Gray Matter
Empowering Intuition

# Video Analytics

# Potential benefits

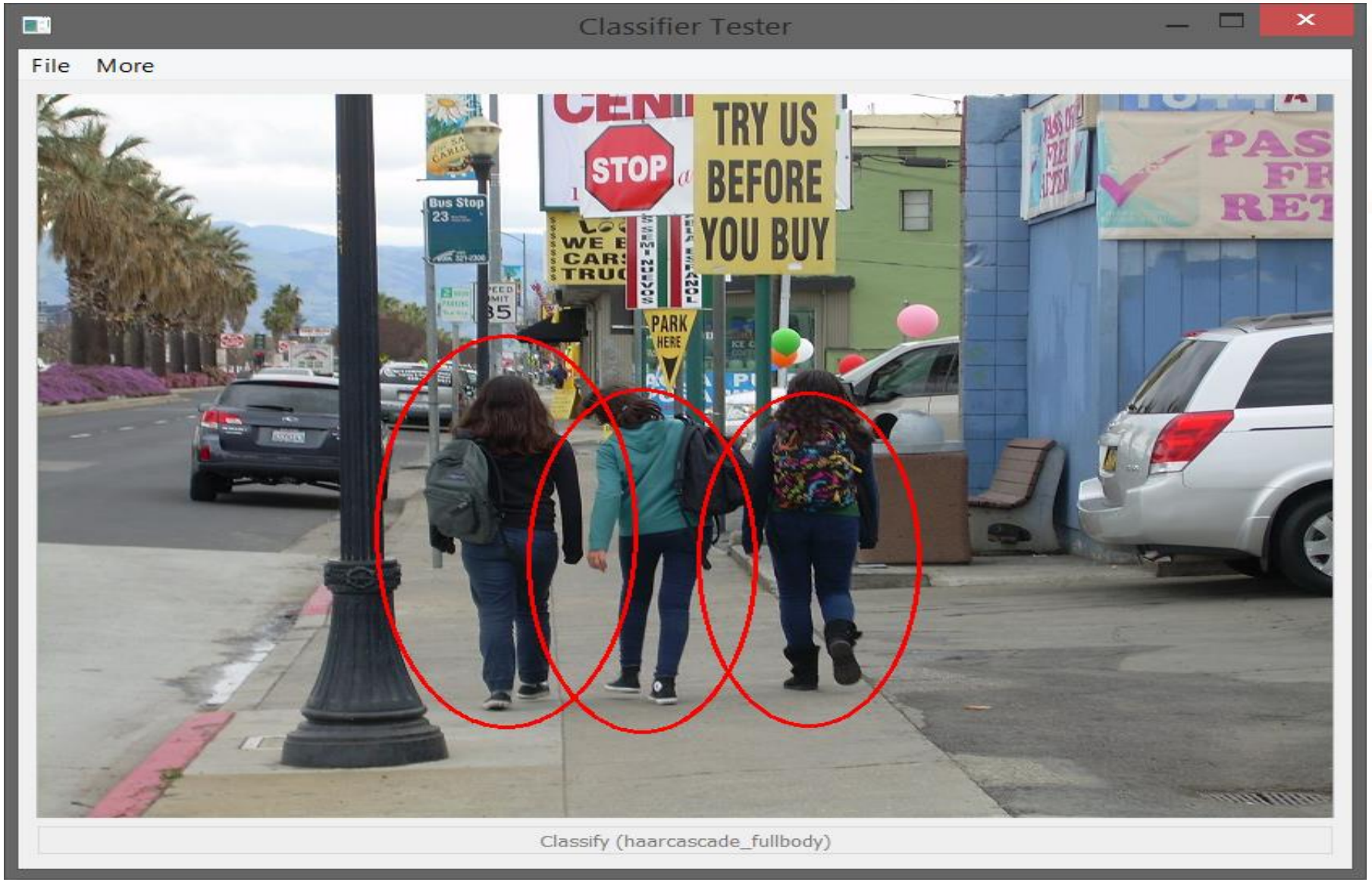
- Better resource allocation
  - Utilities
    - Air conditioning / heating / lighting
  - Personnel
    - Maintenance / security
- Detecting unauthorized facility access
- Better Queue management by detecting number of people in the Queue
  - Advance intimation of time-to-service
  - Opening of new counters
- Identify areas that attract people or that people avoid

