Project Computer Vision 2023 - Vinícius Schaedler Damin

This is a small file just to help illustrate what happens in the difficult parts of the code.

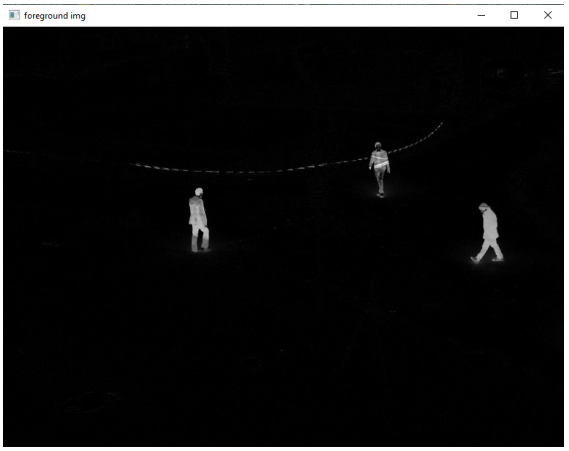
1. Morphological transformations

To make the analysis, one important step is the **morphological transformations** that are applied to the image, so we can binarize it, do the connected component analysis and finally retrieve the data to create the bounding boxes.

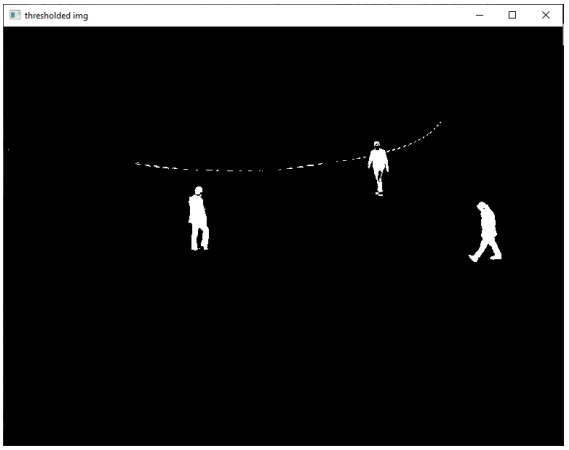
Original image:

Removing background (through median):

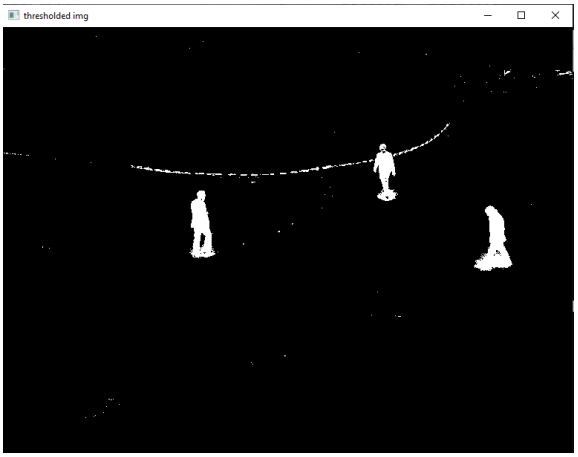
Foreground image:



Binary image (**Threshold 50-255**):



(if we used threshold 15-255):



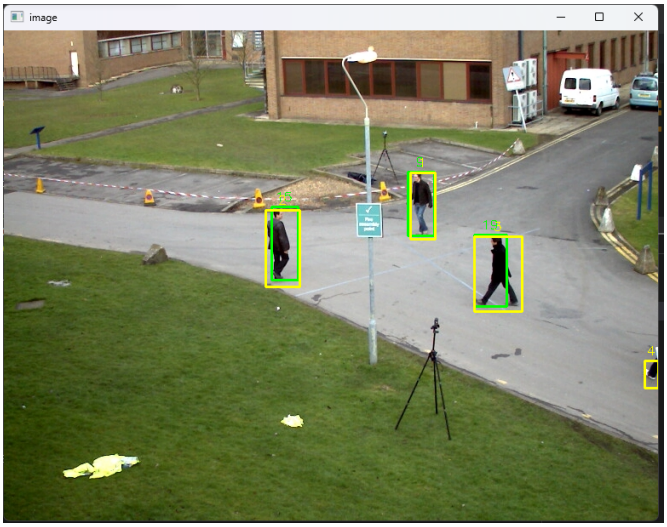
Opened image (needed to remove noise):
(kernel 5x5 and kernel 2x2)

Also, there were dilation and closing in the algorithm, but these examples are enough to illustrate the process.

