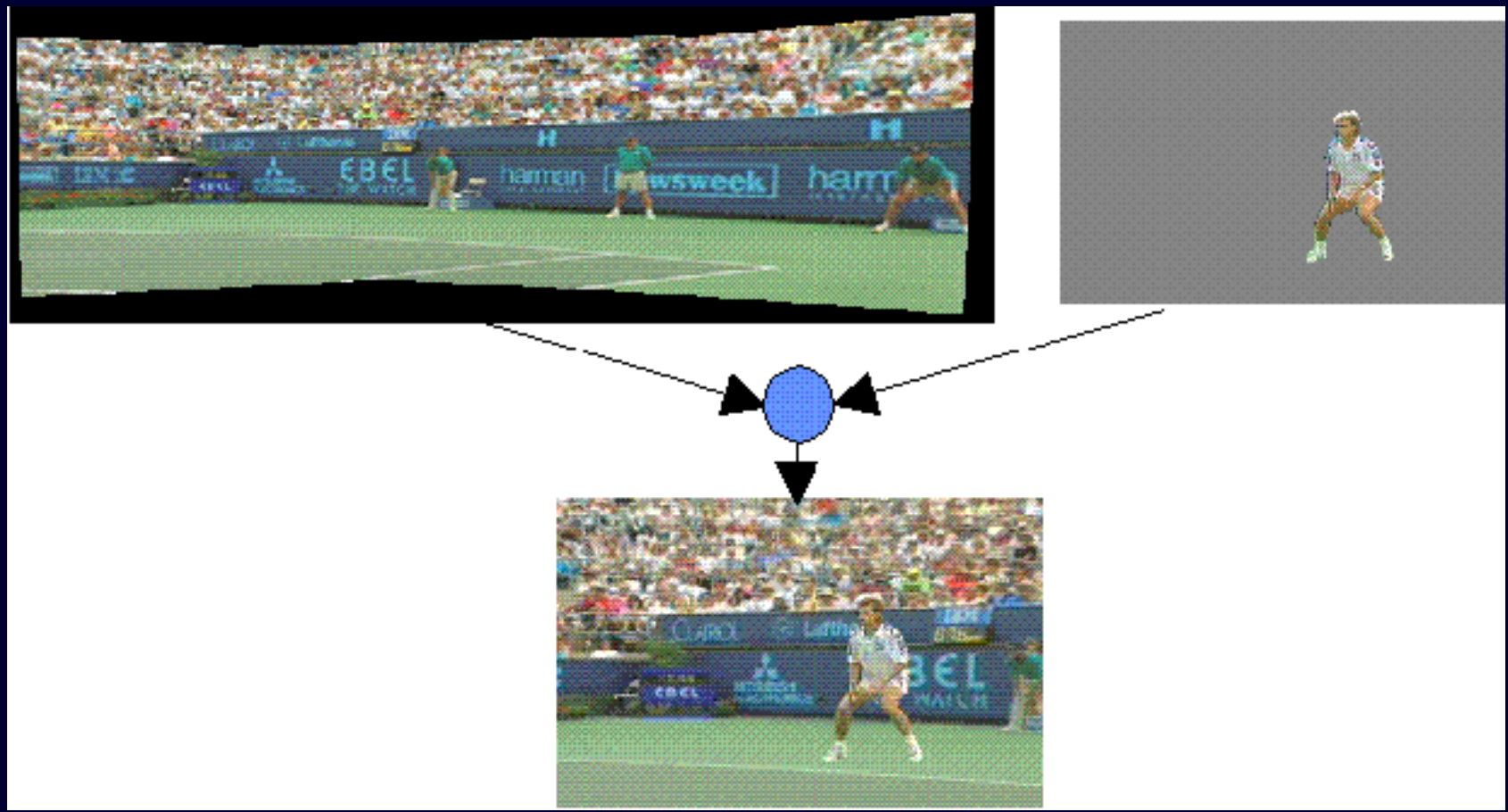
user events
video compositor projection plane
audio compositor
hypothetical viewer
display
speaker
user input

MPEG-4 [4/4]



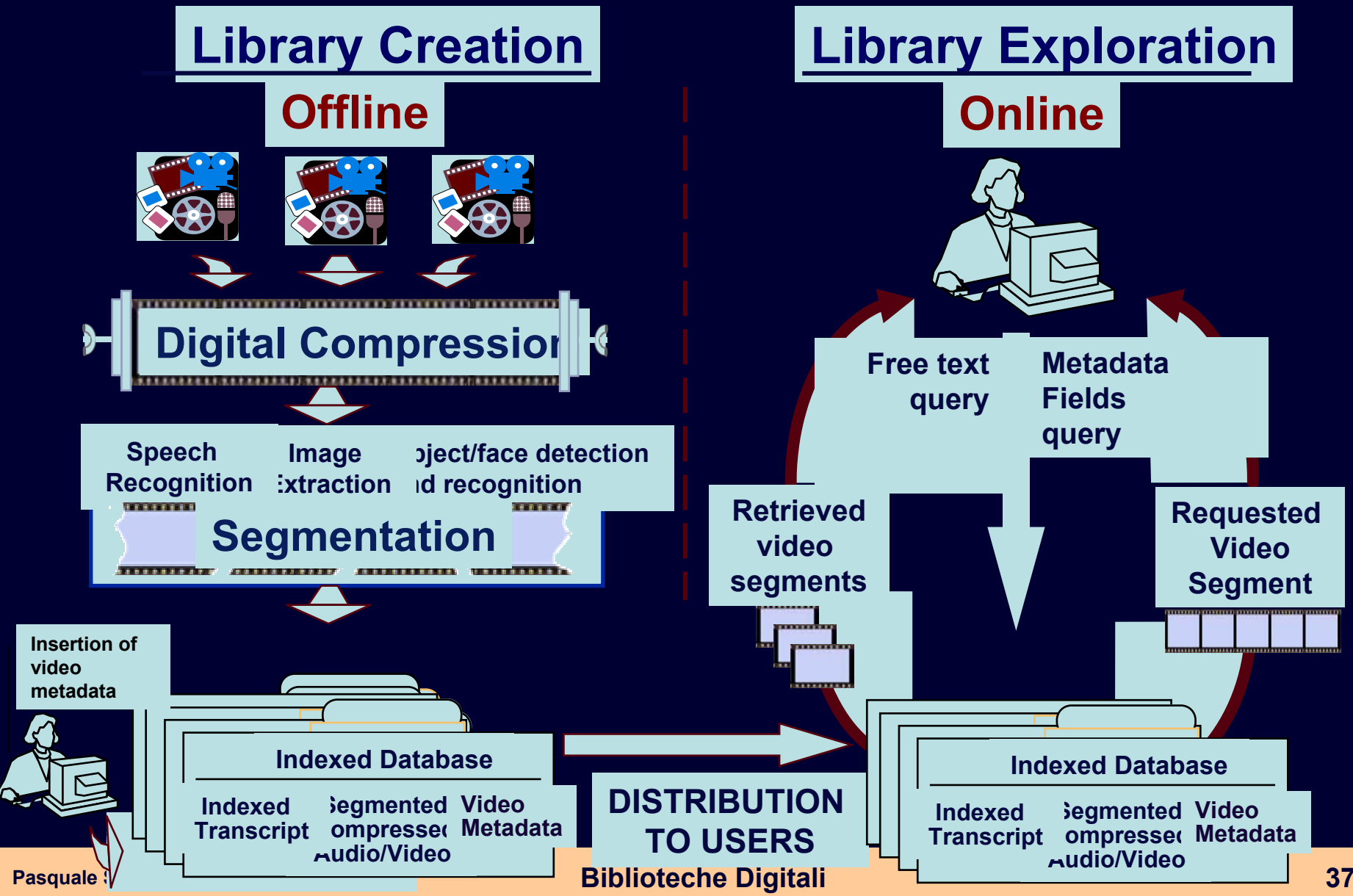
Digital Video representation

- **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**

