Research Areas

Özgür Ulusoy

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- Text-to-SQL Systems
- Web Search Engines
- Multimedia Database Systems
- Social Network Analysis
- Resourse Optimization in WSNs

Text-to-SQL Systems

- Schema Linking
- Keyword Mapping
- Explainable Text-to-SQL
- Query Recommendation

Text-to-SQL Systems

Schema Linking - associating elements in a natural language query with the corresponding components in a database schema

- A novel pipeline (E-SQL) designed for direct schema linking
- Augmented by generating candidate predicates

- H. A. Caferoğlu, Ö. Ulusoy**, '***E-SQL: Direct Schema Linking via Question Enrichment in Text-to-SQL'***, arXiv:2409.16751**, 2024**.**

Text-to-SQL Systems

Keyword Mapping - mapping between tokens in the query and relational database elements

- **Keyword mapping formulated as sequence tagging problem in NLP**
- **An end-to-end keyword mapper (DBTagger)**

- A. Usta, A. Karakayalı, Ö. Ulusoy**, '***DBTagger: Multi-Task Learning for Keyword Mapping in NLIDBs Using Bi-Directional Recurrent Neural Networks'***, Very Large Databases (VLDB) Conference**, 2021**.**

Text-to-SQL Systems

Explainable Text-to-SQL - based on Explainable AI

- **Explaining the decisions made by the keyword mapping system using LIME**
- **A novel wrapper around LIME**
- **Using a schema graph to explain join-path inference**

- A. Usta, A. Karakayalı, Ö. Ulusoy, '*xDBTagger: explainable natural language interface to databases using keyword mappings and schema graph'*, **VLDB Journal**, 2024.

Text-to-SQL Systems

Query Recommendation

- A ranking method to create a list of suggested queries
- Distributed representations for database tuples, trained on a relational database
- Graph convolutional networks (GCNs) to learn distributed representations

Web Search Engines

- **Learning to Rank for Educational Web Search**
- **Diversification of Search Results**
- **Efficiency and Scalability Issues**

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Web Search Engines

Learning to Rank for Educational Web Search - machine-learned ranking models

- **A rich set of features employed in educational search**
- **Domain knowledge utilized to build query-dependent ranking models**

- A. Usta, R. Ozcan, I. S. Altingovde, Ö. Ulusoy, '*Learning to Rank for Educational Search Engines'*, **IEEE Transactions on Learning Technologies**, 2021.

Web Search Engines

Diversification of Search Results

- **Multidimensional result diversification**
- **Supervised learning methods for search result diversification**
- **Impact of index pruning on diversification performance**

- S. Yigit-Sert, I.S. Altingovde, Ö. Ulusoy, '*Diversity-aware strategies for static index pruning*', **Information Processing & Management**, 2024.
- S. Yigit-Sert, I.S. Altingovde, C. Macdonald, I. Ounis, Ö. Ulusoy, '*Explicit diversification of search results across multiple dimensions for educational search*', **Journal of the Association for Information Science and Technology (JASIST)**, 2021.
- S. Yigit-Sert, I.S. Altingovde, C. Macdonald, I. Ounis, Ö. Ulusoy, '*Supervised approaches for explicit search result diversification*', **Information Processing & Management**, 2020.

Web Search Engines

Efficiency and Scalability Issues

- **Methods and algorithms for caching, indexing, and query processing in search engines**

- E. Sarıgil, I. S. Altingovde, R. Blanco, B. Cambazoglu, R. Ozcan, Ö. Ulusoy, '*Characterizing, predicting, and handling web search queries that match very few or no results*', **Journal of the Association for Information Science and Technology (JASIST)**, 2018.
- E. Sarıgil, O. Yılmaz, I. S. Altingovde, R. Ozcan, Ö. Ulusoy, '*A "Suggested" Picture of Web Search in Turkish*', **ACM Transactions on on Asian and Low-Resource Language Information Processing,** 2016.
- R. Ozcan, I. S. Altingovde, B. B. Cambazoglu, Ö. Ulusoy, '*Second Chance: A Hybrid Approach for Dynamic Result Caching and Prefetching in Search Engines*', **ACM Transactions on the Web**, 2014.

