Recognition of Abnormalities in Harbours with Computer Vision

Tunc Alkanat

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Outline

- Introduction
- System Overview
- Location-based Anomalies
- Vision-based Anomalies
- Conclusions

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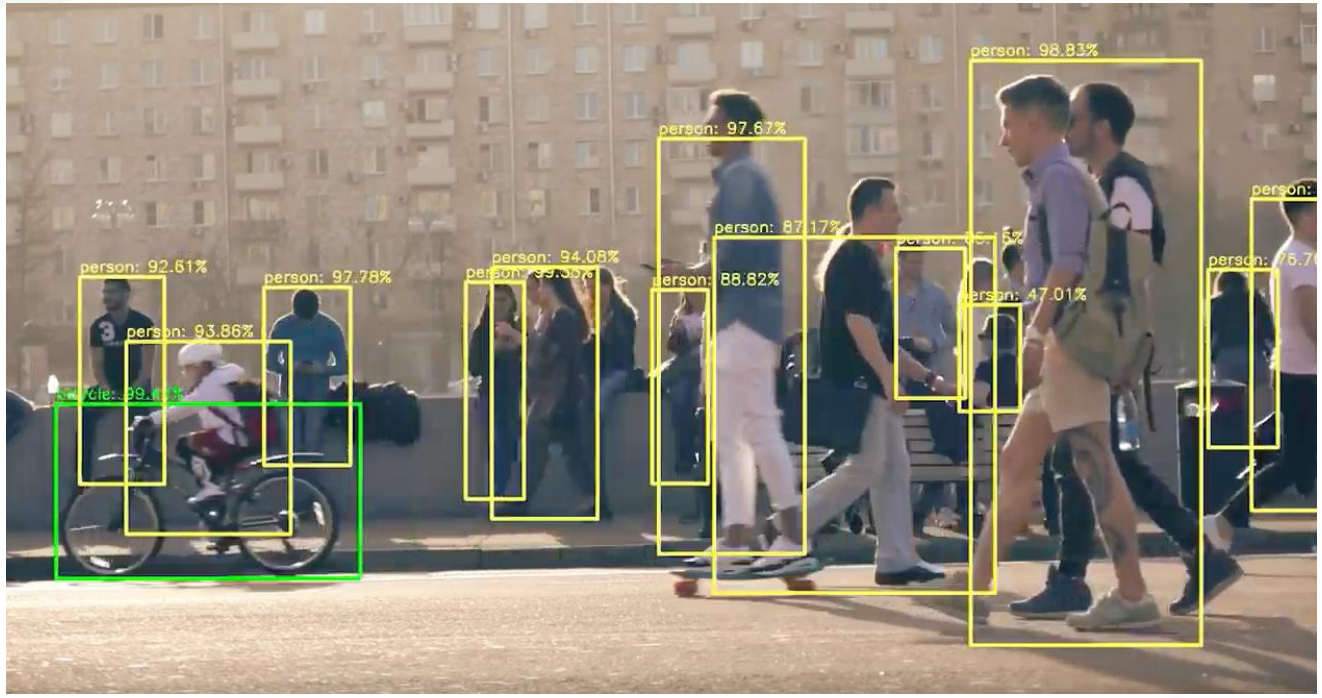
Introduction: Computer Vision

- Computer vision is a field of computer science that enables computers to interpret and understand the visual world.
- Computer vision aims to extract useful information from given images.



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Introduction: The PASSAnT Project

- At present, public safety continues to be a major concern of society.
- Ports are strategic places, where a variety of crimes may take place.
  - Human trafficking
  - Illegal immigration
  - Drug trafficking
  - Burglaries etc.
- Eindhoven University of Technology is responsible for the automated anomaly detection.

