Segmentation algorithm for Infrared Images

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OUTLINE:

- Motivation
- Flowchart
- Image thresholding and labeling
- Length based filtering and Morphological processing
- Height_weight ratio filtering
- Morphological refining
- Segmented Output
- Results and conclusion
- References

Motivation:

- One image is worth thousand words. Computer vision is the area where the computer are taught how to see!
- Segmentation is a crucial step in it! According to wikipedia, segmentation is the processing of partitioning images into multiple segments.
- An effective segmentation algorithm paves way for good classification or object localization.
- In following slides, we will see segmentation algorithm based on morphological operations.

FLOW CHART:

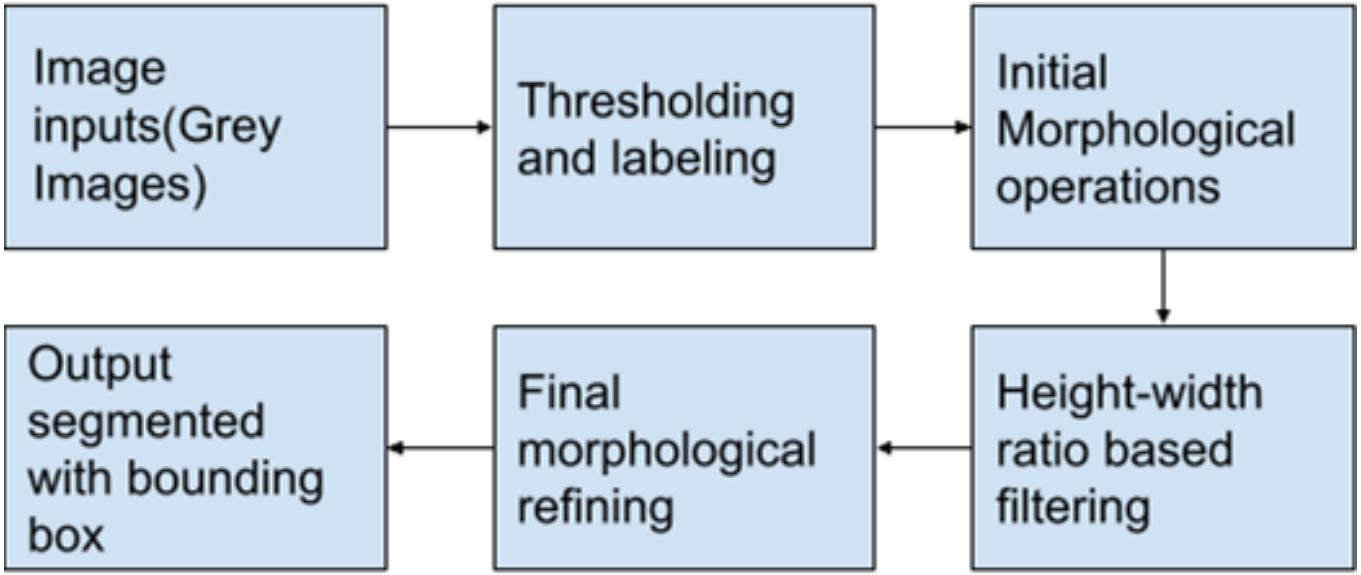


Image inputs(Grey Images)
Thresholding and labeling
Initial Morphological operations
Height-width ratio based filtering
Final morphological refining
Output segmented with bounding box

