Towards a more effective method for analyzing mobile eye-tracking data:

integrating gaze data with object recognition algorithms

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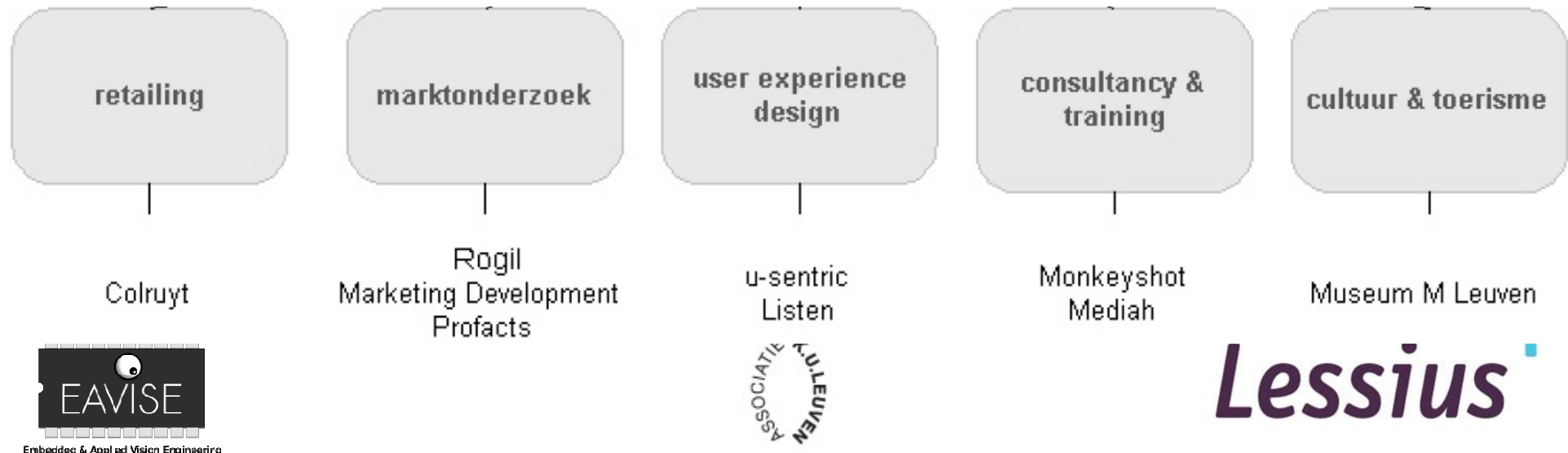Embedded & Applied Vision Engineering

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Project details

New starting project with the following partners:
- Dep. Applied Linguistics, Lessius Antwerp, Belgium:
    - Geert Brône and Bert Oben
- Embedded and Applied Vision engineering, Lessius Mechelen, Belgium:
    - Toon Goedemé and Kristof Van Beeck
- User commission of company partners:

| retailing | marktonderzoek | user experience design | consultancy & training | cultuur & toerisme |

| Colruyt | Rogil Marketing Development Profacts | u-sentric Listen | Monkeyshot Mediah | Museum M Leuven |

Introduction

- Mobile eye-tracking hardware boom
    - SMI Iview X
    - Tobii Glasses
    - Mangold Mobile Eye

- Big potential: natural environment, beyond lab conditions
    - Supermarket
    - Sports court
    - On the road

- Problem: *manual* data analysis
    - Large amounts of data
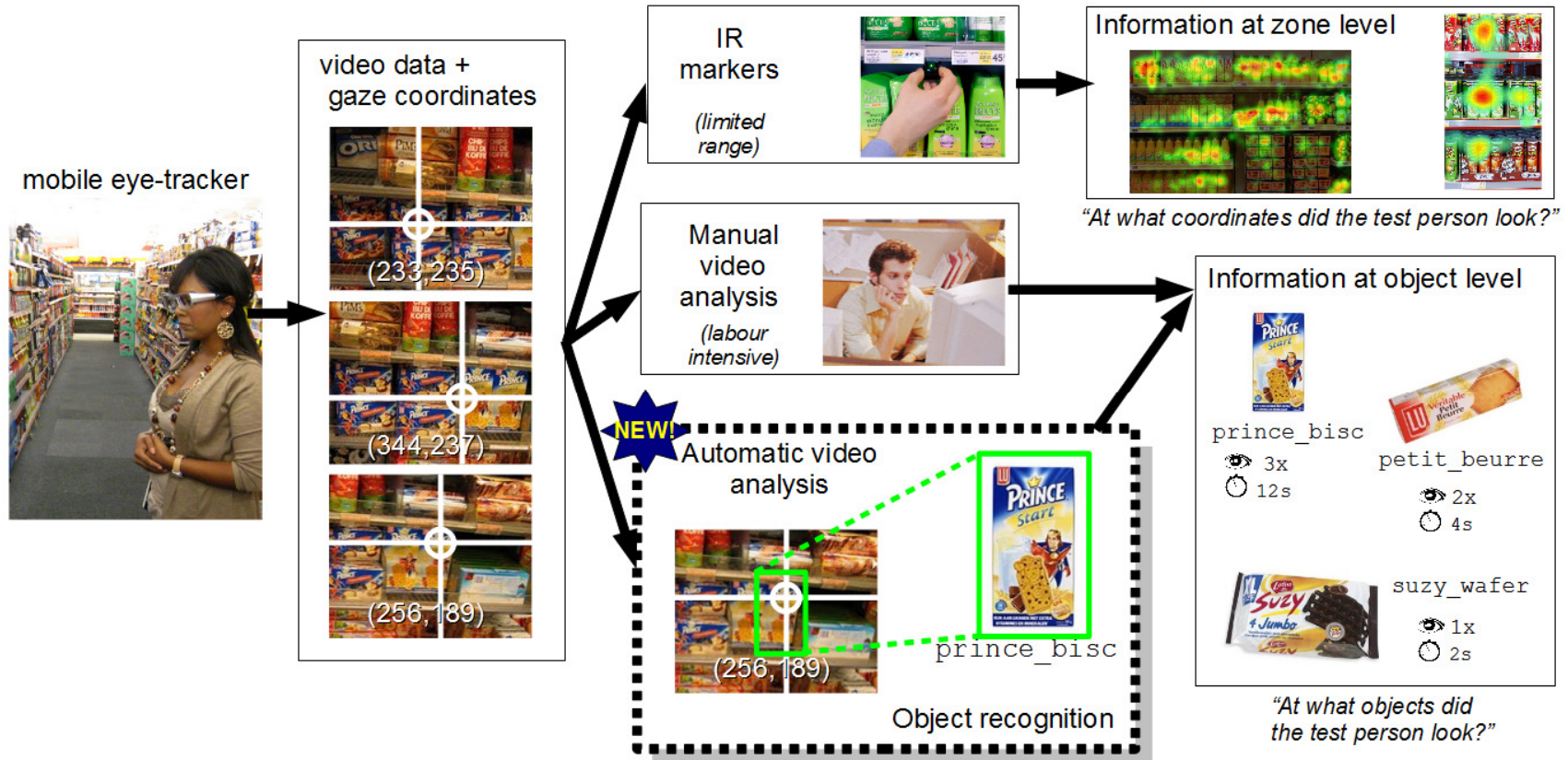   - Existing methods for automatic processing not applicable

