

Real-time Tracking System for Swarm Robotics

Système de tracking temps réels pour la robotique en essaim

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Master I Informatique IMA

Projet IMA

Superviseurs: Séverine Dubuisson et Nicolas Bredeche

Le 11 Avril 2016 à Université Pierre et Marie Curie (Paris VI)

► Problem and Scientific Motivation

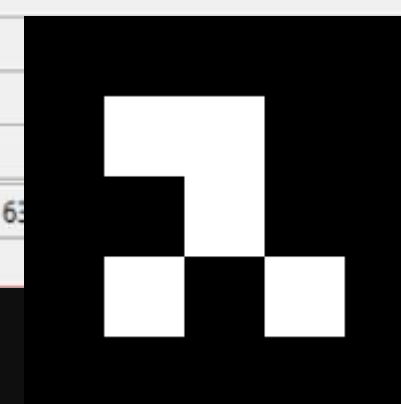
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Specifications

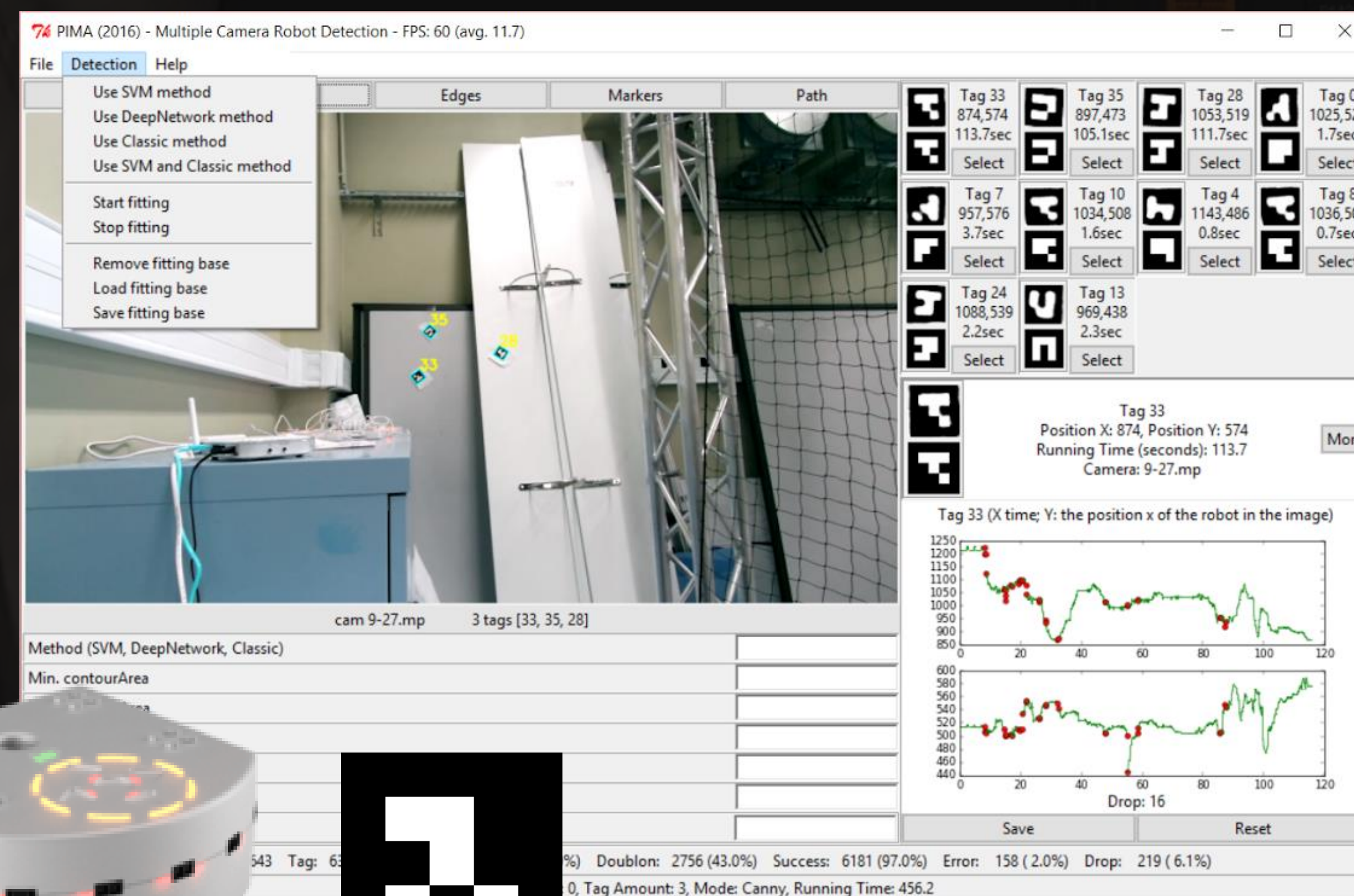
- Real-time method
- Using multiple cameras
- Simultaneously view a swarm of robots
- Multiple angles
- High resolutions
- Using visual cues
- Integrate information
- User interface



Thymio Robot



Visual cue



Tracking Interface



Solutions

Multiple camera

How we stitch images ?