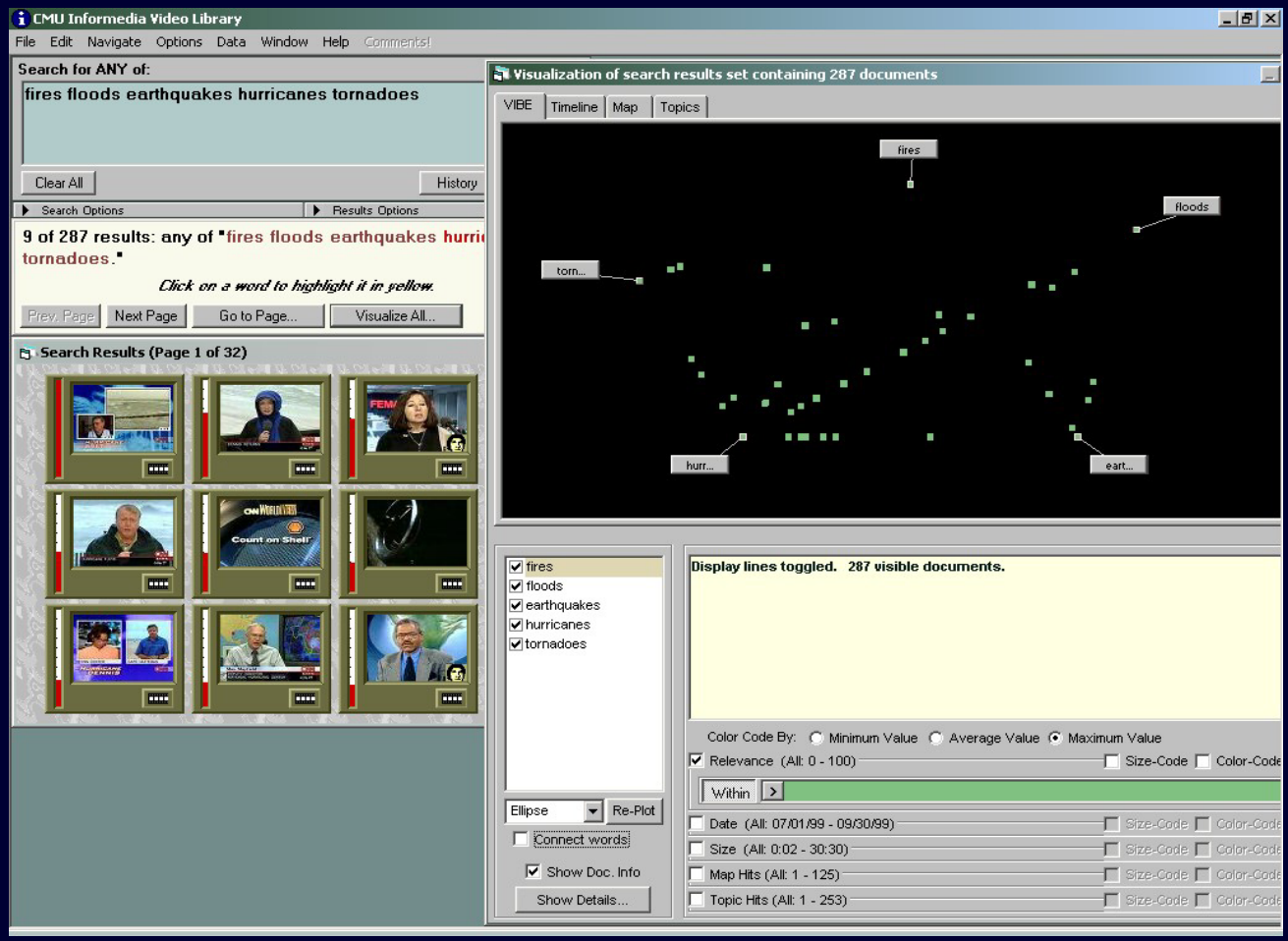
Operations of an A/V Digital Library

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

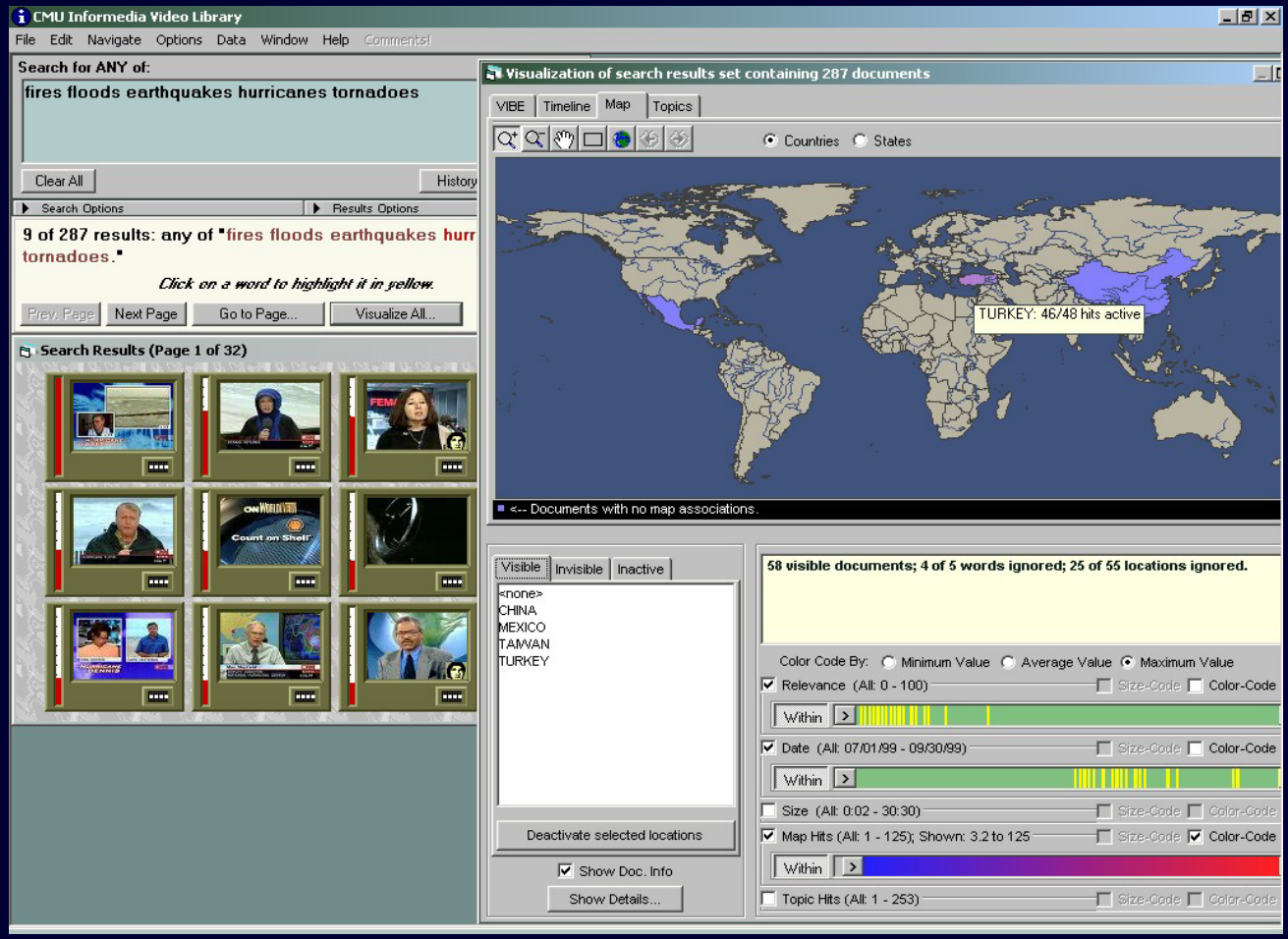
Summary of all phases & operations



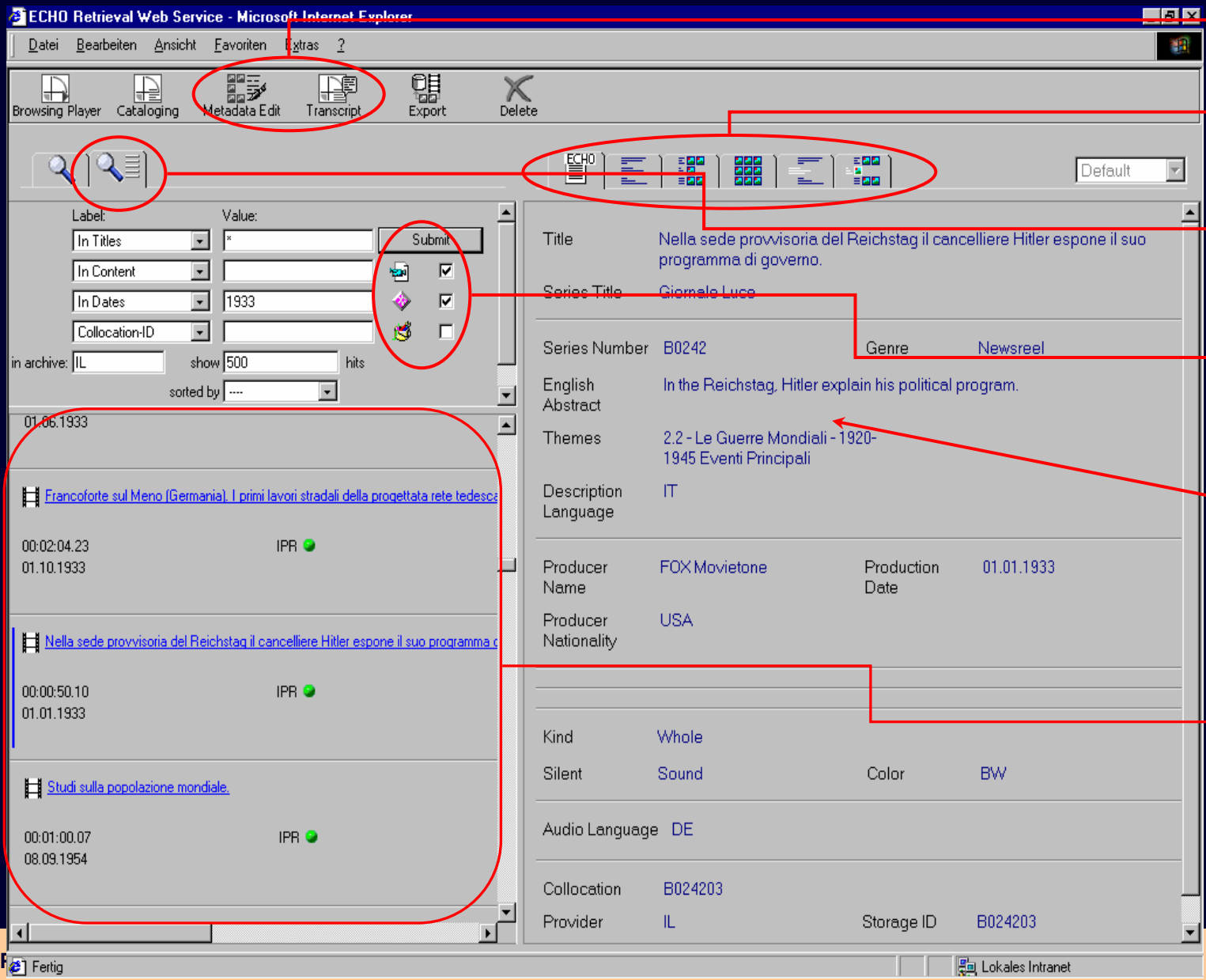
Informedia – an example



