Local Spatio-Temporal Propagation and Constraint Based Model Generation for 1ms Foreground Detection System

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Background

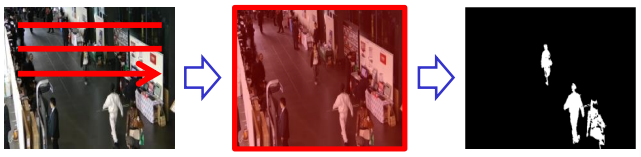
- Key for human-machine interaction applications
  - Projection mapping
  - Self-driving
  - Surveillance

- Target:
  - Implement 1ms foreground detection system.
- Challenges:
  - High speed up & Reduce storage consumption
  - Robust for illumination change
  - Distinguish different objects

Proposal

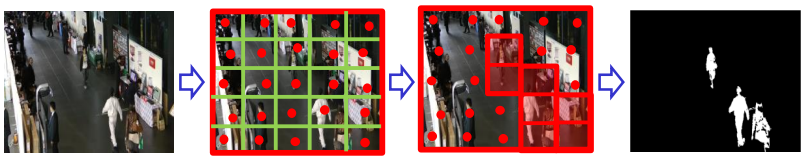
Proposal 1: Local Spatio-Temporal Propagation

Conventional work



Build models for all pixels

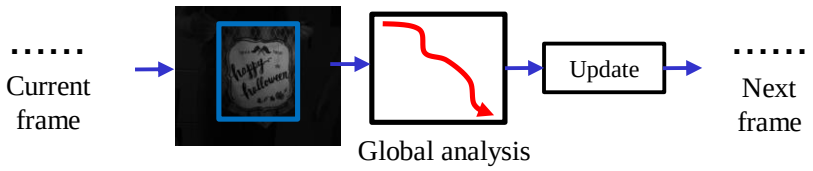
Proposed



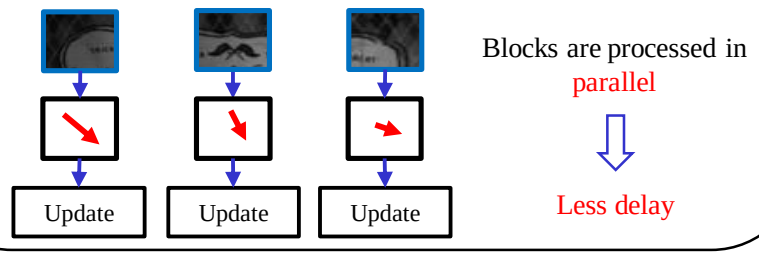
Only build models for foreground blocks

Proposal 2: Local Linear Illumination correlation

Conventional work

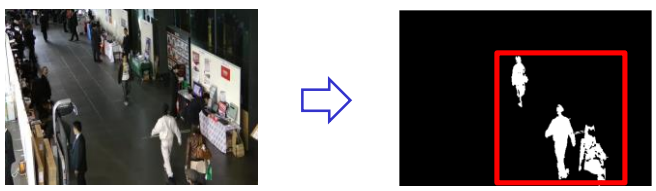


Proposed



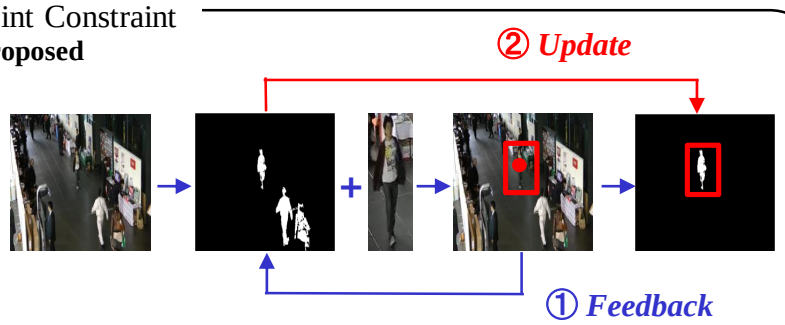
Proposal 3: Local Keypoint Constraint

Conventional work



Lack of constrained conditions

Proposed



Evaluation result

- Detection accuracy:

	ViBe	P1	P1+P2	P1+P2+P3
Average	78.78%	80.12%	80.56%	85.17%

- Hardware performance:
  - Input frame rate: 784fps
  - Processing delay: 0.908ms/frame

Resource	Utilization
# LUT	131976 (64.76%)
# Flip Flop	131209 (32.19%)
# BRAM	87.50 (19.66%)
# DSP	36 (4.29%)

Conclusion

- Average F-score of P1+P2+P3 is 85.17%, 6.28% higher than original ViBe. And reducing storage around 3 times
- Solving the problems caused by illumination change and multi-objects

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