# People detection: Methodology

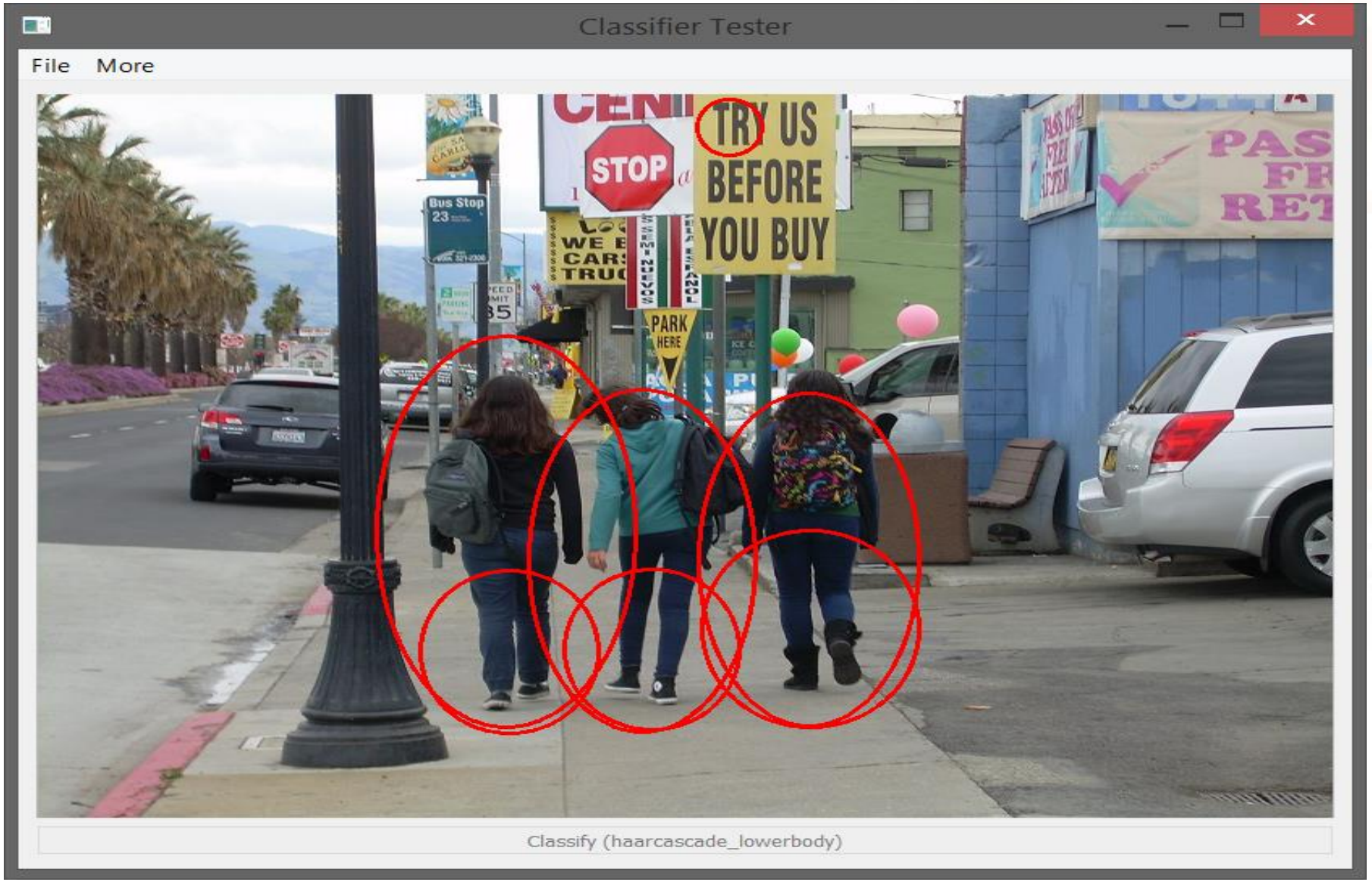
- Feature detection
  - Works with separate images (doesn't need a video)
  - Vulnerable to background clutter and occlusions
  - Training a new classifier requires many sample images

- Movement detection
  - Works well if the surroundings can be controlled (e.g., camera location)
  - Detects all movement – Not just people
  - Motionless objects become a part of the background
  - Multiple targets may be combined into one detection
  - Need feeds from fixed camera, camera movement can create movement in environment