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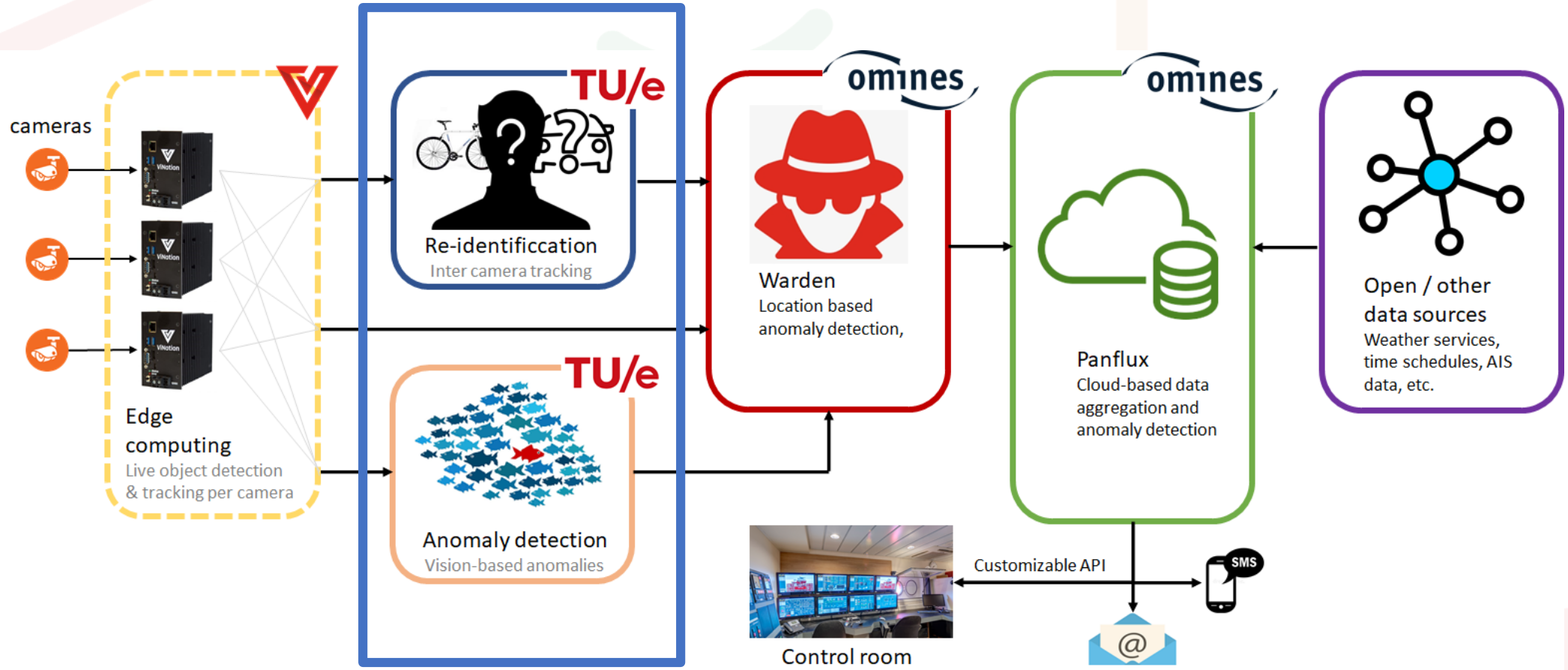
Introduction: Work Package 3



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System Overview: Use Cases

- **Examples of suspicious abnormal behavior:**
  - Climbing-Crawling
  - Digging
  - Vandalism
  - Violence
  - Scouting
  - Drug dealing
  - Traffic anomalies
  - Human trafficking etc.