Informedia – an example



ECHO Retrieval Interface



Integration of Clients and Services in GUI

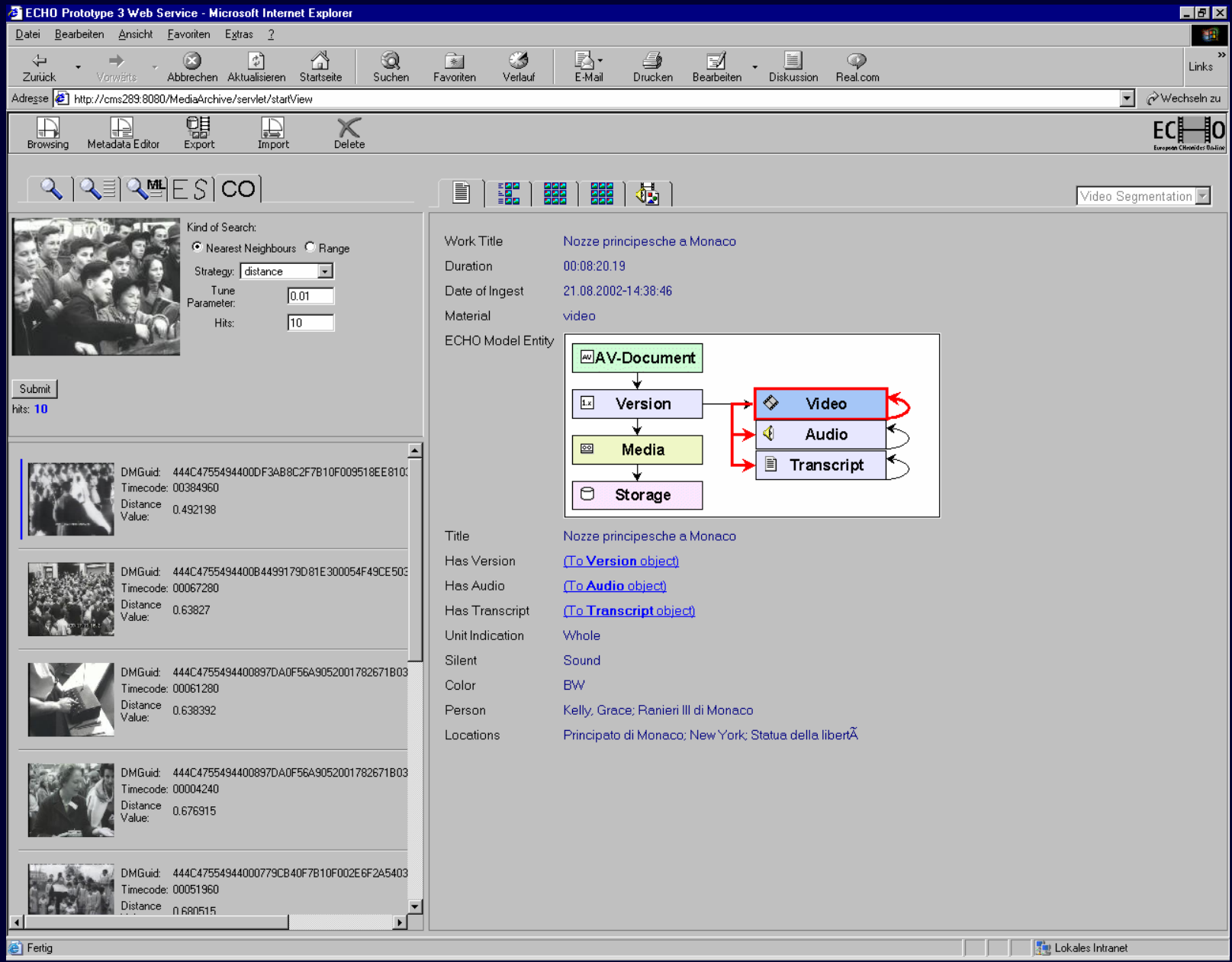
Views on the material

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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Video Segmentation