Multimedia Databases

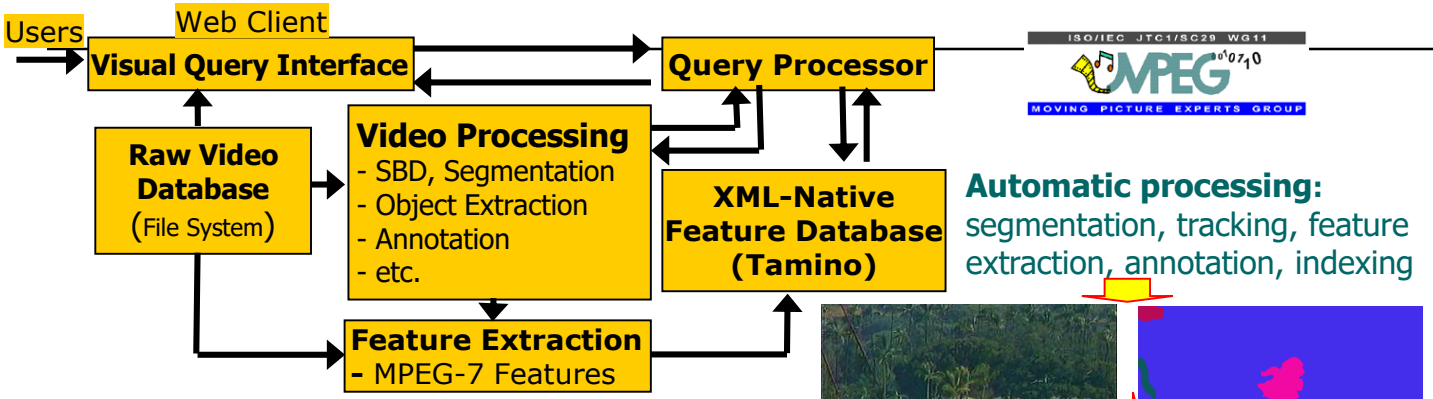
(joint work with Prof. Uğur Güdükbay)

- Video Retrieval Systems
- Mobile Visual Search
- Learning Visual Similarity for Image Retrieval

http://www.cs.bilkent.edu.tr/~bilmdg

Multimedia Databases

BilVideo-7: An MPEG-7 Compatible Video Retrieval System



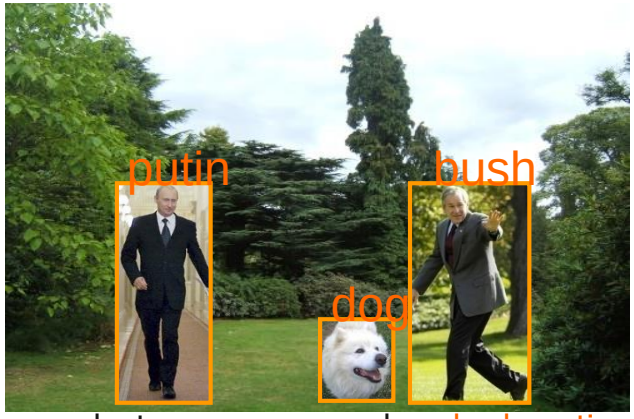
ISO/IEC JTC1/SC29 WG11 MPEG MOVING PICTURE EXPERTS GROUP

Automatic processing:
segmentation, tracking, feature extraction, annotation, indexing

segmentation

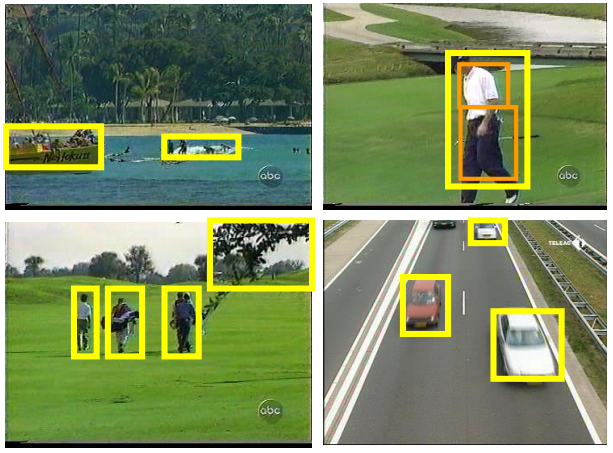
Powerful querying capability for video data