# Feature Detection: Full Body



# Feature Detection: Lower Body



# Movement Detection: Background Subtraction

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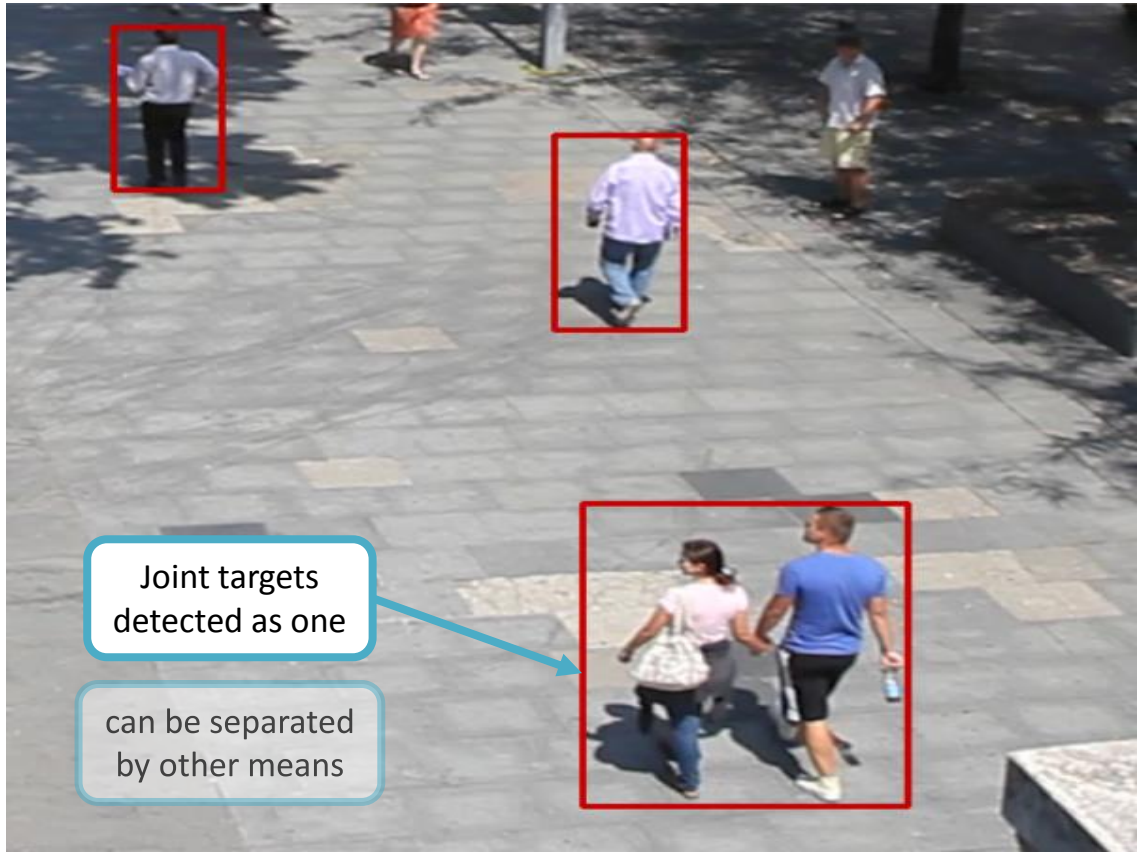
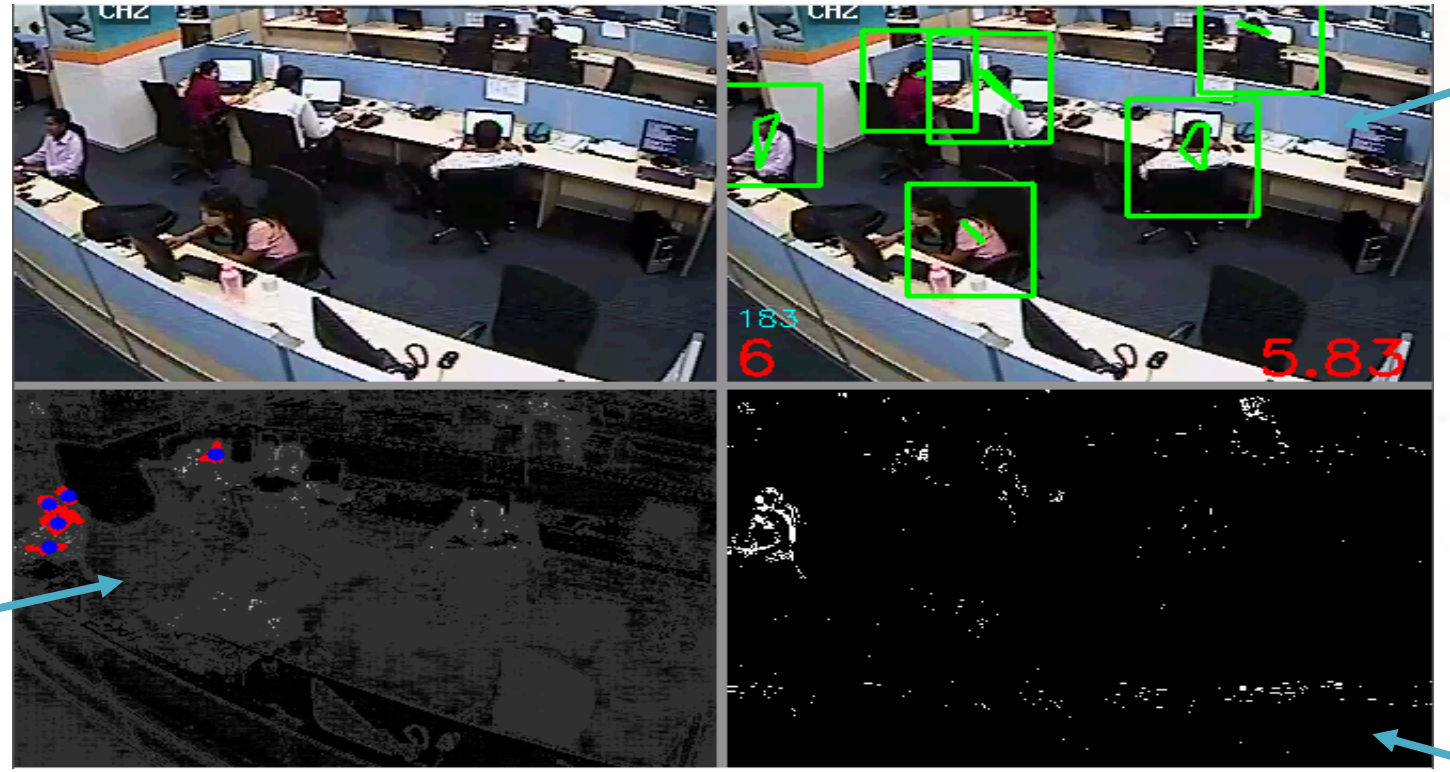