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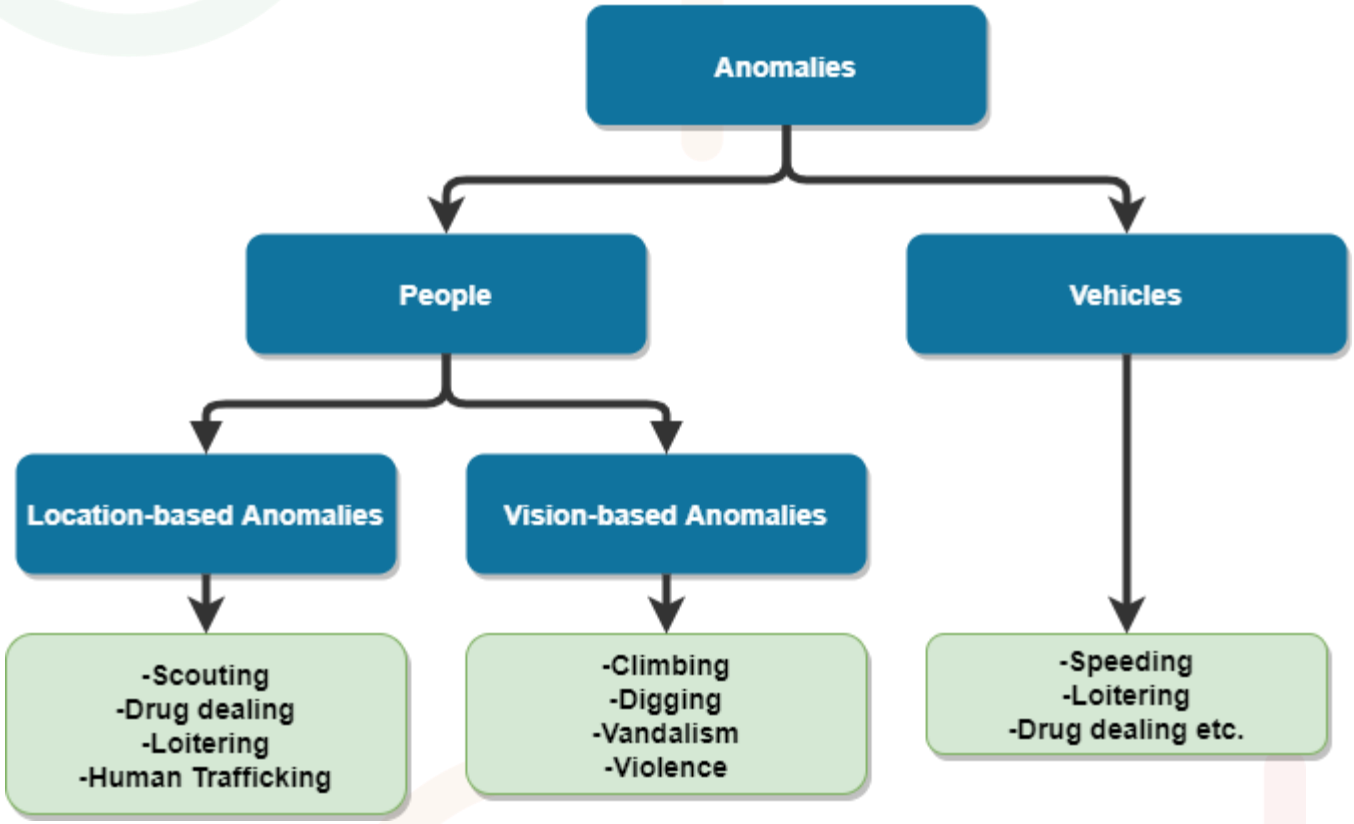
System Overview

- **Location-based anomalies**
  Suspicious movement patterns over a large area.

- **Vision-based anomalies**
  Real-time analysis of video streams for abnormal behavior.