INPUT IMAGES : IR images in raining conditions

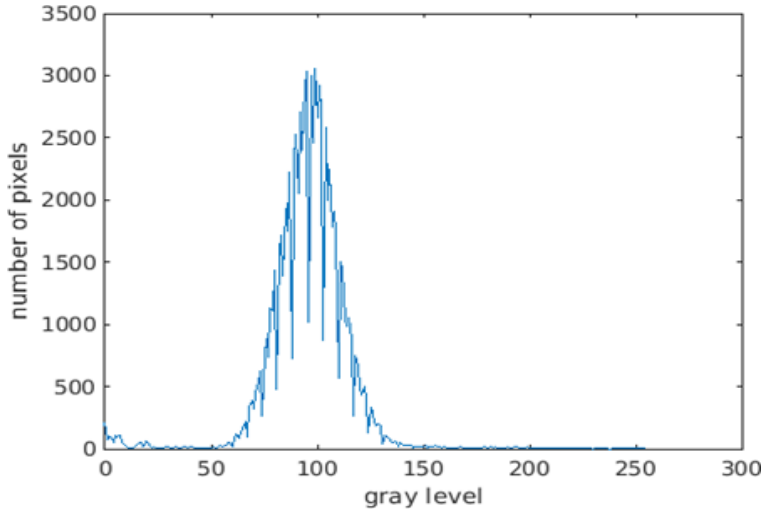
Training Image

Testing Image

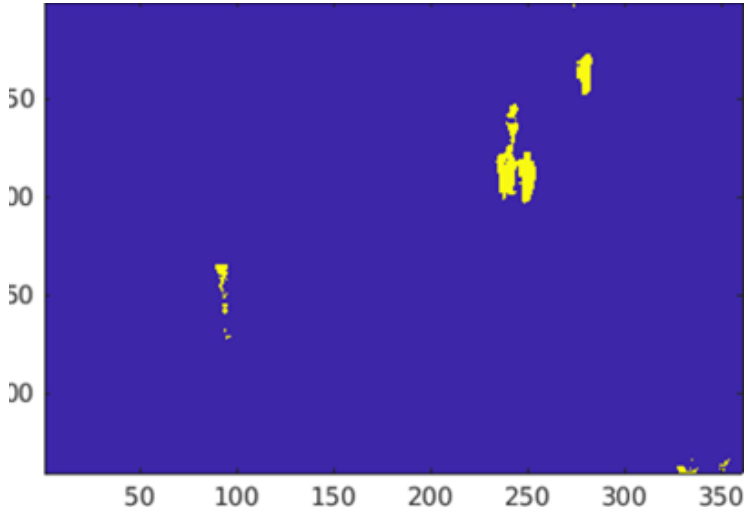
(from OCTBVS infrared data set)

Thresholding(Training)

Histogram of training image

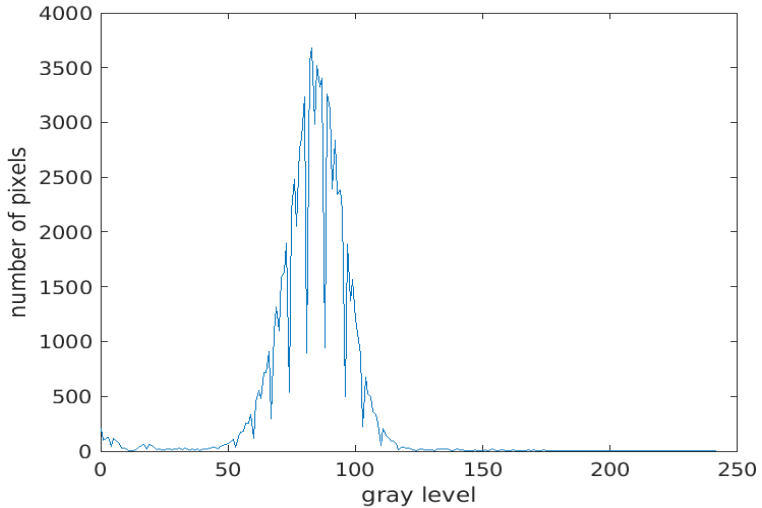


Thresholded Image (Threshold value: 156)