# Use Case 1: Office Environment

- Detecting person sitting in an office
- Low video quality
  - Poor resolution
  - Moving distortions
- Feature Detection methods fail
  - Not enough features to track
    - Persons mostly behind a chair or otherwise partial view
- Movement Detection method provides acceptable results
  - Challenges:
    - Very little movement
    - Background cannot be properly separated from the distortion

# Use Case 1: Office




Detected persons

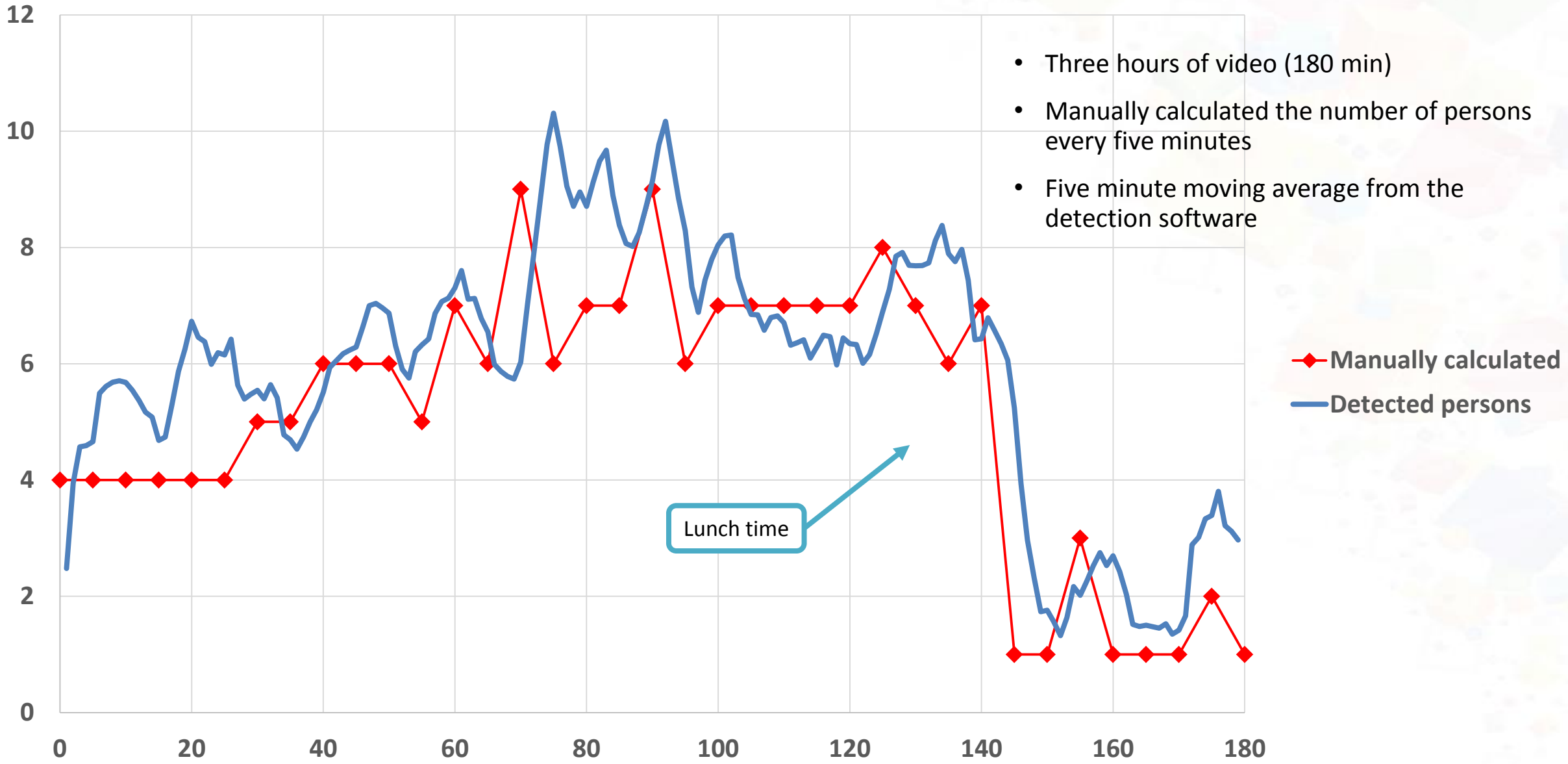
Moving distortion

Areas with constant movement

Detected movement

Play video

# Use Case 1: Results




- Three hours of video (180 min)
- Manually calculated the number of persons every five minutes
- Five minute moving average from the detection software

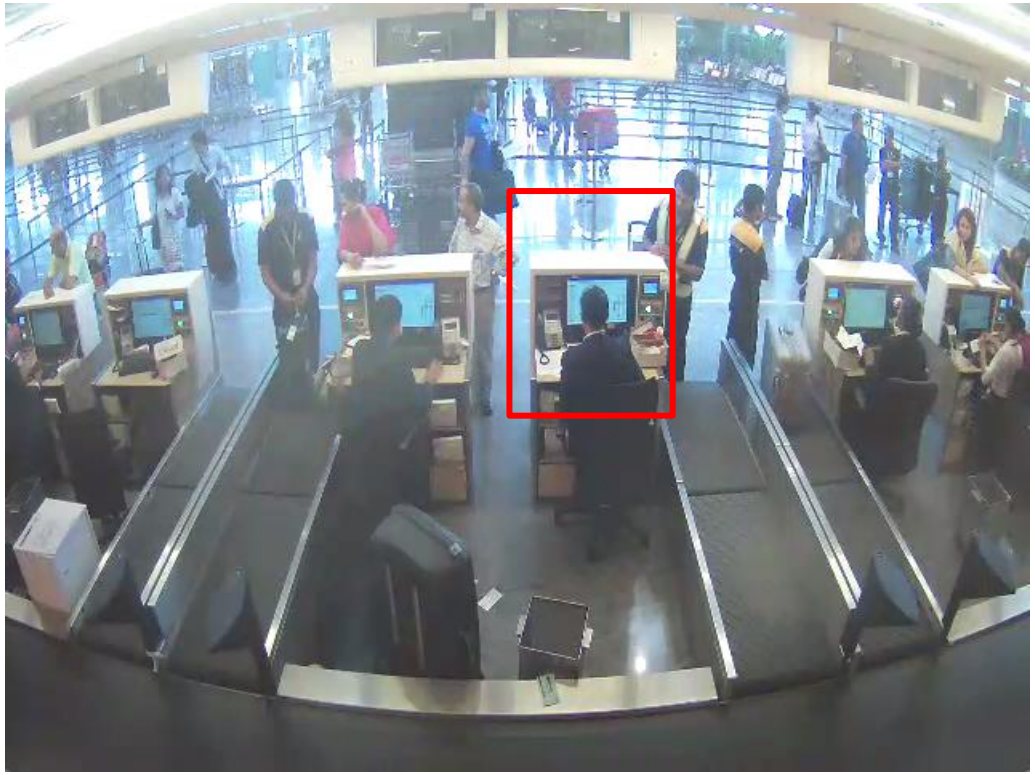
# Use Case 2: Objectives

- Monitor check-in counters
- Determine the average number of people in the queue
- Determine the average queueing time