- Detect keypoints
- Extract their local invariant descriptors
- Match features between images
- RANSAC to estimate homography matrix
- Warp transformation

Camera choice

- Accurate in light changes
- High resolution = More covered area



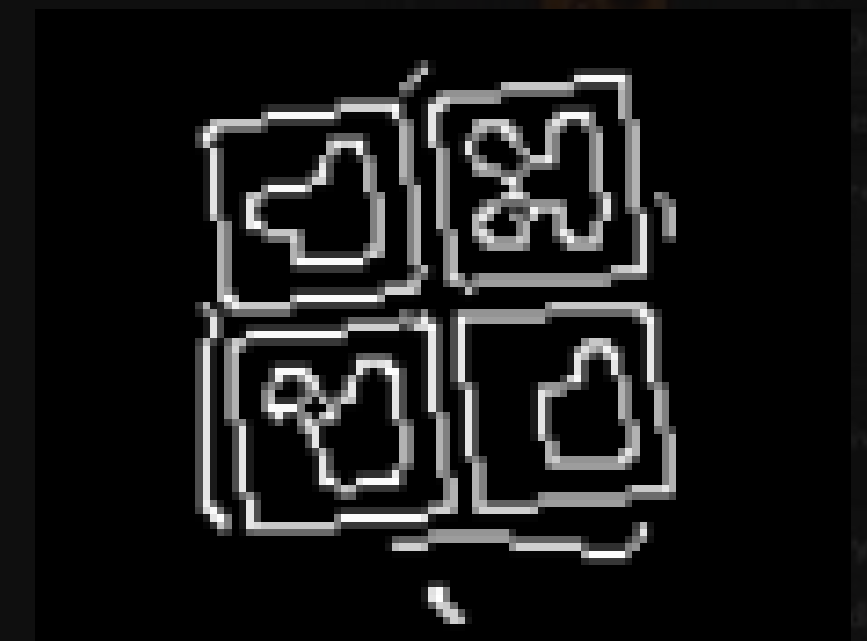
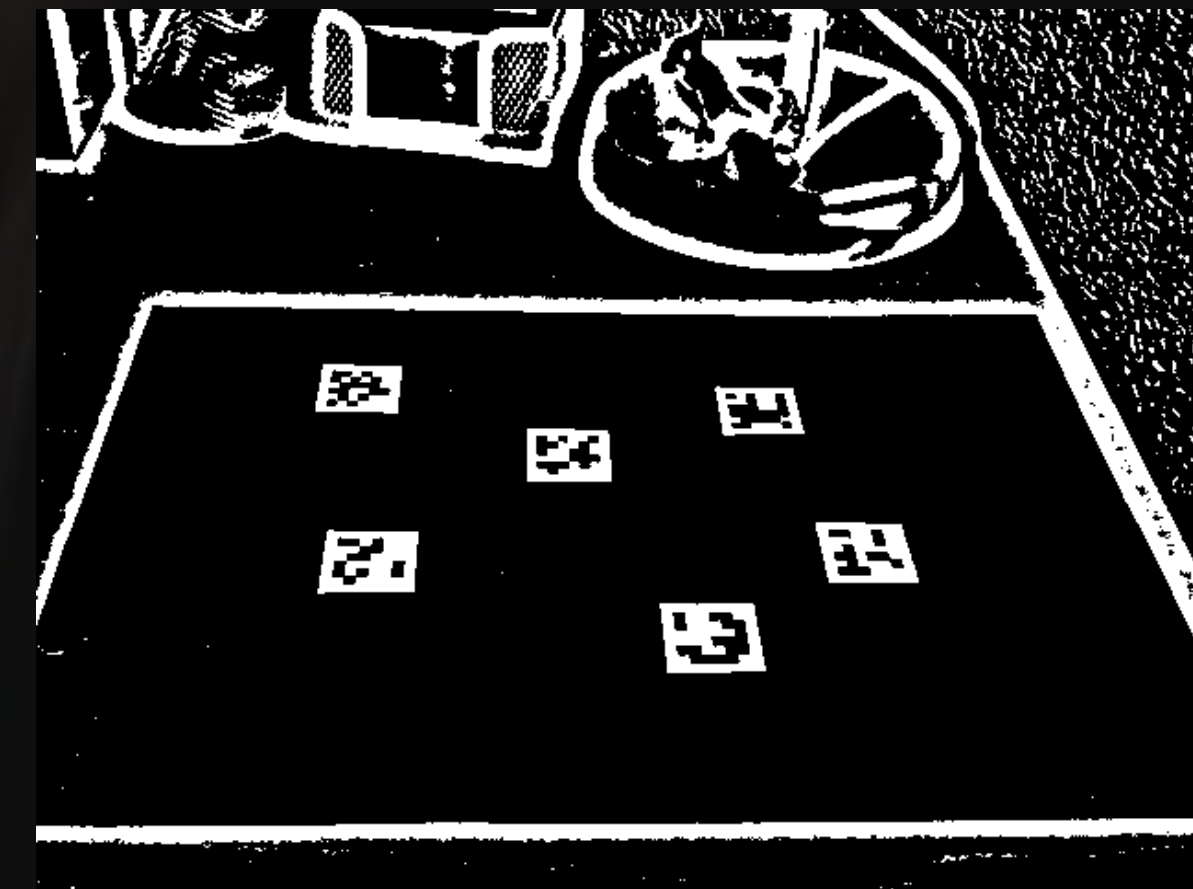
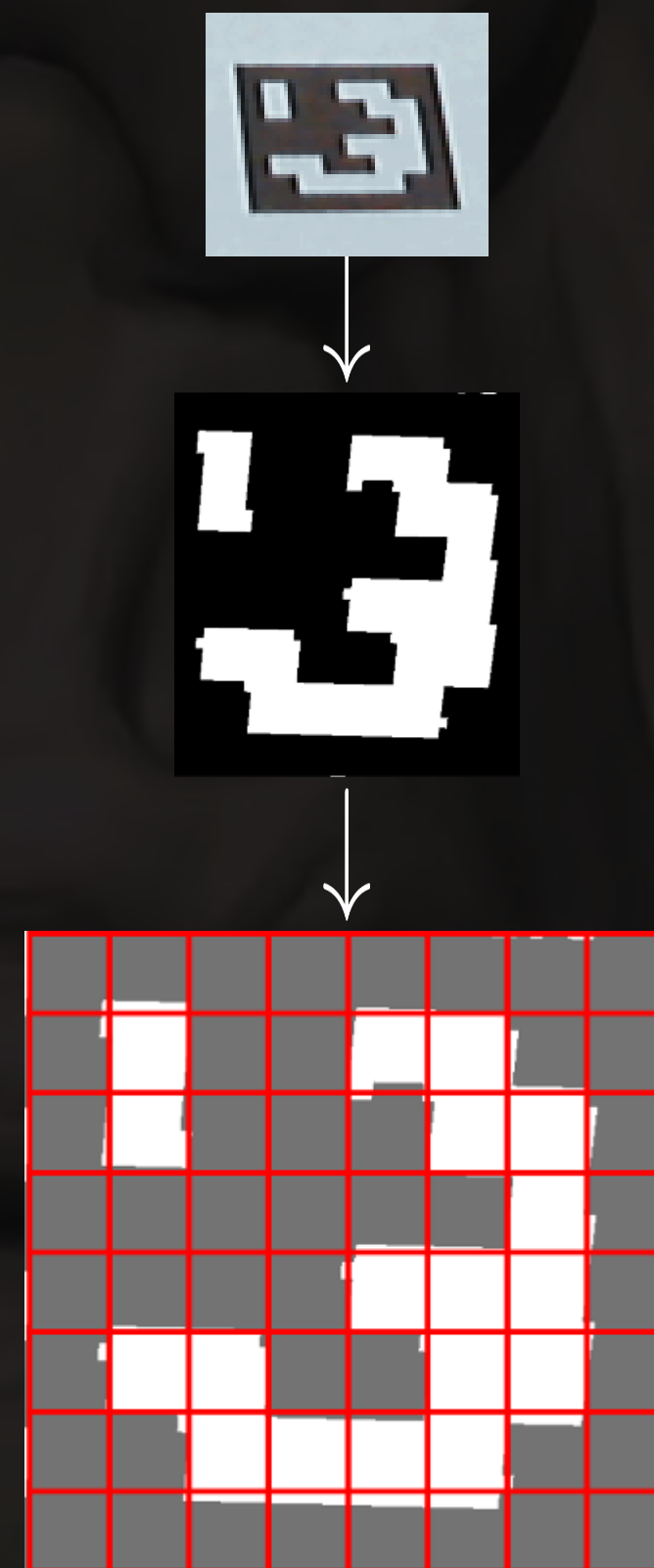