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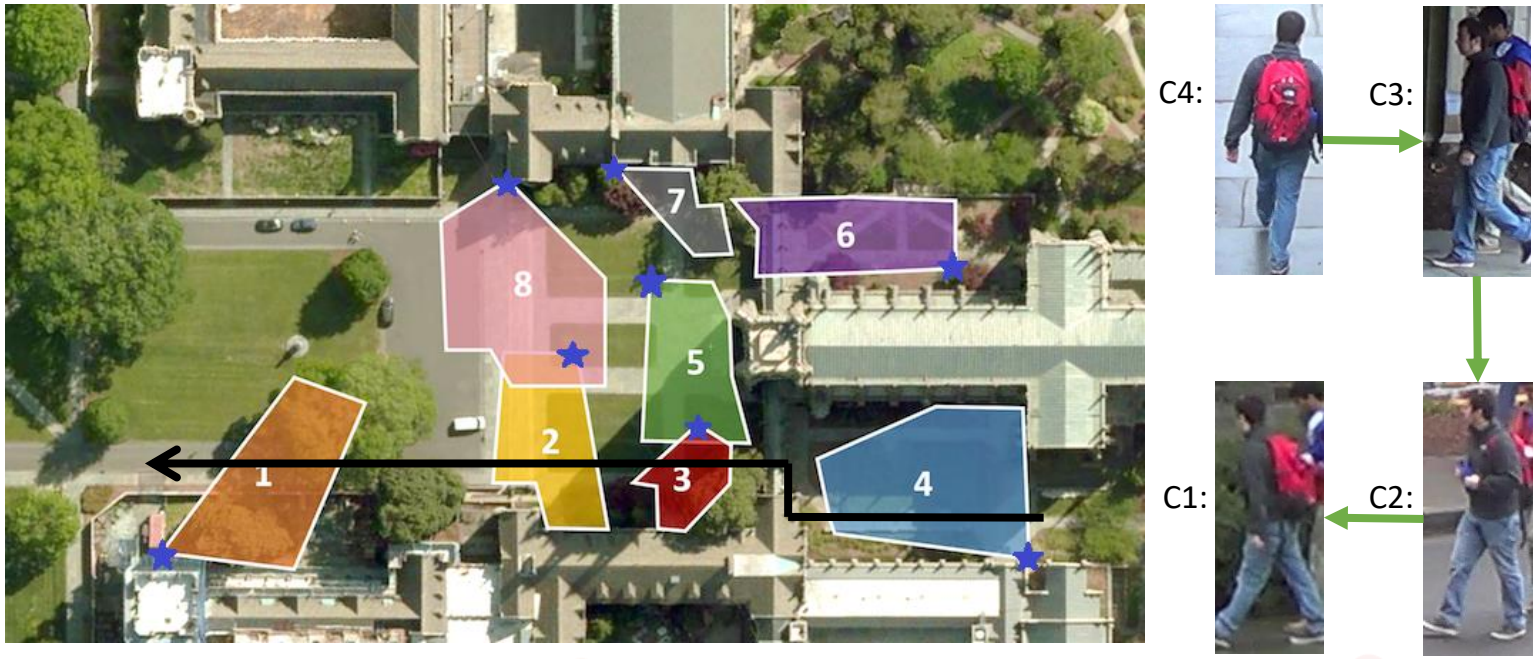
Location-based Anomalies

- Detection and tracking of people within a camera view is well-known.
- But what happens when a person leaves the camera view and enters another one?
