CHORUS
AUDIO-VISUAL SEARCH
IST - 045480

Chorus: Status and Challenges of MMSE Technology

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Fraunhofer Institut Intelligente Analyse- und Informationssysteme
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AGENDA

- Landscape of MMSE projects
- Functional Description of a MMSE
- Content Enrichment Methods (Creating metadata)
  - Speech
  - Music
  - Images
  - Video, 3D (talk by Oliver Schreer)
  - Multimodal Analysis
- Conclusion

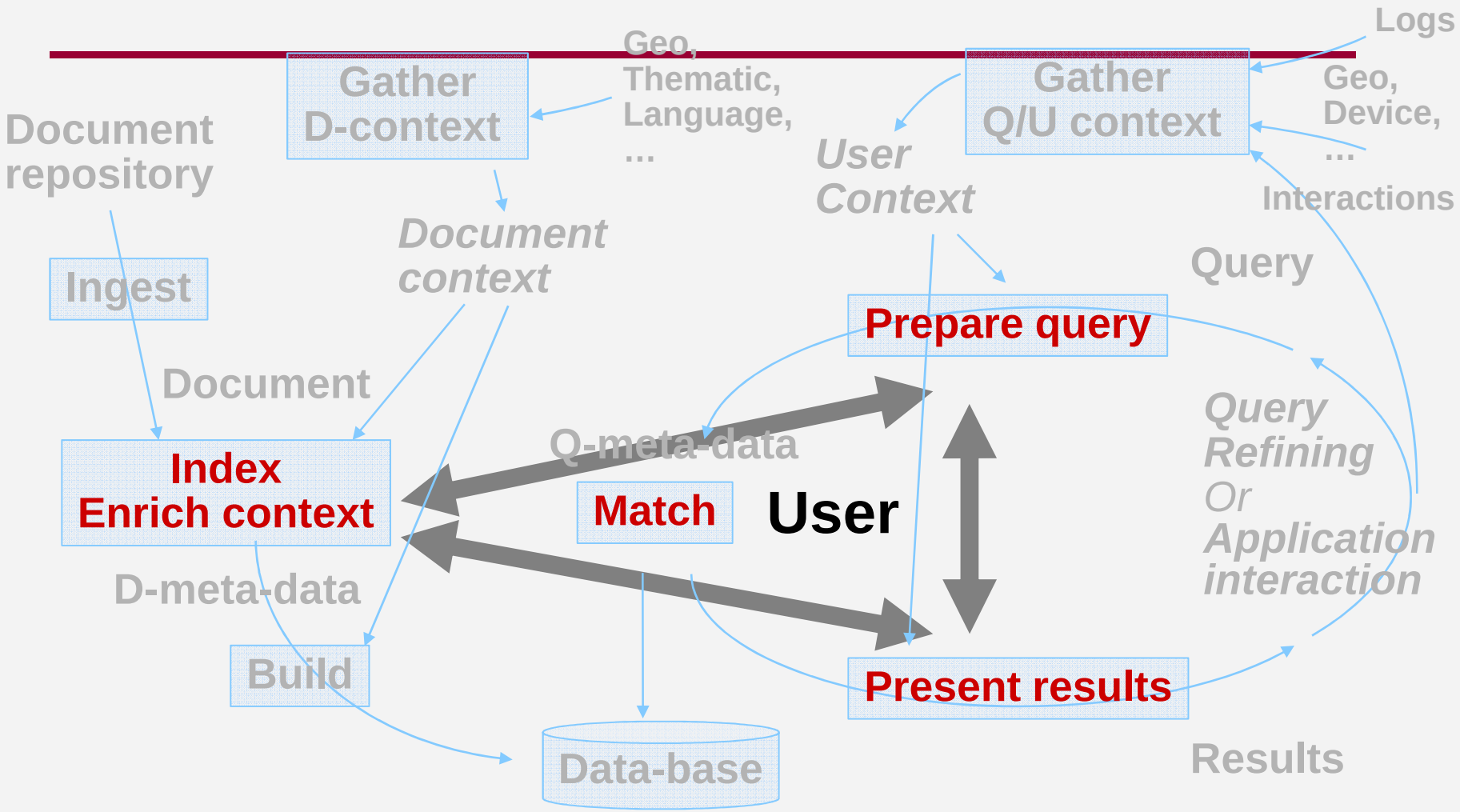
Overview about the AV indexing activities in the 9 IST projects