- keyword and content-based queries
- spatio-temporal object queries



Example query formulation

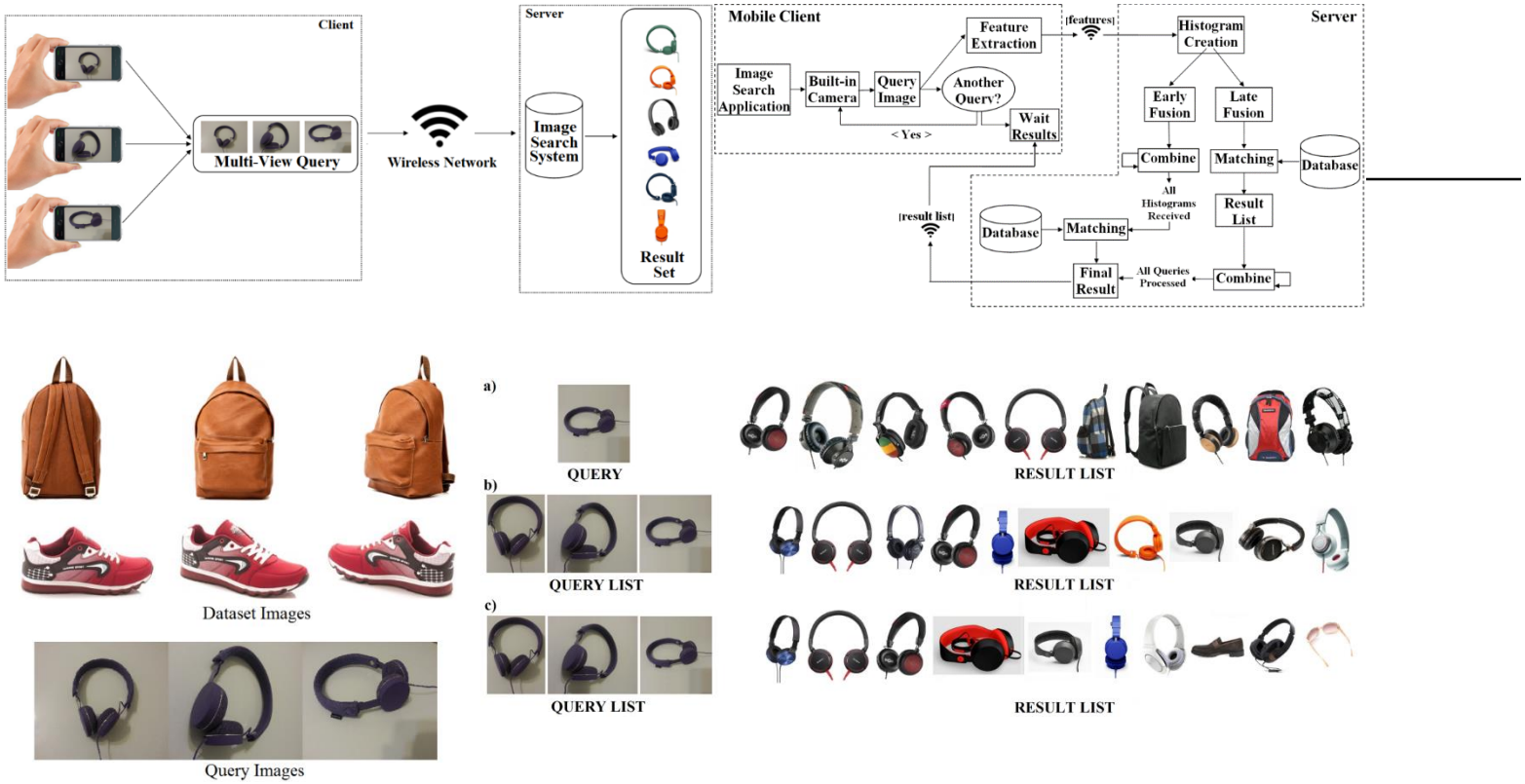
keywords: trees, greenery, sky – bush, putin, dog



