Caliph & Emir

Semantics in Multimedia Retrieval and Annotation

Mathias Lux
mlux@know-center.at

http://www.know-center.at

© Know-Center - gefördert durch das Kompetenzzentrenprogramm Kplus
Overview

Introduction
Related Work
Annotation with Caliph
Retrieval with Emir
Prototype Demonstration
Outlook
Introduction

- Growth of Personal Digital Libraries
  - 300 Mio. Digital Cameras
  - 27 Billion Digital Images in 2004
- Emerging Standards
  - EXIF
  - MPEG-7
- Representation of Knowledge in Metadata
  - Annotation
  - Retrieval
Related Work

Commercial Products
- Google Picasa, Adobe Photoshop Elements, ...
- DAM Products like Virage, Cumulus, Artesia

Research
- IBM’s Marvel
- VizIR
- Ben Shneiderman’s Photofinder
- Know-Center’s IMB & Elarm
Annotation with Caliph (1/2)

Extraction of
- MPEG-7 CBIR Descriptors
  - ColorLayout
  - ScalableColor
  - EdgeHistogram
- EXIF and IPTC metadata
- Thumbnail
- Media Instance Metadata (Size, Format, etc.)
Annotation with Caliph (2/2)

Textual Description
- Structured (The W’s)
- Free Text

Quality Rating
- Subjective, Scale from 1 to 5

Administrative Metadata
- Creator
- Meta²
Semantic Annotations (1/3)

Main Goals for Annotation
- Human readable Creation & Presentation
- Support for Computation

Main Tools
- MPEG-7 Descriptors for Semantics
- “Drawing” Annotations
- Library for Semantic Objects
Semantic Annotations (2/3)

Semantic Annotations are Directed Graphs

Semantic Objects which are the Nodes

Semantic Relations, which are the edges

Structured Annotation can be extracted

In predefined domains textual descriptions can be generated
Semantic Annotations (3/3)

Where: Registration Desk, TU Graz
Who: Mathias Lux
When: Summer 2002
Annotation Visualization

User defined Graph Layout
  - Moving Nodes to desired Position

Radial Layout
  - Automatic Positioning Nodes around Virtual Center

Spring Embedding
  - Based on Metaphor:
    ◆ Node = Metal Ring,
    ◆ Edge = Spring connecting Metal Rings
Spring Embedding

Algorithm based on Peter Eades’ Spring Embedding:

- Springs with logarithmic force: $C1 * \log(d/C2)$
- Nonadjacent nodes repel each other with inverse square law force: $C3/sqr(d)$
- Fixed Number of Iterations:
  - Calculate Force Vector: $f$
  - Move Node along the Force Vector: $C4 * f$

Changes & Additions for Semantic Annotations:

- New Stop Condition: When overall movement “stops”
- Added invisible attracting Centre Node: Separated Graphs are positioned around the Centre
Retrieval

Supported Types of Retrieval:

- Simple Prototype Search Capabilities
  - Keyword and File Based Retrieval
  - Content Based Image Retrieval
  - File Based XPath Search
- Index Based Search Engine
- Search for Semantic Annotations
Semantic Annotation Retrieval

**Stable Version supports**
- 3 Nodes with 2 Relations
- Wildcards for Nodes and Relations
- Linear Processing Time

**Experimental Version supports**
- Query Language for Graphs
- Any Number of Nodes and Relations
- Wildcards for Nodes
Demonstration
Magick

Magick is a *Cross Media Retrieval* Application

- Text Documents & Images in Combination are handled independent from their Media Type

Requirements for Magick

- Identification and Visualisation of Hidden Interconnections
- Using Clustering and Multidimensional Scaling
- Equal Treatment for Images and Text
Magick - Concept

Extraction & Normalizing of Metadata
  - IPTC, Dublin Core, EXIF, HTML Meta Tags
Normalization of the content
  - ColorLayout, ScalableColor in Case of Images
  - Words, Sentences, Stemming, Stop Words, ...
Definition & Linking of Metrics
  - Similarity and Distance of Content and Metadata
Processing and Visualization
  - Clustering (HAC) und Multidimensional Scaling (FDP)
Magick – Metrik

- Feature Spaces
- Weighted Distance Measure scaled to [0,1]
- Arithmetic Mean Using Multiple FS
Magick - Visualization
Magick Evaluation

- Implemented Visualization & Retrieval Techniques can be applied in Cross Media Retrieval
- Identification of Main Focuses is Possible
- Documents Need Common Denominator
  - Otherwise Outliers Will Happen
  - Common Denominator Can Be Small (e.g. Keywords, Hierarchy)
- Common Denominator is Main Criterion, Other Features Separate too Dense Clusters
Animation: Too Dense Clusters
Future Work

_integration of Semantic Annotations FS in KnowMiner, especially Magick_

Simplification of Semantic Annotation by

- Grouping/Clustering of Images (on EXIF, Timestamps, ...)
- Innovative User Interfaces
- Automatic Extraction of Concepts (see Marvel)

Generalization of Semantic Annotations from MPEG-7 to more General Formats (e.g. Domain Ontologies)