2. Evaluation metrics

To analyze how well the algorithm performed we used the IoU (intersection over union) to see the following metrics: **success plot and TP, FN, FP.**

- **For frame number 10**

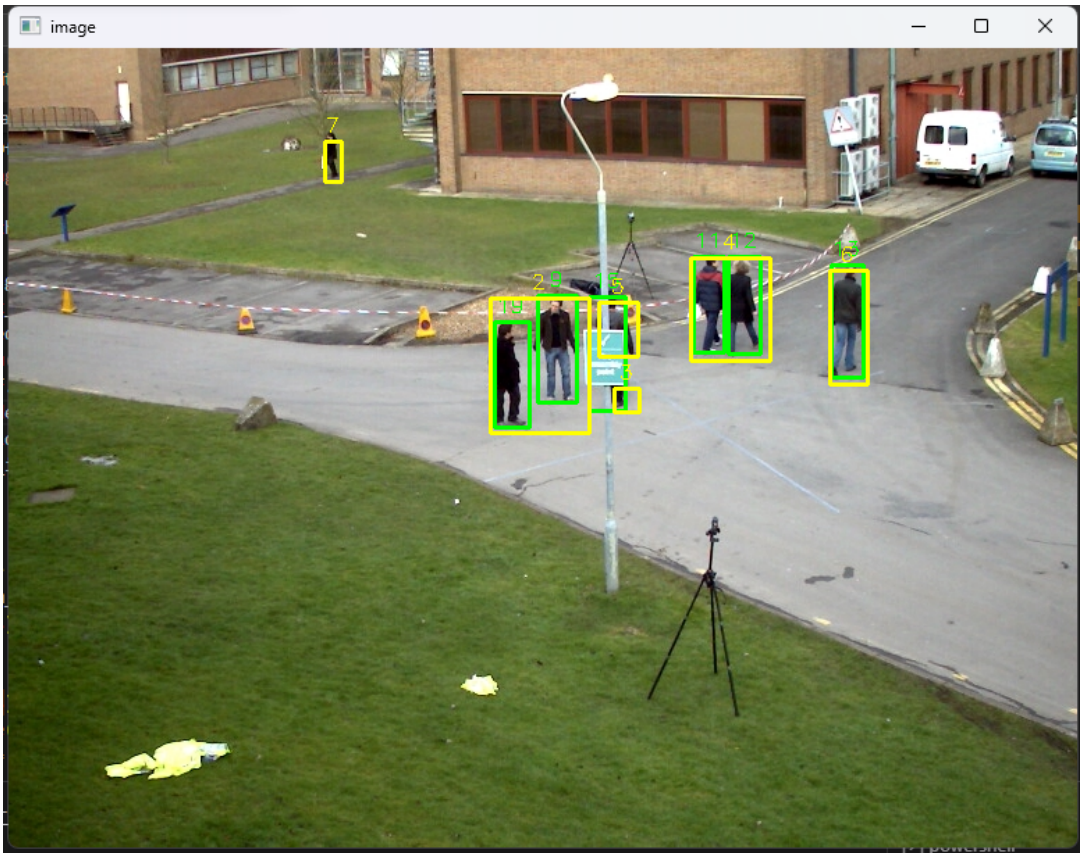



```
 gt_box [552.    240.     38.934  84.048]
pred_box [477. 167.  29.  78.]
calculate_iou(gt_box, pred_box): 0.0

 gt_box [552.    240.     38.934  84.048]
pred_box [307. 211.  40.  90.]
calculate_iou(gt_box, pred_box): 0.0

 gt_box [552.    240.     38.934  84.048]
pred_box [552. 242.  56.  88.]
calculate_iou(gt_box, pred_box): 0.6381424424295639

 gt_box [552.    240.     38.934  84.048]
pred_box [752. 388.  16.  32.]
calculate_iou(gt_box, pred_box): 0.0
```

```
[[0.82645678 0.         0.         0.        ]
 [0.         0.69094729 0.         0.        ]
 [0.         0.         0.63814244 0.        ]]
```

Each collumn is a yellow box (my algorithm) each line is a green box (from the ground truth) You can see that the yellow box number 4 has no green box with it, which means that my algorithm got a false positive (that is why the column is full of zeroes)

- **For frame number 100**




```
 gt_box [417.    179.     26.308  82.665]
pred_box [424. 183.  28.  39.]
calculate_iou(gt_box, pred_box): 0.2995585675046382

 gt_box [417.    179.     26.308  82.665]
pred_box [435. 245.  18.  17.]
calculate_iou(gt_box, pred_box): 0.059109822917493865

 gt_box [349.    197.     25.137  76.253]
pred_box [227.  67.  12.  29.]
pred_box [346. 180.  71.  97.]
calculate_iou(gt_box, pred_box): 0.2783173603891389

 gt_box [349.    197.     25.137  76.253]
pred_box [424. 183.  28.  39.]
calculate_iou(gt_box, pred_box): 0.0

 gt_box [349.    197.     25.137  76.253]
pred_box [435. 245.  18.  17.]
calculate_iou(gt_box, pred_box): 0.0
[[0.         0.         0.         0.31523752 0.         0.        ]
 [0.         0.36914536 0.         0.         0.         0.        ]
 [0.         0.37702468 0.         0.         0.         0.        ]
 [0.         0.         0.80200757 0.         0.         0.        ]
 [0.         0.         0.         0.         0.29955857 0.05910982]
 [0.         0.         0.         0.27831736 0.         0.        ]]
```

Example: yellow box 2 contains green box 19 and 9, so in the second column there is the IoU of two ground truth boxes (0.369 and 0.377).
So, in the case 2,9,19. For the threshold 0.35 I correctly detected both ground truths, however for threshold 0.40 there are no correct detections for these same set of bounding boxes.