Salient video object extraction

Multimedia Databases

Mobile Image Search Using Multi-View Object Image Queries

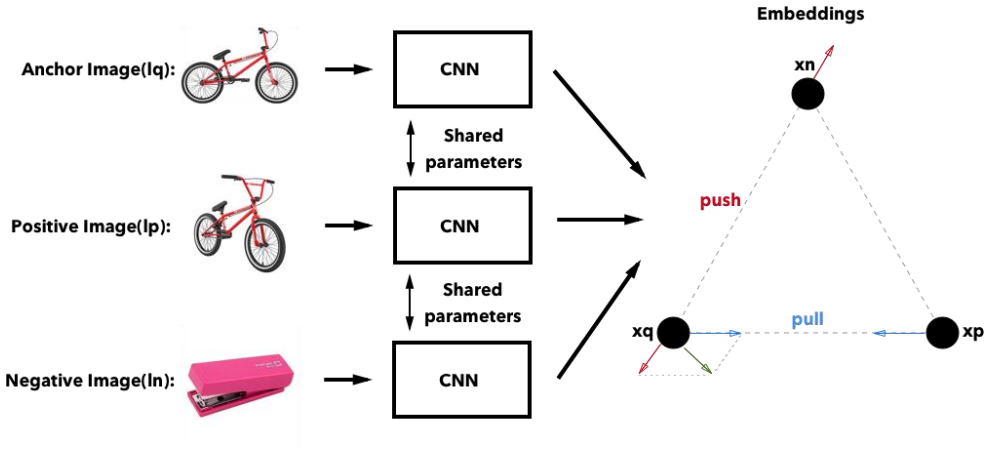


- F. Calısır, M. Bastan, Ö. Ulusoy, U. Güdükbay, '*Mobile Multi-View Object Image Search'*, **Multimedia Tools and Applications**, 2017.

Multimedia Databases

Learning Visual Similarity for Image Retrieval with CNNs

- **Learning efficient visual similarity for image retrieval by revealing resemblances and differences between product images**



Triplet loss

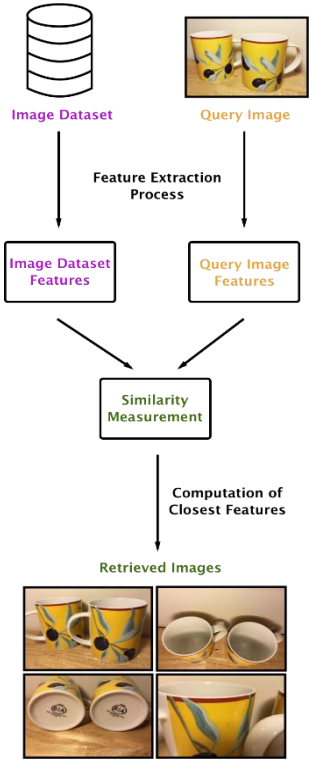


Image retrieval process

- D. Durmus, U. Güdükbay, Ö. Ulusoy, '*Learning visual similarity for image retrieval with global descriptors and capsule networks*', **Multimedia Tools and Applications**, 2024.

Social Network Analysis

- Misinformation Propagation in Social Networks
- Social Network Simulation
- Social Network Data Analysis on Big Data Processing Platforms

Social Network Analysis

Misinformation Propagation in Social Networks

- **Misinformation problem modelled as a game based on the notion of cooperative games**
- **Agents defined to maximize the total reward**
- **A blockchain - machine learning hybrid approach for addressing misinformation in a crowdsourced environment**

- T. Yilmaz, Ö. Ulusoy, '*Misinformation Propagation in Online Social Networks: Game Theoretic and Reinforcement Learning Approaches*', **IEEE Transactions on Computational Social Systems**, 2023.

Social Network Analysis

Social Network Simulation

- An open-source framework developed to facilitate modeling, simulation, and analysis of social networks
- Agent-based modeling methodology adopted for realistic modeling of human behavior
- Case studies implemented to demonstrate the framework's capabilities and ease of use

- A.N.N. Rende, T. Yilmaz, Ö. Ulusoy, '*Crowd: A Social Network Simulation Framework*', **arXiv:2412.10781**, 2024.

Social Network Analysis

Social Network Data Analysis on Big Data Processing Platforms

(joint work with Prof. İbrahim Körpeoğlu)

- **Community detection formulated as a multi-k-core problem**
- **Distributed multi-k-core construction and maintenance algorithms running on a big data platform**

- H. Aksu, I. Körpeoğlu, Ö. Ulusoy, '*An Analysis of Social Networks based on Tera-scale Telecommunication Datasets*', **IEEE Transactions on Emerging Topics in Computing**, 2019.
- H. Aksu, M. Canim, Y. C. Chang, I. Körpeoğlu, Ö. Ulusoy, '*Distributed k-Core View Materialization and Maintenance for Large Dynamic Graphs*', **IEEE Transactions on Knowledge and Data Engineering**, 2014.

Resourse Optimization in Wireless Sensor Networks

(joint work with Prof. İbrahim Körpeoğlu)

- **Application placement with shared monitoring points in WSNs**
- **Application scheduling with multiplexed sensing of monitoring points in WSNs**

- M. C. Cavdar, I. Körpeoğlu, Ö. Ulusoy, '*Application Scheduling with Multiplexed Sensing of Monitoring Points in Multi-purpose IoT Wireless Sensor Networks*', **IEEE Transactions on Network and Service Management**, 2024.
- M. C. Cavdar, I. Körpeoğlu, Ö. Ulusoy, '*Application placement with shared monitoring points in multi-purpose IoT wireless sensor networks*', **Computer Networks**, 2022.