# Use Case 2: Challenges

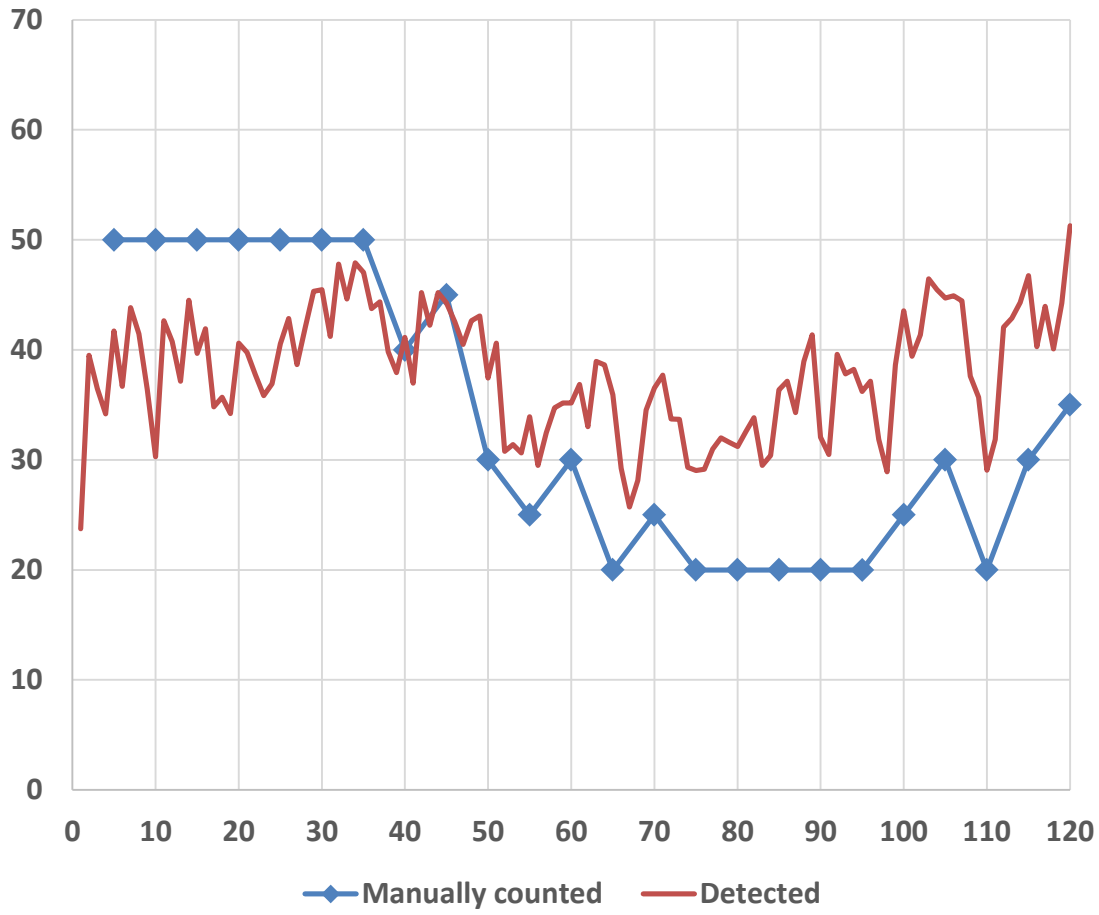
- Low camera angle causes heavy overlap between people
- The most interesting information is on a small area of the image
- Low contrast on certain areas of the image

# Use Case 2: Challenges



- Strong backlight creates large shadows
  - Additional movement on the area the queue is supposed to be
- Reflective floor confuses shadow detection
  - Floor color (bright, almost white) differs too much from the shadow color

# Use Case 2: Results




- Manual count is approximative
  - Difficult even for a human to count
  - Human eye is specialized in detecting persons
- The approach works, and it's able to detect the changes in the queue length
  - The accuracy of the count is not as good as it should – why?