- **Person re-identification** allows you to recognize a previously seen person on another camera.



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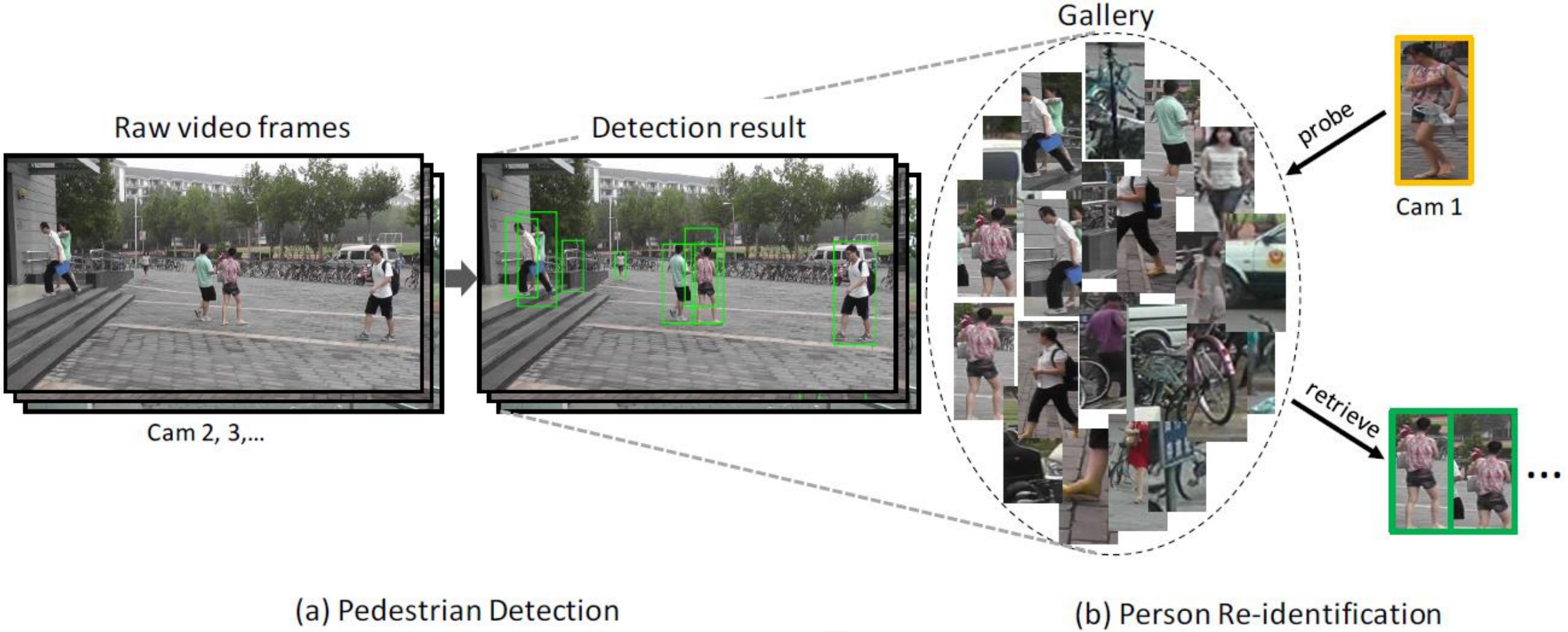
Re-identification