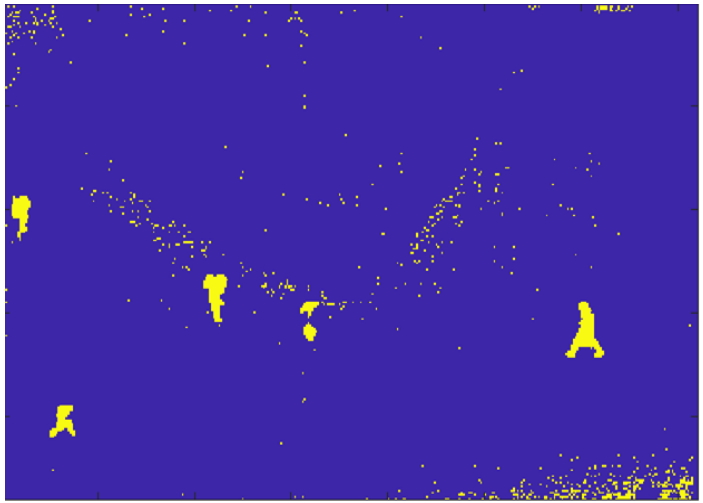


Thresholding(Testing)

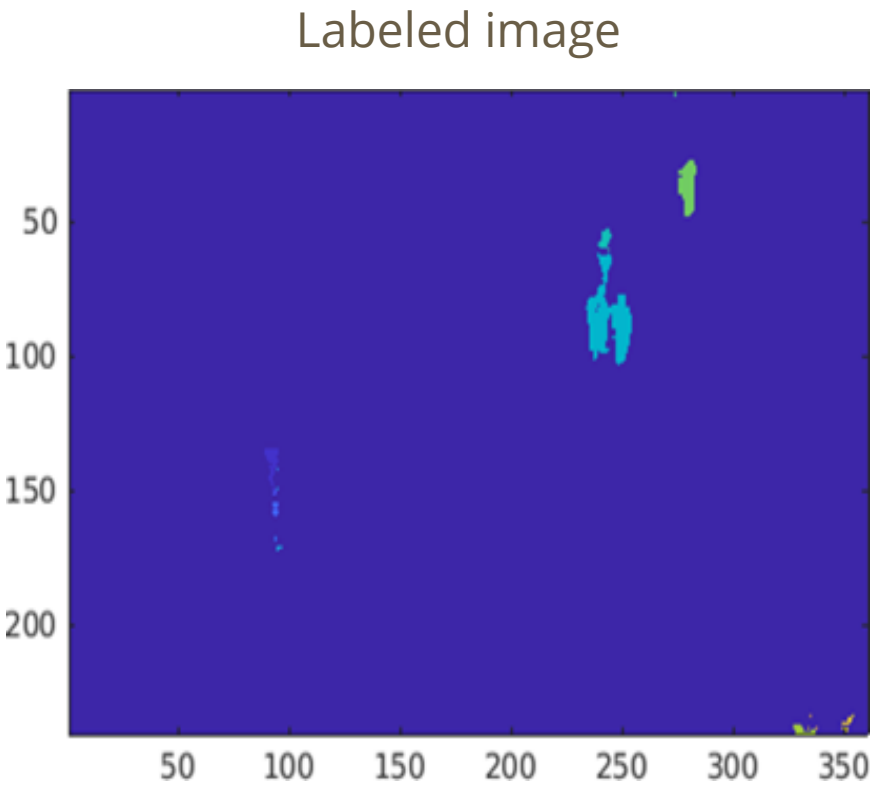
Histogram of testing image



Thresholded Image (Threshold value: 110)