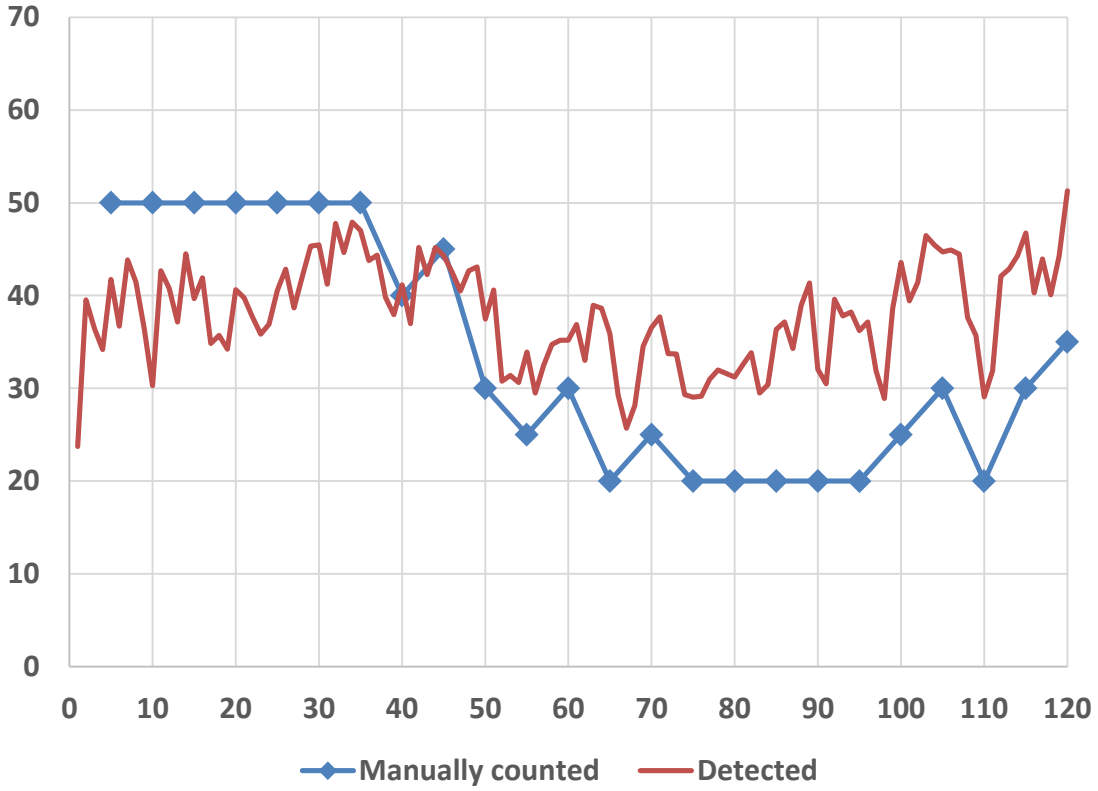
# Use Case 2: Poor Accuracy due to Congestion

- Because of the overlap, we miss some targets when the scene is crowded, and because of the reflections, we get false detections when there's plenty of room
  - The person count alone is not fully reliable
- We need more information about the level of congestion
- Solution: Let's monitor the type of targets – moving or still
  - When the congestion is high, people have a little room to move
  - When the congestion is low, there are more moving targets
  - The ratio of the two describes the level of congestion