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Re-Identification: Results

- Evaluated on the test set of the Port of Moerdijk dataset, our person re-identification module can retrieve the top-1 correct match with **94% accuracy**.
- Our method can process 17.8 re-identifications **per second** on a single GPU. This means **more than 64k** new appearances per hour!

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Vision-based Anomalies

- Not every anomaly is associated to position.
  - Some abnormal behaviors are stationary.
  - We cannot analyze this with the location information alone.
  - Vision-based anomaly detection can help.
- We address the following use cases with vision-based anomaly detection:
  - Digging
  - Fighting
  - Vandalism
  - Climbing
  - Throwing etc.

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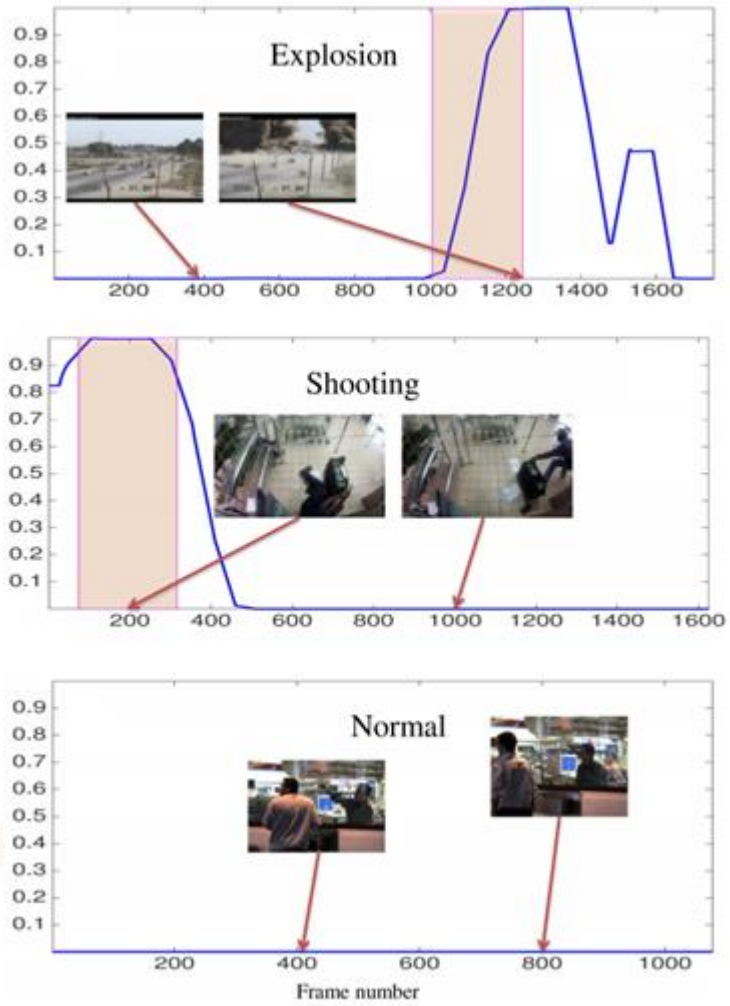
Anomaly Detection