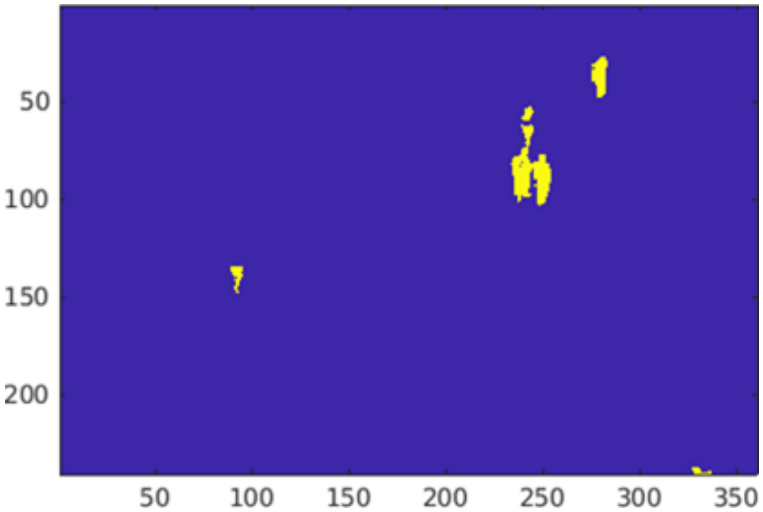


Labeling

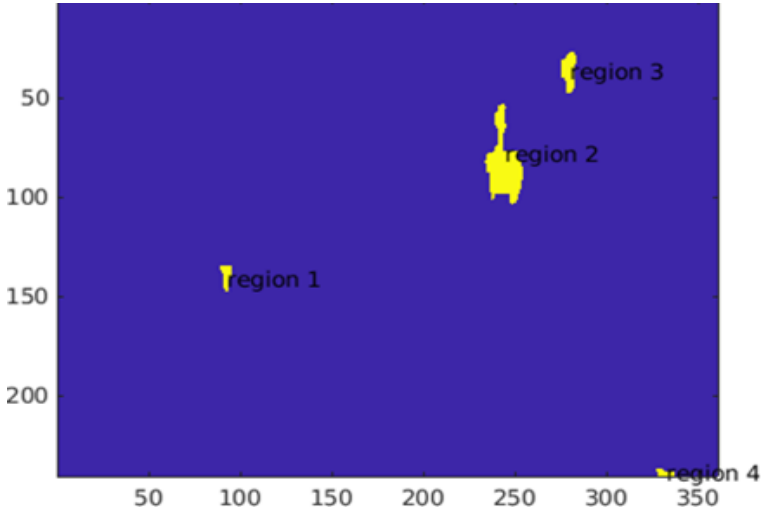


Length based filtering and morphological processing

Length based filtering(length range above 20)

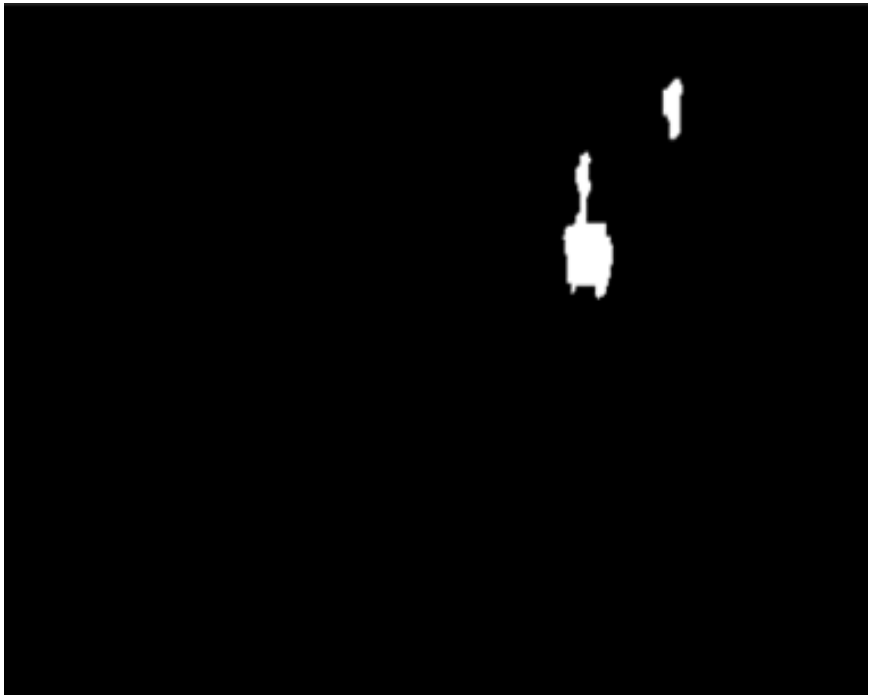


Morphological closing (Square : 7 x 7)