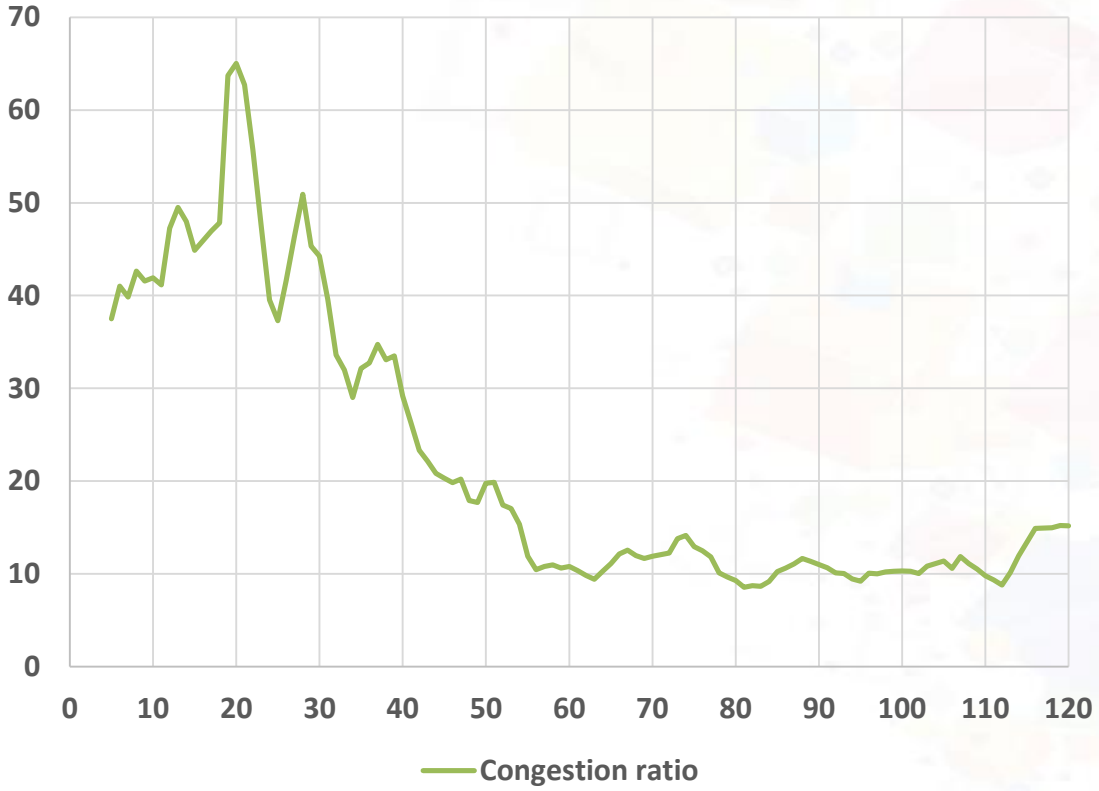
# Use Case 2: Congestion detection

# Use Case 2: Congestion ratio

## Previous results




## Congestion ratio

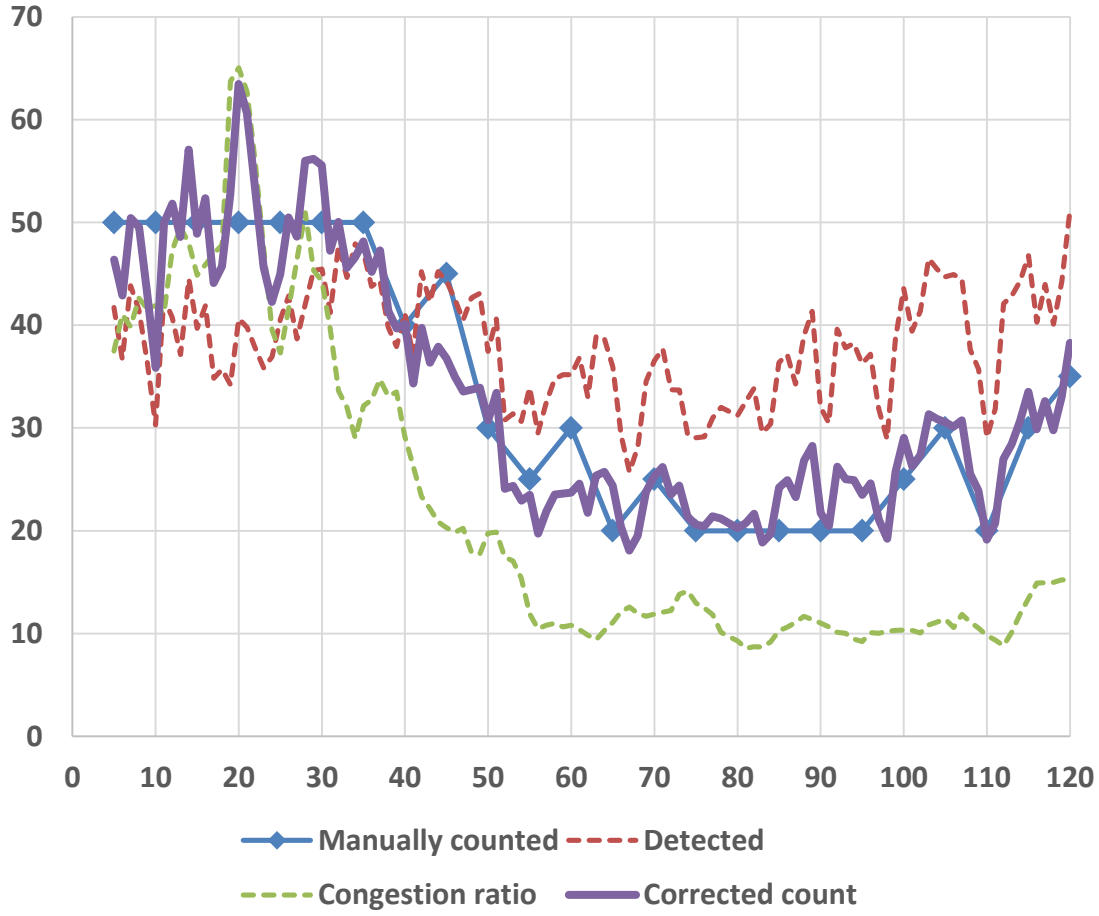







https://drive.google.com/file/d/0B5jyDSutmTF3NC0wdEJyQ080TlE/view?usp=sharing

# Use Case 2: Corrected results




- After using congestion ratio to correct the detected count, the results improved significantly

# Technology

- Implemented in C/C++

- Video and Image processing library used: OpenCV
  - OpenCV (Open Source Computer Vision) is a library of programming functions mainly aimed at real-time computer vision
  - The library is cross-platform
  - Free for use under the open source BSD license

# Summary

- People detection is a hard problem for a computer
  - Humans start practicing as babies
- There is no method that can properly cover all scenarios
- Different methods can be combined depending on:
  - Required accuracy
  - Available computing capacity
  - Video quality (resolution, angle…)
  - Each camera requires calibration of parameters