- How it works?
  - Learns “normal” behavior from regular video streams.
  - Algorithm outputs an anomaly score at each frame.
  - High anomaly score => Trigger to the control room.
- Advantages
  - No labeling necessary.
  - Supports hard-to-model anomalies.
- Disadvantages
  - Does not distinguish between different anomaly types.
- Real-time implementation
  - Our implementation takes only 4 msecs to process a single detection.
  - Easily adaptable to new cameras & locations.



Sultani, W., Chen, C., & Shah, M. (2018). Real-world anomaly detection in surveillance videos. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 6479-6488).

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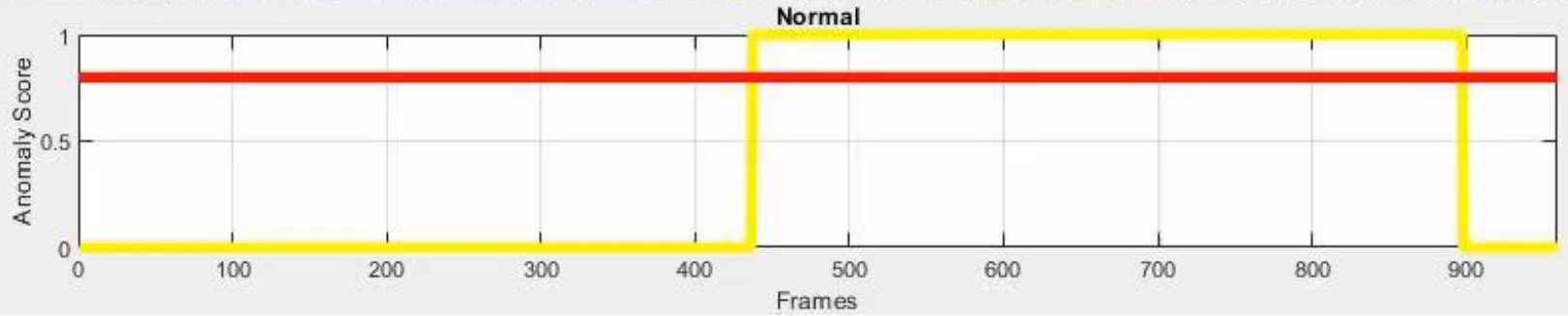
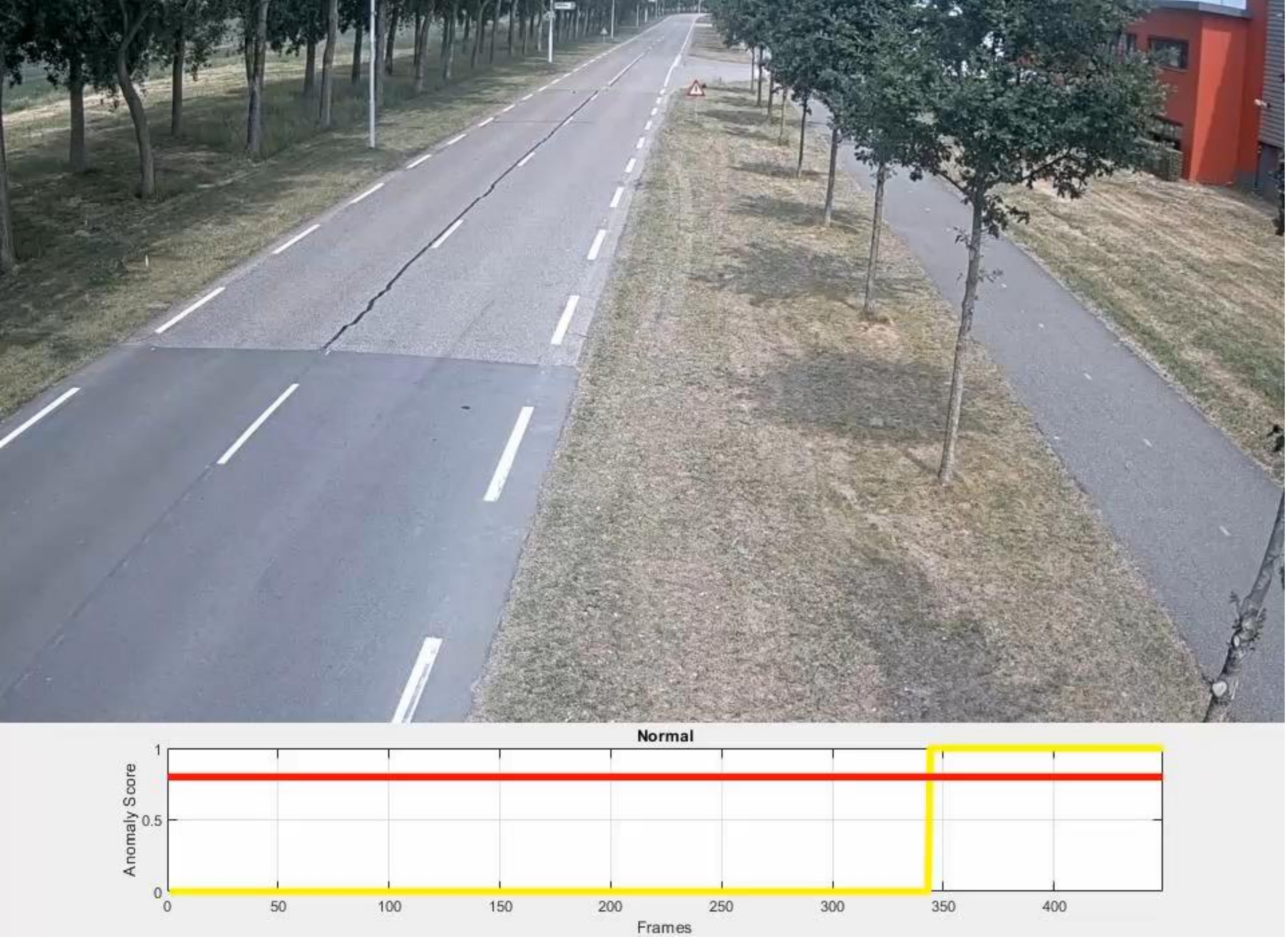
Fighting #1

