

Alma Mater Studiorum University of Bologna

Artificial Intelligence - Computer vision
Intrusion detection project

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Introduction

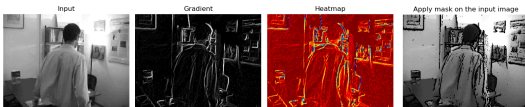
Problem

Build an intrusion detection system using a static background as a reference

Introduction

What is a pipeline?

A sequence of transformations and operations



```
pipeline.add_operation("Input",  
    lambda frame: frame)  
pipeline.add_operation("Gradient",  
    lambda frame: get_grad(frame))  
pipeline.add_operation("Heatmap",  
    lambda frame: cv2.  
        applyColorMap(frame, cv2.  
            COLORMAP_JET))
```

```
pipeline.add_operation("Input",  
    lambda frame: frame)  
pipeline.add_operation("Gradient",  
    lambda frame: get_grad(frame))  
pipeline.add_operation("Mask",  
    lambda frame: frame < 30)  
def showonlymask(mask):  
    import numpy as np  
    input = pipeline.input.copy()  
    out = np.empty_like(input)  
    out[mask] = input[mask]  
    return out
```

```
pipeline.add_operation("Apply_mask_  
    on_the_input_image",  
    showonlymask)
```

Preprocessing

Gaussian blur

INPUT_NO_BLUR



INPUT_BLUR



DIFF_NO_BLUR



DIFF_BLUR



OUTPUT_NO_BLUR



OUTPUT_BLUR



Preprocessing

Median filter

Input



Background



Current frame



Difference



MEDIAN FILTER 3



OPENING 3



MEDIAN FILTER 9



OPENING 9



Output



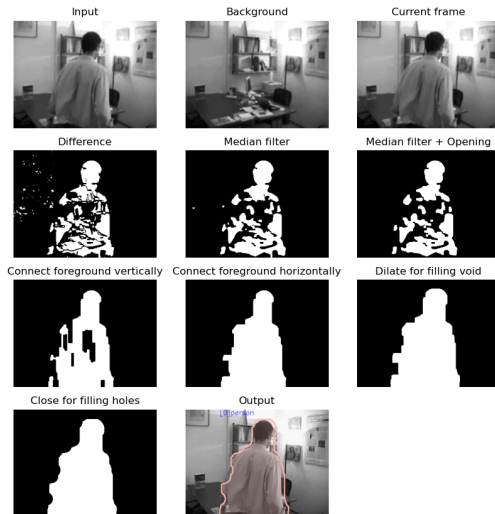
Detector

Background subtractor

- ▶ Use a **static** background
- ▶ Use the interpolation of the **first** 100 frames
- ▶ Use an **adaptive** background that computes the weighted sum of the current frame and the previous one

Detector

Pipeline - static, first



Detector

Pipeline - adaptive



Detector

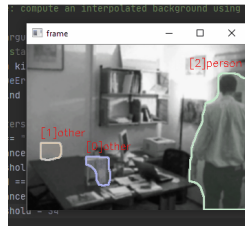
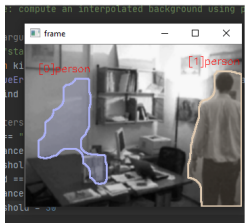
Parameters

kind	distance	threshold	alpha ¹
static	max_distance	30	-
first	max_distance	34	-
adaptive	l1	5	0.70

¹alpha regulates the update speed (how fast the accumulator "forgets" about earlier images).

Detector - first

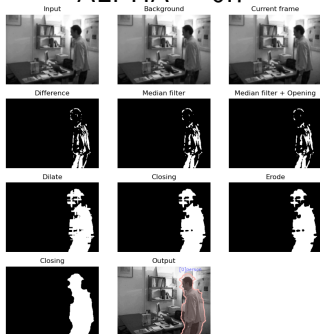
Difference between threshold 30 and 34



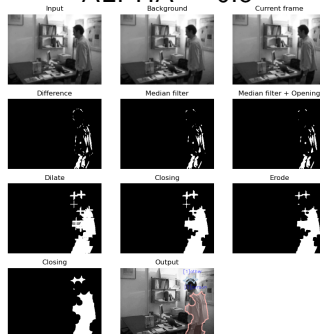
Detector - adaptive

alpha parameter

ALPHA = 0.7



ALPHA = 0.8



Detector

Filtering and handling false positive

index	area	perimeter	ratio	circularity	rectangularity	mean	std	label
0	1243.0	146.76	0.80	0.93	1545.35	0.13	0.203	other
1	855.0	113.45	1.06	1.06	803.18	0.013	0.020	other false positive
2	15028.5	587.80	0.47	0.93	31897.22	0.09	0.177	person

Filtering

Labelling

False positive

rectangularity > 5000:

else

perimeter > 100 and area > 300

area > 3000 or ratio < 0.3

std < 0.1

Conclusion

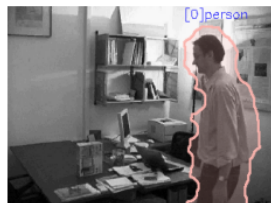
Output of the frame 481



static



first



adaptive