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Strategy: distance
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Date of Ingest 21.08.2002-14:38:46
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AV-Document
Version
Media
Storage
Video
Audio
Transcript
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Has Version (To Version object)
Has Audio (To Audio object)
Has Transcript (To Transcript object)
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Locations Principato di Monaco; New York; Statua della libertÃ
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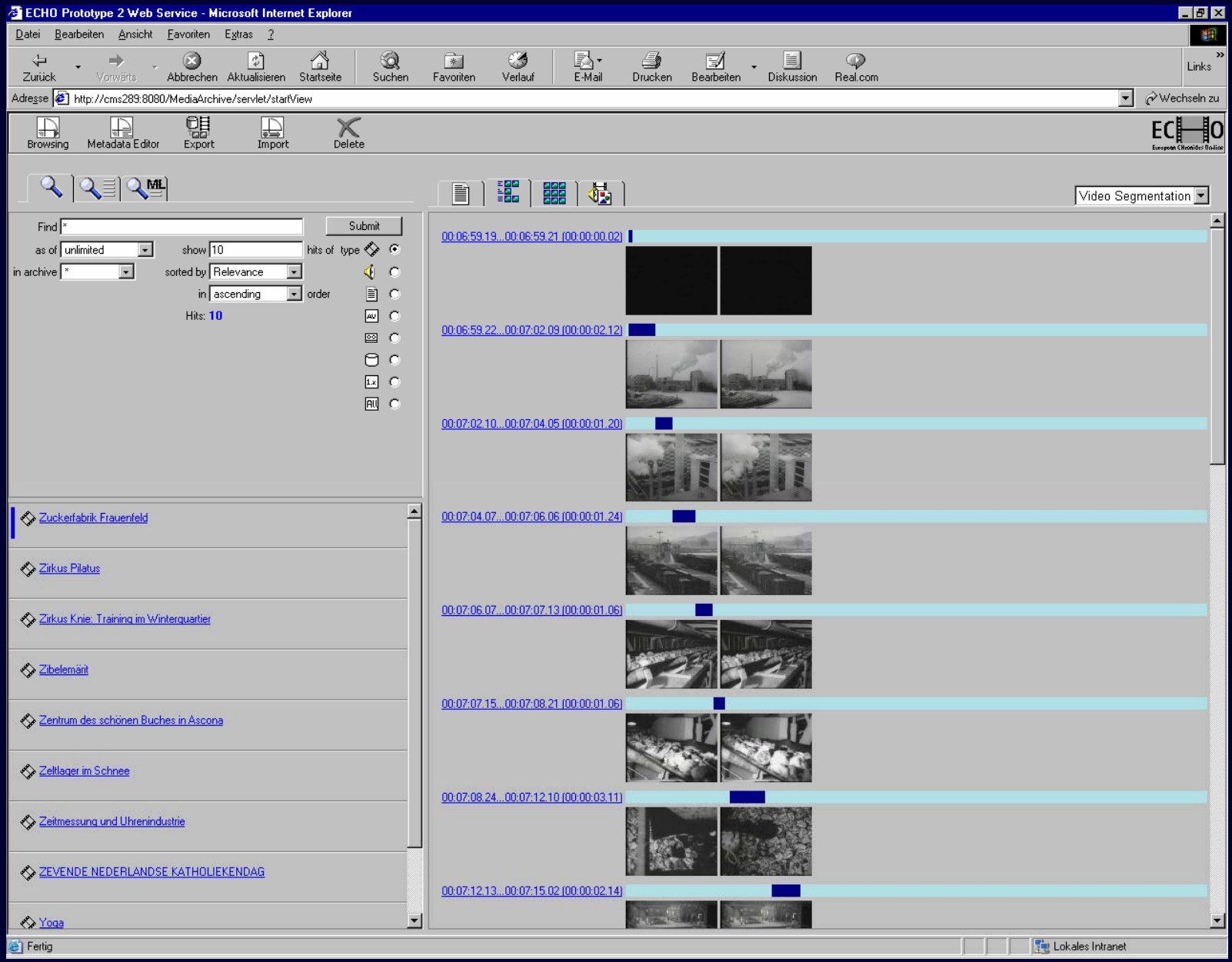
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Video Segmentation
Zuckerfabrik Frauenfeld
Zirkus Pilatus
Zirkus Knie: Training im Winterquartier
Zibelemärit
Zentrum des schönen Buches in Ascona
Zeltlager im Schnee
Zeitmessung und Uhrenindustrie
