Tracker trees: hierarchies to spot rare events

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Motivation
• Autonomous living of elderly people in their homes.
• Aging society requires new solutions.
• Install cameras in peoples homes.
• Goal: Analyze the behavior of a person in the scene and report all kinds of abnormalities.

Our approach
Input

Tracker tree for elderly care

⇒ Foreground blob
⇒ (Partial) human appearances
⇒ Specific actions
⇒ Actions: person specific

Reasoning

Unusual event detection

Tracker tree concept

• Arrange trackers in a tree-like structure.
  • A tracker at each node.
  • Get semantically more rich, from bottom to top.

• Abnormal event detection
  • Assumption about the normal world no longer holds,
  • Anomaly: one tracker reacts, but none of its more specialised children,
  • Semantic interpretation is possible from the location of the anomaly in the tree.

Examples

Normal
Fall
Intruder

• Requirement: trackers at different levels of detail.
• Technical implementation:
  - A1: CAMshift tracker [Bradski 98],
  - B1: Person detector [Felzenszwalb 2008] (tracking-by-detection),
  - B2-4: Model tracking (training on body parts),
  - C1-2: Model tracking (training on actions),
  - D1-2: Model tracking (training on individuals).

Tracking method

⇒ Representation:
  - BG subtraction,
  - Down sampling,
  - Distance transform.

⇒ Learning a low dim model
  • Non-linear dimensionality reduction,
  • Exploit the small number of intrinsic d.o.f.,
  • One manifold encodes one human action.

⇒ Model interpretation

⇒ Probabilistic tracking

• Likelihood estimation
  • 6D particle filter
  • posterior PDF for each frame.

Results

• No standard dataset is available for the evaluation of in-house rare events.
• Tests on different recordings and scenarios.
• Plot posterior probability of the independent trackers over time, infer model belonging, perform reasoning.

videos: www.vision.ee.ethz.ch/~fnater/tracker-trees