	Speech/Audio	Image	3D	Video	Text/Semantics
DIVAS	FhG IDMT Sail Labs			Elecard ICCS	
PHAROS	Univ. P. Fabra FhG IDMT Sail Labs	EPFL		EPFL Open Univ., UK	Web Models L3S Research
RUSHES	Brunel Univ.	Brunel Univ.	FhG HHI	Queen Mary Univ. Brunel Univ.	Queen Mary Univ. Brunel Univ.
SAPIR	IBM Univ. of Padova	CNR		Eurix	Xerox
SEMEDIA				Joaneum Research Fundacio Barcelona Univ. P. Fabra UPC Barcelona Digital Video Systems Univ. of Glasgow	
TRIPOD		Dublin City Univ.			Sheffield Univ.
VICTORY			Certh/ITI		
VIDI-VIDEO	INESC Lisboa	U. Surrey UvA ITI U. Florence		UvA ITI U. Florence	
VITALAS	FhG IAIS	INRIA Robotiker		INRIA CWI Certh/ITI	Univ. of Sunderland EADS

Overview about the AV indexing activities in national research projects

	Speech/Audio	Image	3D	Video	Text/Semantics
Quaero (French)	**Limisi RWTH Aachen Univ. Karlsruhe VecSys IRCAM**	**INRIA Univ. J. Fourier Jouve**		**INRIA LTU Univ. J. Fourier**	**Jouve Limsi INRIA**
Theseus (German)	**FhG IAIS M2Any**	**FhG HHI FhG First Siemens CT**	**FhG HHI FhG IGD**	**FhG HHI Siemens**	**Univ. Karlsruhe FhG IAIS DFKI FZI**
iAD (Norway)				**Dublin Univ.**	**Fast/Microsoft**
MultimediaN (Dutch)	**U. Twente TU Delft**	**CWI U. Amsterdam**		**U. Amsterdam CWI TU Delft Philips**	**U. Twente**
SECO (Italian)					**DEI (Univ. Milano)**
Internet Score Cards (Swiss)					**IFAAR**

Functional Description of a MMSE



Content Enrichment Methods: State-of-the-Art: Speech Analysis

- Approaches/Technologies
  - Speech recognition: HMM based LVCSR systems, Spoken Document Retrieval, Subword indexing (SAPIR, VITALAS, PHAROS, Quaero, Theseus, MultimediaN)
  - Speech Segmentation: speaker clustering and recognition (DIVAS, VITALAS, Quaero, Theseus, MultimediaN)
  - Speech-to-video transcoding (DIVAS)
- Systems
  - IST AV-projects: IBM speech system (SAPIR), Audiomining System from Fraunhofer IAIS (VITALAS), Sail Labs Technolgoy (DIVAS), Voxalead from Limsi & Vecsys (Quaero)
  - Others: BBN, HTK-Group Cambridge, RWTH Aachen, Nuance, etc.
- Applications
  - Indexing of broadcast news/archives (VITALAS, DIVAS, VIDIVIDEO, Quaero, Theseus, MultimediaN)
  - Podcast/Videocast search (Potzinger, Blinkx)
  - Audio archives (Parliament data, historical archives)

Best Practice: Speech Search

Advanced Content Enrichment Methods: Speech

Applied Technology

- Statistical based speech recognition (Hidden-Markov-Models)
- Speech segmentation
- Speaker recognition (Gaussian Mixture Models)

Trends

- Hybrid speech retrieval systems (combination of word and subwords, like phonemes and syllables), indexing of lattices
- Robustness (Background noise, double talk, etc.)

Challenges

- Variety of languages (multilingual applications)
- Lexicon dependency of existing ASR systems
- Domain dependency (broadcast news versus meetings)
- Very complex audio sounds (composition of different sounds)

Promising Directions

- audio modelling and mining (i.e. using of anchor models)
- phonetic or syllable based approaches, new forms of context dependency

State-of-the-Art: Music Analysis

- Approaches/Technologies
  - Music segmentation: Spectral Flatness (MPEG-7 Audio), Genetic Algorithms (DIVAS, PHAROS, Quaero, Theseus)
  - Music retrieval and Recommendation (SOMs) (SAPIR, Theseus)
- Systems
  - IST projects: Fraunhofer IDMT (DIVAS, PHAROS), M2Any (Theseus), IRCAM (Quaero)
  - Others: Barcelona Music & Audio Technologies, FhG AudioID, PlaySom (Univ. Vienna), SyncPlayer (Univ. Bonn), etc.
- Applications
  - Indexing of music collections
  - Query by humming
  - Audio-music identification
  - Recommendation engines

Best Practice: Music Search

- Jointly develop AudioID-Sonos Technology - a generic framework for content-based semantic annotations and recommendations (FhG IDMT)
- SDK and business solutions available from Mufin GmbH