Solutions

Tracking system

Detection algorithm

- Selecting a dictionary
- Thresholding (Canny)
- Contour filtering
- Bits Extraction
- Marker identification
- Corner Refinement



Marker creation and selection

- Similarity metric (Hausdorff, Count consecutive pixels in both direction), Large border



Solutions

Machine-learning-based approach

Supervised learning

- Former detection method used for training
- Each marker is labelled with its id
- Error in training data-set can't be quantified
- But can be lowered by strong requirements

Method tested

- Support vector machine
- Restricted Boltzmann machine

Why use machine learning ?

- Extremely fast prediction (dot product)
- Training time isn't a problem
- Could be more powerful than bit-wise detection

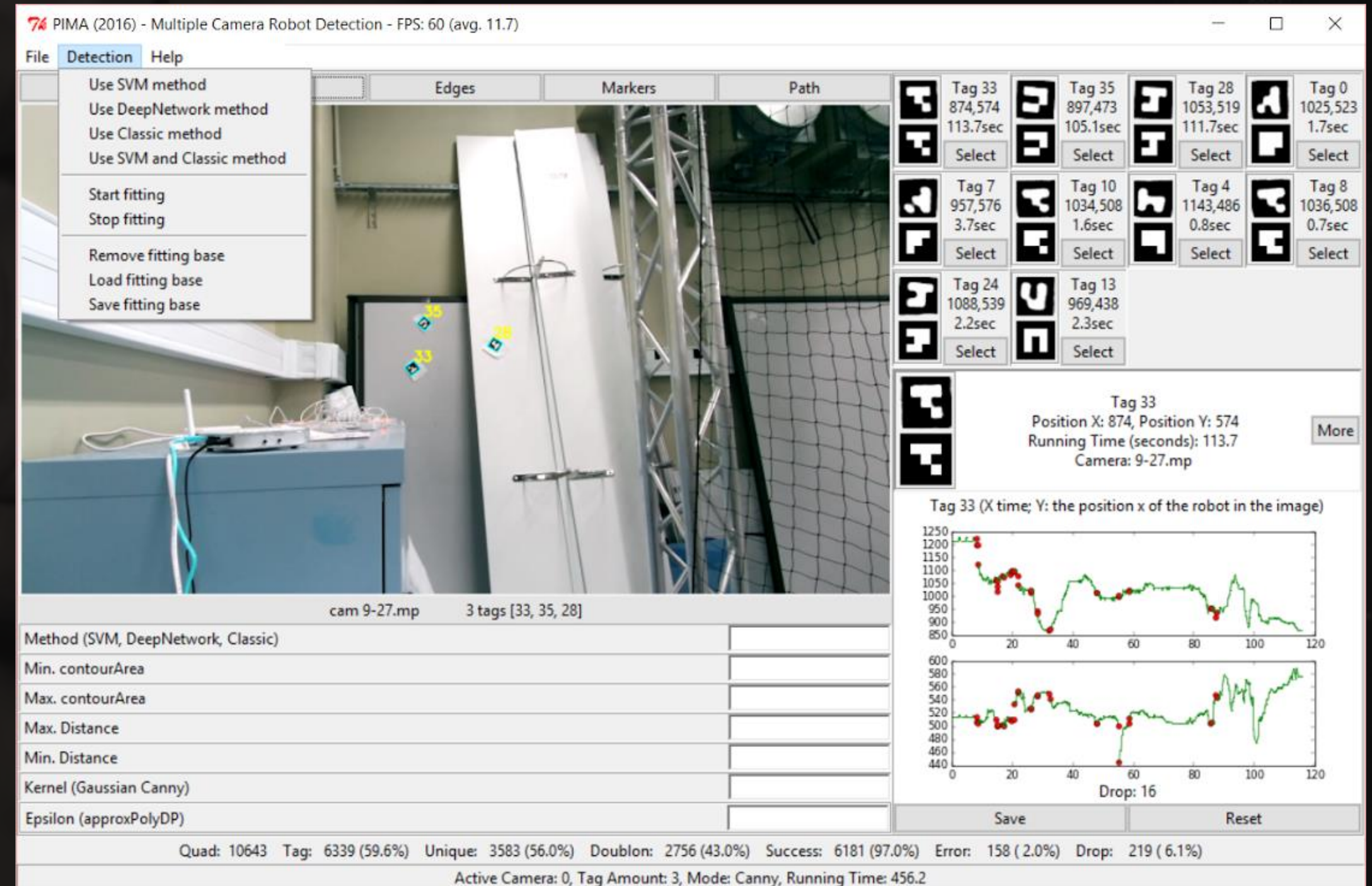


Solutions

User-friendly Graphical Interface

Tracking interface

- Customize parameters (Canny,...)
- Mode view (canny, edges, path)
- Position X and Y graph
- Allow focus on a robot
- Monitoring (error, detection rates)
- Orientation (soon)
- Change method on the fly (soon)
- Stitch view (merge all cameras)