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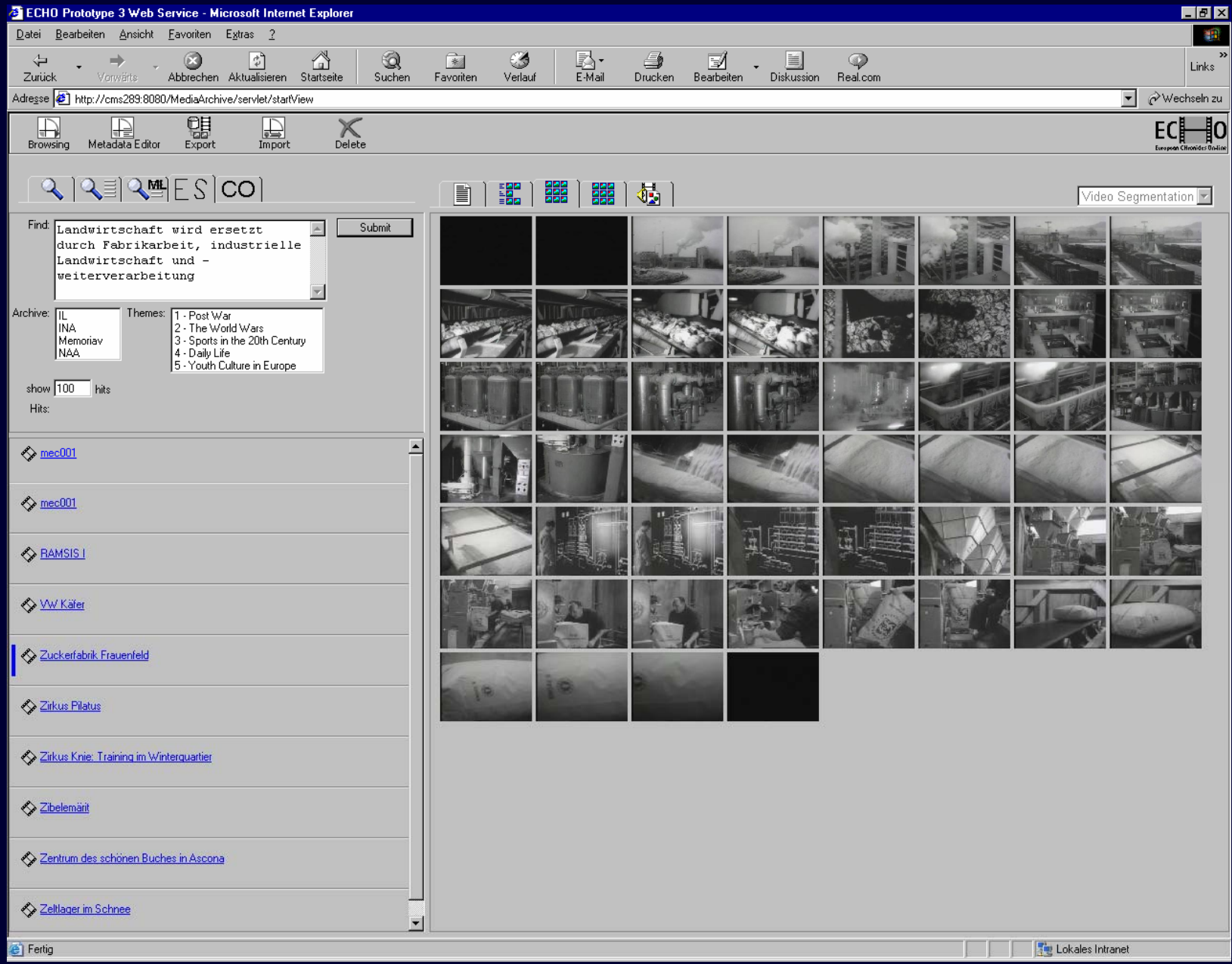
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Find: Landwirtschaft wird ersetzt durch Fabrikarbeit, industrielle Landwirtschaft und -weiterverarbeitung