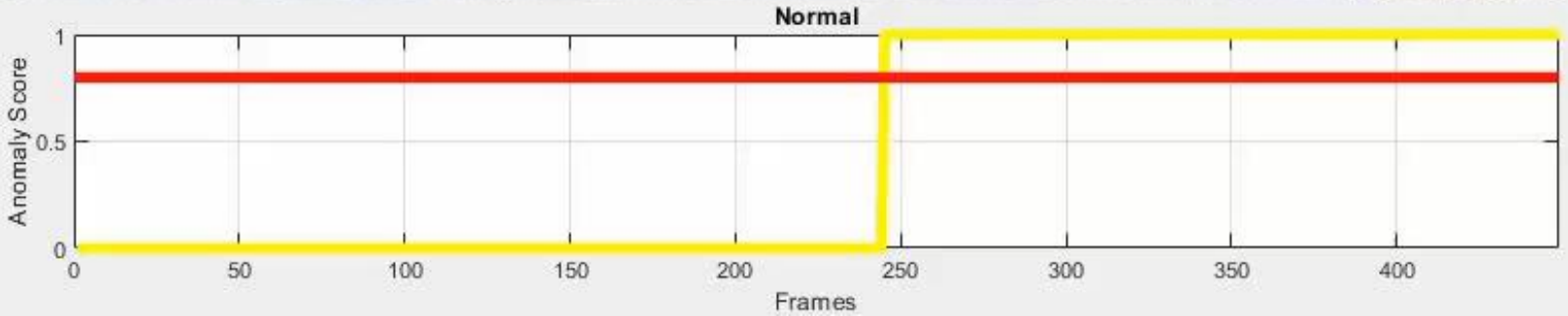


IPASSANT

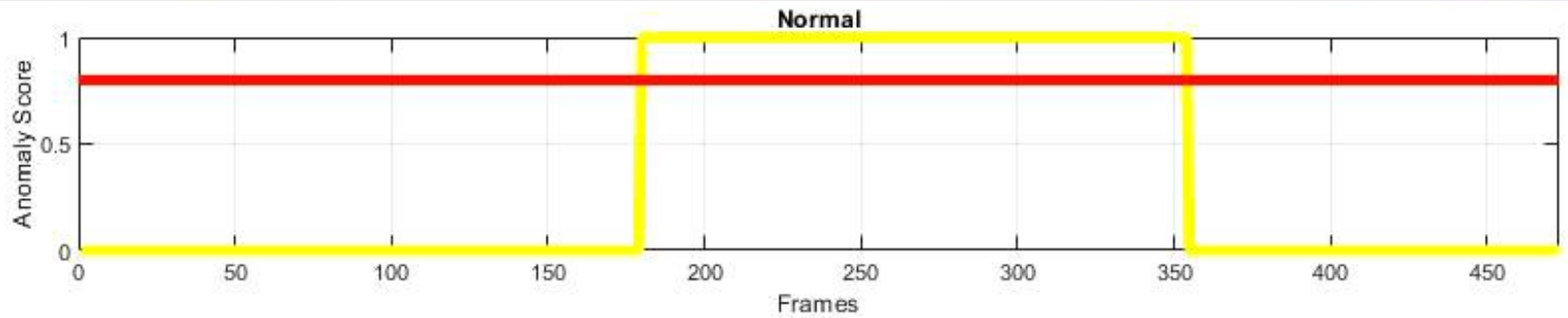
Fighting #2


Normal
Anomaly Score
Frames
1
0.5
0
0
50
100
150
200
250
300
350
400

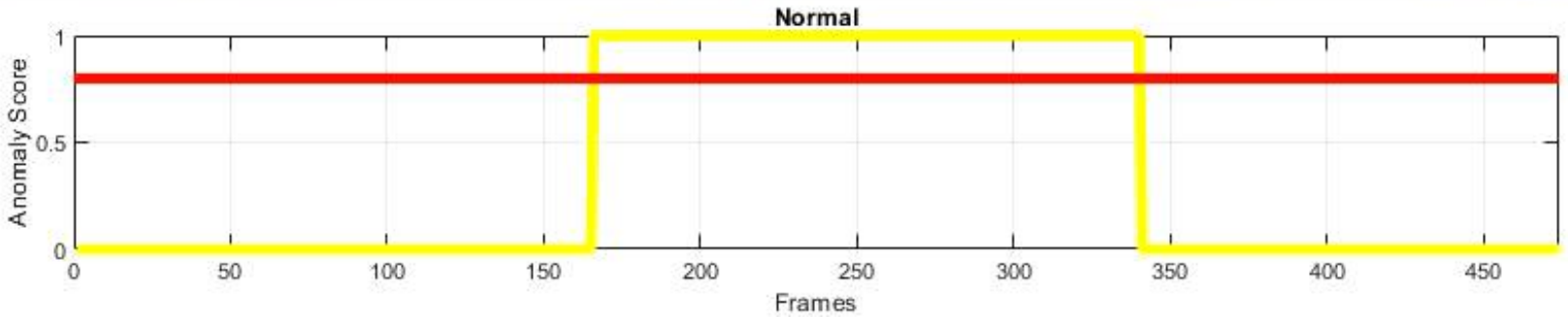
Digging


Normal
Anomaly Score
1
0.5
0
0
50
100
150
200
250
300
350
400
Frames

Snatching



Climbing over the fence



Climbing over the fence #2

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Conclusions

Our work package enables:

- Tracking of people over non-overlapping camera views.
- Revealing full movement patterns.

- Automatic detection of vision-based anomalies for the whole camera network.
- Easy integration with the control room as part of the anomaly detection work package.
  - Also features a dedicated dashboard with live security information: See *“Intelligent video surveillance for large premises”* work session for details.

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Thank you for your time and attention!

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