Advanced Content Enrichment Methods: Music

Applied Technology

- Low level feature extraction:
  - Appl. 1: audio fingerprinting (find identical audio segments)
  - Appl. 2: audio matching (find similar audio segments)

Trends

- Towards music semantics (users and music scientists):
  - genre classification, artist recognition, mood detection, automatic playlist generation, music recommendation
  - music summarization, rhythm and melody extraction

Challenges

- High complexity of music signal (e.g. polyphonic music)
- Strong subjective component for mood and genre classification

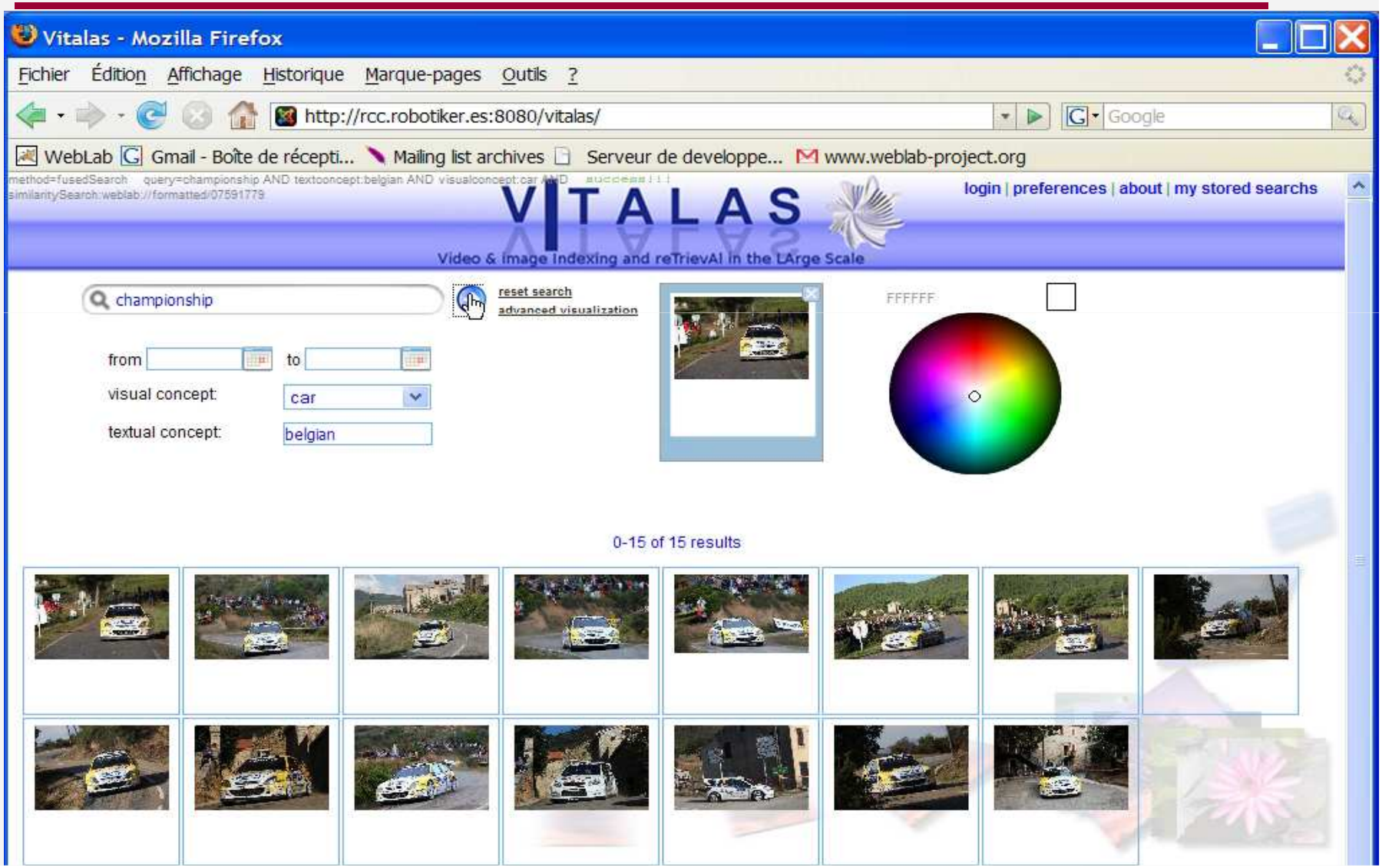
Promising Directions

- Moving from controlled audio situations to more complex situations
- Robust extraction of high-level information
- Machine Learning algorithms for time-series data

