Mobile Vision for Ambient Learning in Urban Environments

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Motivation

- Mobile vision for personal assistance
  - Automated mobile image analysis
  - Outdoors object detection and identification
  - Vision providing object and context awareness

- Urban environments
  - Tourist city information systems
  - Shopping assistants
  - Assistive technology for the visually impaired

- City exploration and learning
  - Intuitive multimodal Human Computer Interfaces (HCI)
  - Contextual learning
Motivation
Mobile Vision - State of the Art

Multimedia VTT, Finland

AR-PDA, Germany

CMU Pittsburgh, USA
(Yang et al. 2001)
Motivation

JR Outdoors
Object Recognition

- **EU Cognitive Vision Projects**
  - EC Project DETECT: logo detection
  - EC Project MACS: purposive robot vision
  - Mobile Vision

- **Industrial Projects**
  - Mobile road sign inventory
  - Traffic surveillance systems

- **JRP ASF Cognitive Vision – Key Technology for Personal Assistants**
  - Attentive recognition strategies
  - Contextual memories

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Motivation

Urban Information Systems

- Vision enhanced city explorer
- Information in field of view
- No maps or addresses
Mobile Learning in Urban Environments

Urban Objects
Mobile Learning in Urban Environments

Ambient Learning

- Exploration of urban environment
- Responsive to objects in the field of view
- Object awareness

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MLEARN 2004, Lago Bracciano, Italy
Mobile Learning in Urban Environments
Multimedia User Interface

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Local environment (*Hauptplatz Graz*)

- 10 objects (*7 buildings, 3 statues*)
- Each from 3 different viewpoints
- Imagettes *10x10, 15x15, 20x20, 25x25*
- Informative features and voting
Learning Discriminative Features

ROI for training samples

Discriminative imagettes
Discriminative Features

- Discriminative features
- Voting of responses
- Integration of votes
Computer Vision Methodology
Sight Identification

Hauptplatz building
Opera house

Church statue
Hauptplatz building
**Computer Vision Methodology**

**Viewpoint Changes**

- **ROI for training samples**
- **Glacis avenue building**
$H_a(\Omega|g) = -\sum_{\alpha_k \in \Omega} P(\alpha_k|g) \log(P(\alpha_k|g))$

Fritz et al. AAAI 2004
Informative Representations

- Entropy threshold \( \Theta \)
- Maximum a posteriori interpretation
- Sparse object representation \( \leq 10\% \)
Robust on Occlusion and Noise

40% occlusion

80% occlusion

50% Gaussian noise
Occlusion Performance Analysis

INFORMATIVE imagettes

ALL imagettes

Recognition Rate [%]

Occlusion [%]

Fritz et al. ICPR 2004

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MLEARN 2004, Lago Bracciano, Italy
Conclusion and Outlook

- **Conclusion**
  - Mobile vision and object recognition
  - Learning from city exploration

- **Ongoing and future work**
  - Extended scope - objects, viewpoints, illumination
  - Application using camera phones
  - Logging tourists
    - localisation
    - trajectories
    - focus of attention
Localisation

Legend
- GPS-based position estimation
- Object
- Object capture position (OCP)
- GPS-indexed OCP
Thank You for Your Attention!