Distributed Framework for Multi-Camera People Tracking

Gruenwedel S., Niño J., Jelaca V., Philips W.

Ghent University – TELIN - IPI – IBBT

St-Pietersnieuwstraat 41, B-9000 Gent, Belgium

http://telin.ugent.be

E-Mail: sebastian.gruenwedel@telin.ugent.be

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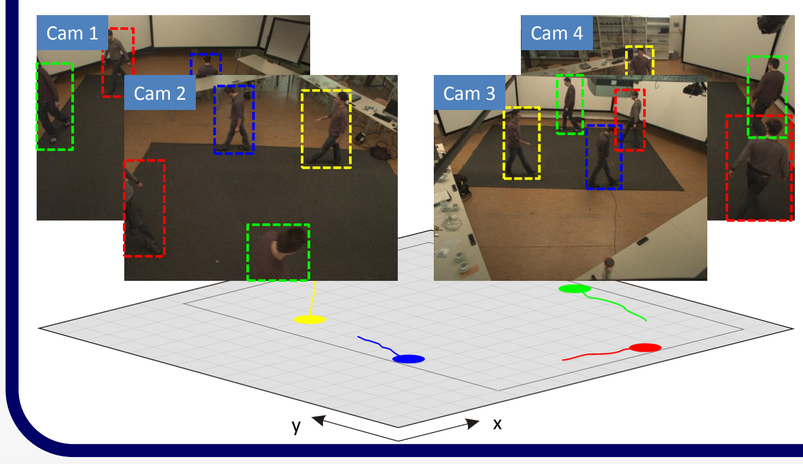
Abstract

This work presents a distributed framework to track people in a multi-camera network designed for real-time and scalability. For the task of foreground detection, we propose an edge-based approach to robustly overcome the problem of lighting changes. We use edge dependencies as statistical features of foreground and background regions and define foreground as regions containing moving edges. Experiments prove the robustness of our method in the presence of lighting changes as well as show promising results for 3D tracking.

Multi-Camera Tracking



The goal is to perform tracking of people based on 2D tracking within a smart camera network with a feedback loop to correct mistakes of an individual camera.

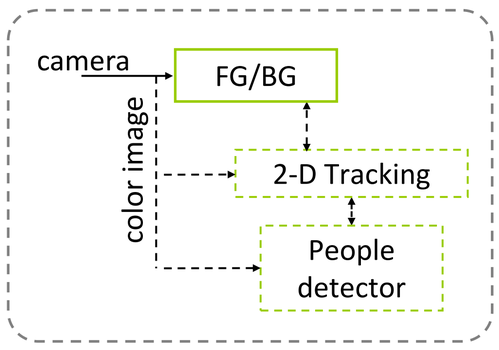
The application targets

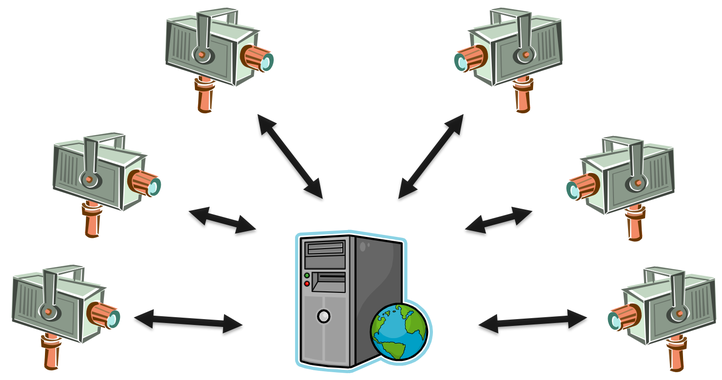
- real-time,
- tracking under illumination changes,
- algorithms to be used in smart cameras and
- a scalable and distributed multi-camera system.

System Architecture

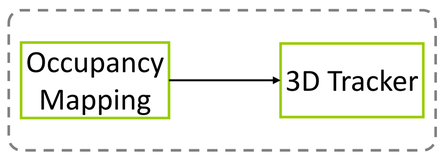
Camera side:

- Smart camera emulation
- 2D tracking approach with allowable mistakes





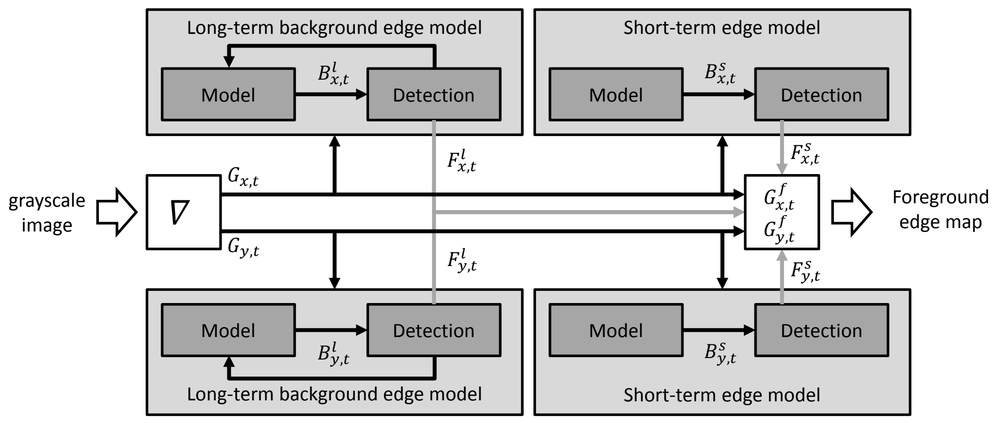
Exchange of meta data



Server side:

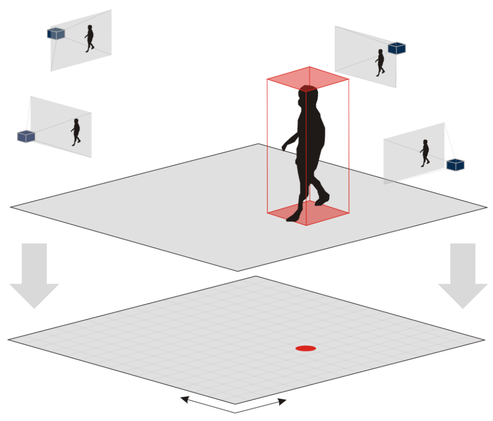
- Tracking of people within a specific space using a smart camera network
- Get meta data from each camera as tracking input
- Feedback loop to each camera to correct 2D tracking in difficult situations

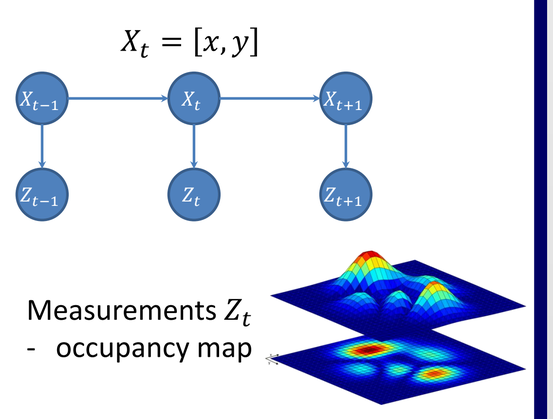
FG/BG: Edge-Based Foreground detection



- Combination of edge detection and recursive smoothing techniques to detect moving objects
- Edges dependencies are used as statistical features of foreground (moving edges) and background regions (static edges)

Occupancy Mapping & 3D Tracking





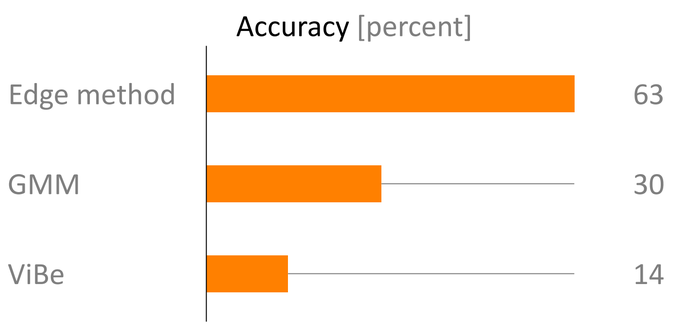
Occupancy mapping:

- Projection of foreground evidence onto the ground plane
- Dempster-Shafer data fusion

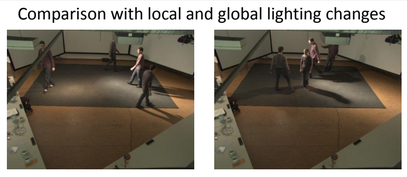
3D Tracking:

- Tracking of people based on the 2D camera information

Results for FG/BG & Conclusion



Comparison with local and global lighting changes



- Our proposed edge method performs best compared to GMM and Vibe.

- Foreground edge features will be used as another cue to improve 2D tracking, esp. under difficult situations (such as lighting changes)

Tracking Results & Conclusion

Number of object losses & mean distance error

Person 1	97 %	24,1 cm
Person 2	95 %	25,3 cm
Person 3	95 %	28,8 cm
Person 4	98 %	20,0 cm

1 2 3

- Preliminary evaluation of 3D tracking based on FG mask as meta data and occupancy mapping
- Ground truth data of 4 cameras, indoor sequence (around 1 min, 4 persons)

- Ongoing research uses a feature vector as meta data (e.g. bounding boxes) to perform tracking in 3D