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Themes: 1 - Post War 2 - The World Wars 3 - Sports in the 20th Century 4 - Daily Life 5 - Youth Culture in Europe
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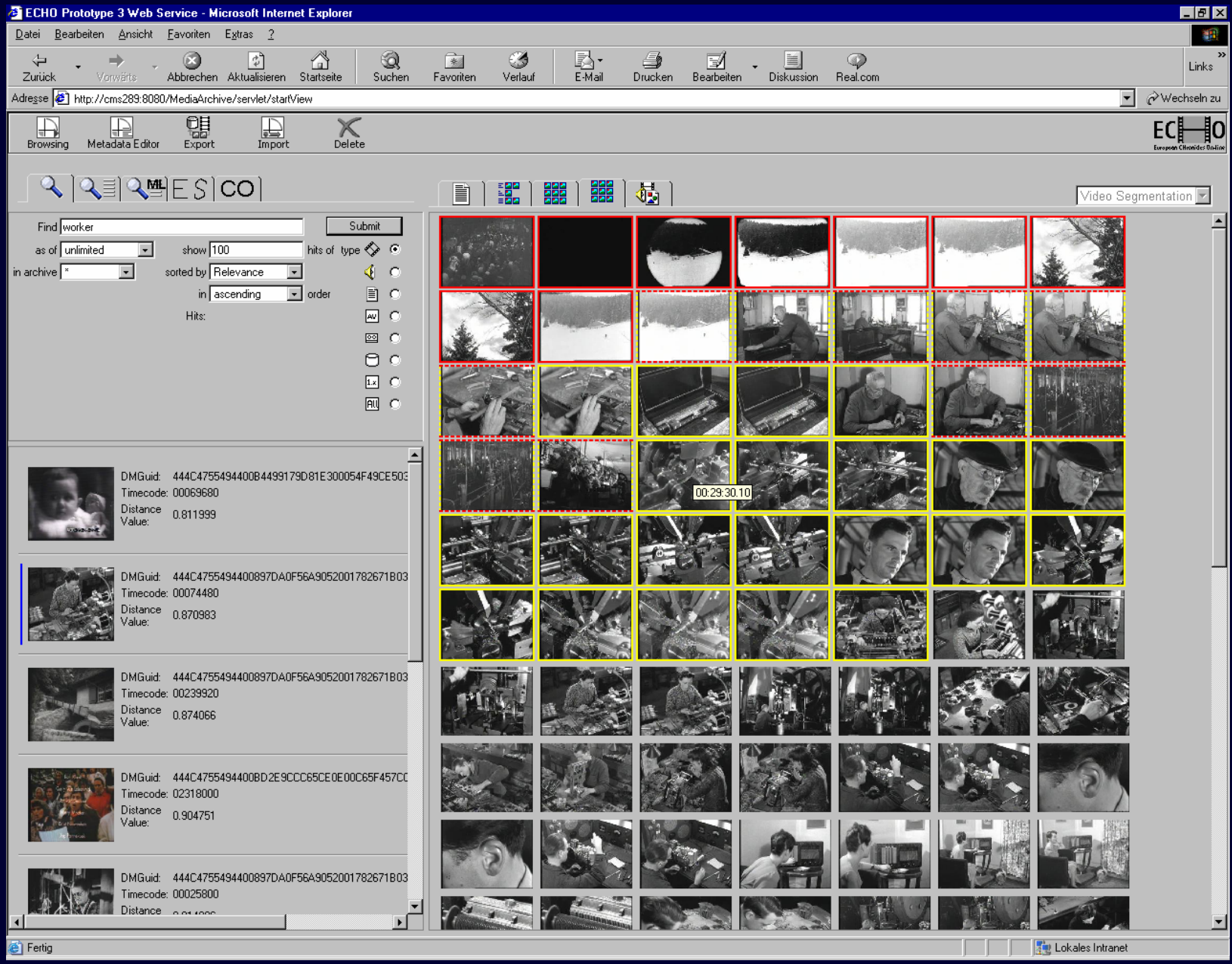
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