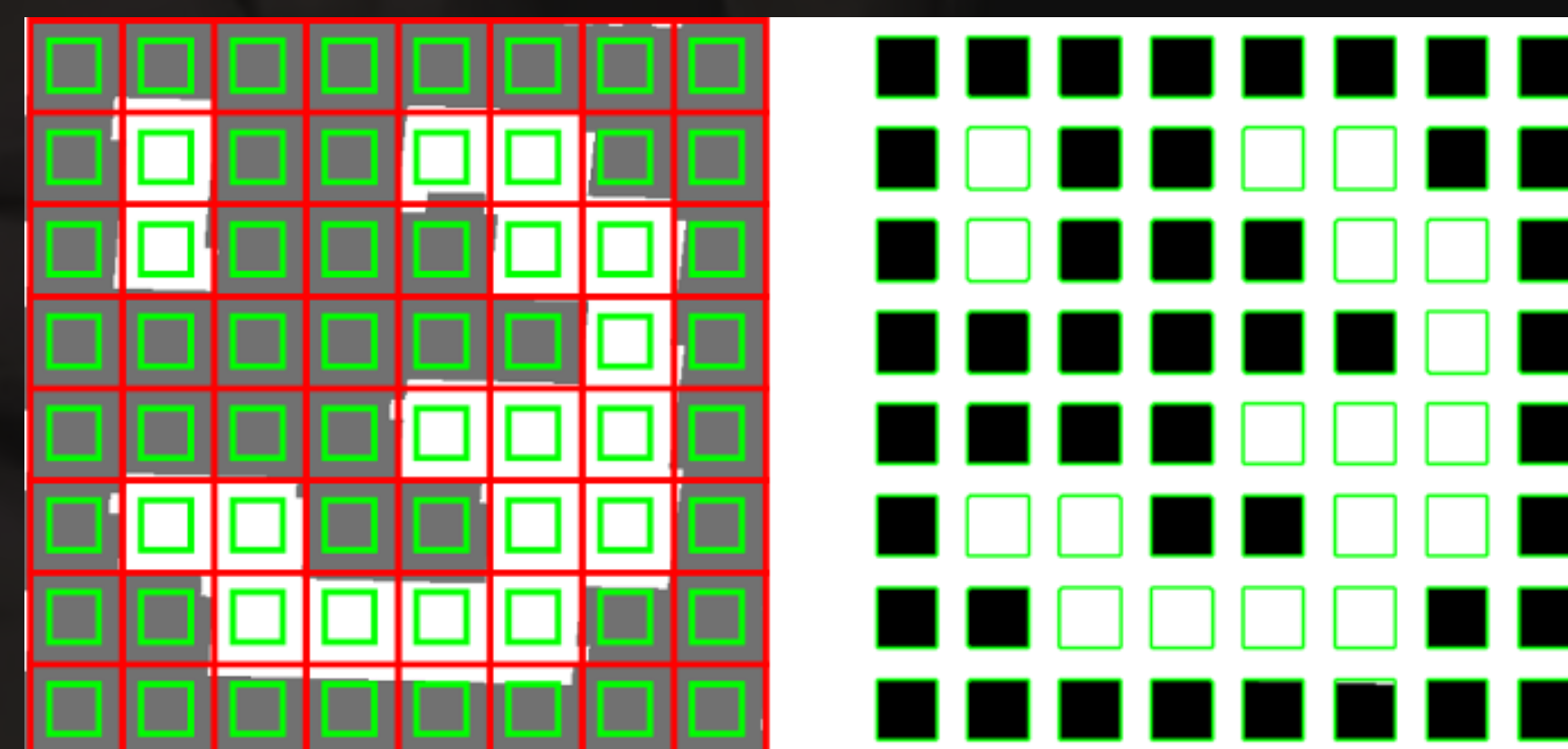


Solutions

Tracking system

Amelioration

- Ignore some pixels in the margins of the cells



Demo

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