Overview

What's wrong with AOA's?

- Commercially available processing technique:
  - IR markers on objects/shelves
  - Define AOA's and AOI's

- Limitations of this system:
  - AOA defined before test
  - Multiple identical objects need multiple markers
  - AOA is 2D
  - Objects must stay fixed
  - Economically unfeasible for large environments
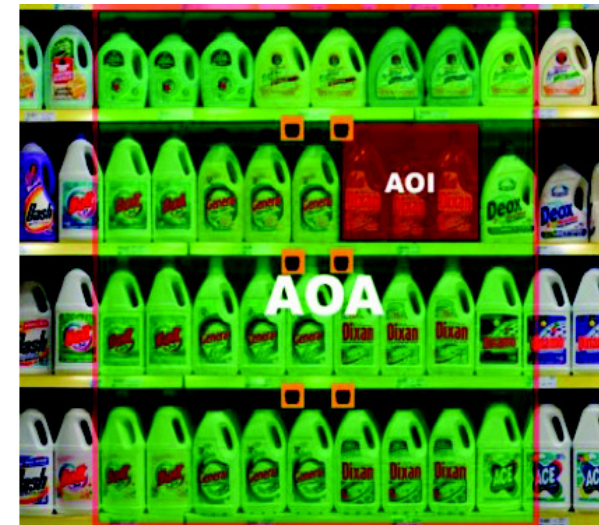
Proposed technique

- Object recognition algorithm automatically analyses video stream (with gaze data)
- Benefits:
  - Target of analysis is not restricted to a region but can be any object (stationary or in motion)
  - Objects do not have to be defined before data capturing
  - Manual labour limited

Anco_zelfr_bloem

Implementation of object recognition

- Requirements: robust against viewpoint changes, partial occlusion and illumination changes
- Invariant region matching techniques
  - Algorithm defines interest regions
  - Descriptor vectors invariantly describe visual content of regions
  - Matching of regions across images
  - Objects recognized when enough regions match
  - e.g.: SIFT (D. Lowe), SURF (H. Bay & L. Van Gool)
- Match area around gaze cursor with object database images

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Extra possibilities

- ## Training-by-looking-at
  - Database images are captured with eye-tracker by looking at objects to be recognized (before or after test)

- ## Object clouds
  - Novel representation method of eye-tracking experiment results
  - Analogous to word clouds
  - Objects that caught the eye more are shown at a larger scale

Case study 1: complex visual setting

- Eye-tracking products and labels in a supermarket
  - Shopper's choices are influenced by
  - Product positioning
  - Product packaging
  - Price labels

- Tests in a real supermarket, no lab situation

- Cross-validation of proposed technique, compared to classic IR-marker based approach

- Evaluation of the technique:
  - performance, time efficiency
  - user-friendliness, flexibility, quality

Case study 2: changing test conditions

- Challenge in eye-tracking:
  - Changing illumination
  - (rapid) movement of objects and reference points, …

- Case: navigation task in a large setting (inside or outside)
  - e.g. Museum or historic city centre
  - Person navigates using sign posts
  - "Does the test person look at the right signs in order to find his/her way to a target position?"

- Not feasible with classic approaches:
  - Lots of IR markers needed
  - Huge amount of video data for manual analysis

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Case study 3: moving objects and background

- IR-marker AOA analysis is limited to static settings

- Case: measurement of visual attention within a moving vehicle
  - Billboards
  - Traffic signs
  - Other road users
  - …

- Difficulty:
  - Large environment
  - Changing background

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Conclusion

- Mobile eye-tracking hardware boom
  - Big potential: natural environment, beyond lab conditions
  - Datasets too large for manual analysis
  - IR-marker-based approaches not applicable in natural environments

- Proposed technique:
  - Object recognition algorithms for data analysis
  - Lots of benefits as compared to IR-markers

- Feasibility study just started
  - 3 case studies chosen
  - Work in progress

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- Questions?

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