State-of-the-Art: Image Analysis

- Approaches/Technologies
  - Low level image processing (histograms, shapes, textures, MPEG7-visual, SIFT) (SAPIR, VIDIVIDEO, VITALAS, SMEDIA, TRIPOD, Rushes, Quaero, Theseus, MultimediaN, IM2)
  - Image similarity measurements (Rushes, VIDIVIDEO, VITALAS, LIVE Theseus, IM2)
  - Relevance Feedback (Rushes, SMEDIA, VITALAS), etc.
- Systems
  - IST projects: INRIA (VITALAS), Univ. of Amsterdam & Univ. of Florence (VIDIVIDEO), etc.
  - Others: IBM (QBIC), Webseek, MPEG-7 search system (Univ. Munich), IKONA (INRIA), etc.
- Applications
  - Content based retrieval in image collections
  - Object recognition, Face recognition (security, photo collections)
  - Automatic annotation of image collections with keywords and textual descriptions

Best Practice: Image Search



Advanced Content Enrichment Methods: Image

Applied Technology

- Content based image retrieval
- Robust feature extraction (e.g. SIFT)

Trends

- Semantic search and concept-based detection in complex background
- Interactive search and agent interfaces
- New learning models (e.g. neuro-based learning)
- Multi-user environments (towards a common query model)

Challenges

- Semantic gap (low level versus high level features and models)
- Image segmentation (only solved for restricted domains)
- Interpretation: this refers to the user model and context

Promising Directions

- New machine learning algorithms based on human perception and cognition
- High-performance computing
- Folksonomies

State-of-the-Art: Video Analysis

- Approaches/Technologies
  - Shot detection, keyframe generation (DIVAS, Rushes, SAPIR, VIDIVIDEO, VITALAS, Quaero, Theseus, MultimediaN, IM2)
  - Object tracking based on motion based features, closed captions recognition, etc. (Rushes, VIDIVIDEO, VITALAS, Quaero, Theseus, MultimediaN, IM2)
  - Object detection and recognition (ANN, Adaboost, SIFT) (VIDIVIDEO, VITALAS, SMEDIA, VITALAS, Quaero, Theseus, MultimediaN, IM2)
  - Video annotation and summarization (Rushes, SMEDIA, VITALAS, Quaero, Theseus, MultimediaN, IM2)
  - Video event detection (SMEDIA, VITALAS, VIDIVIDEO)
- Systems
  - IST projects: Univ. Amsterdam & Univ. Florence (VIDIVIDEO), Joaneum Research (SMEDIA), CERTH/ITI (VICTORY), VITALAS (INA/INRIA, CERTH-ITI), Fraunhofer (Theseus),
  - Others: Virage, TrecVideo-participants, Informedia, Univ. of Marburg, etc.
- Applications
  - Indexing of broadcast material, media observation, Indexing of videocast material
  - Recommendation Engines, Video fingerprinting, logo detection, security, etc.
  - 3D video (Rushes, VICTORY, Theseus)

Advanced Content Enrichment Methods: Video

Applied Technology

- Concept detection based on low level features (TrecVid)
- Shot based classification
- Combining features using SVM or other classifiers

Trends

- Incremental improvements:
  - from SVM to more sophisticated kernel methods
  - more robust and efficient features such as keypoint/codebook features
- Inclusion of temporal dimension (using the dynamics in videos)

Challenges

- Broad-domain applicability
- Lack of training data

Promising Directions

- Leveraging social tagged media as substitute for training data
- High-performance computing
- Video behavior analysis

Multi- and Cross Modal Search (Univ.of Marburg: Videana)

Philipps Universität Marburg

Fraunhofer IAIS Institut Intelligente Analyse- und Informationssysteme

Videana Demo
Semantic Video Search

Concept: Meeting Search

- Flag
- Flag Usa
- Food
- Football
- Golf
- Government Building
- Government Leader
- Graphics
- Grass
- Hassan Nasrallah
- Horse
- Horse Racing
- House
- Hu Jintao
- Indoor
- Kerry
- Lahoud
- Male
- Maps
- Meeting

Multi- and Crossmodal MMSE Challenges and Limitations

- Amount and quality of data and annotations
- Availability of keyword vocabulary
- Low-level representations of information
- Quality of machine learning algorithms
- Lack of bootstrapping mechanism
- Context information to reduce the domain space

Conclusion

- More efficient and robust multimedia indexing techniques (especially for “object” based search)
- New media search paradigms (from keyword based search to event/context based search)
- Modeling implicit and explicit feedback to empower personalization and recommendations
- Exploiting user annotations (weakly labeled data)
- More informative user interfaces for MMSE (exploration and experienced based)
- Scalability (algorithms and network infrastructure)

Thanks for your attention

http://www.ist-chorus.org/

More Information:
Deliverable D2.2