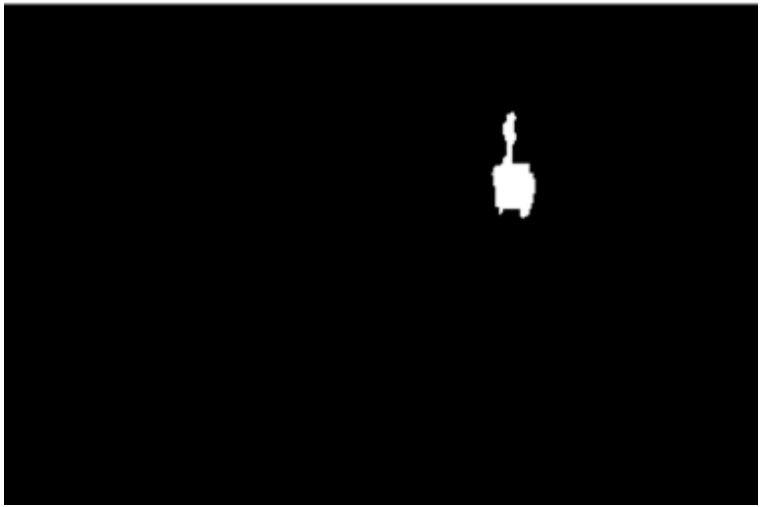
Height width ratio based filtering

Range of height width ratio: above 1.1



Morphological refining

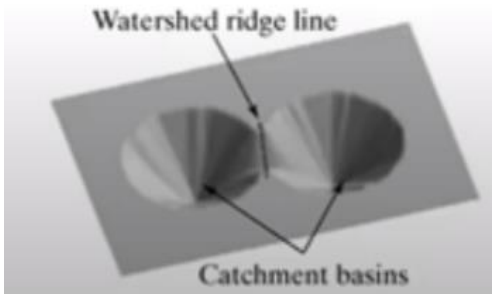
Sticky objects:



Sticky objects separated:

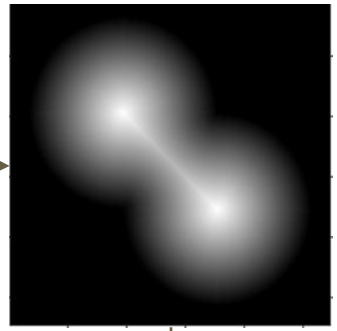
Segmented output : Trial watershed segmentation

Basic idea

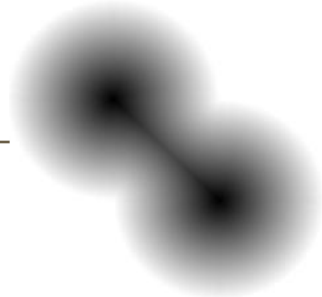


Sticky objects

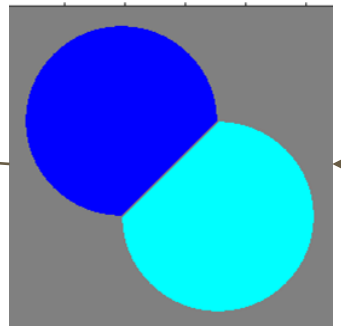
Distance transform



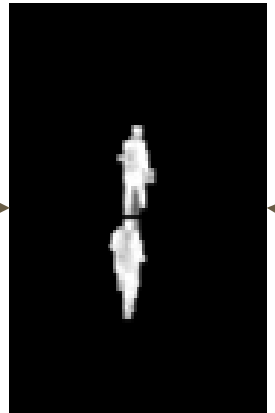
Inverse



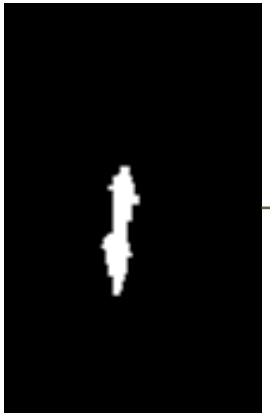
Finally separated!



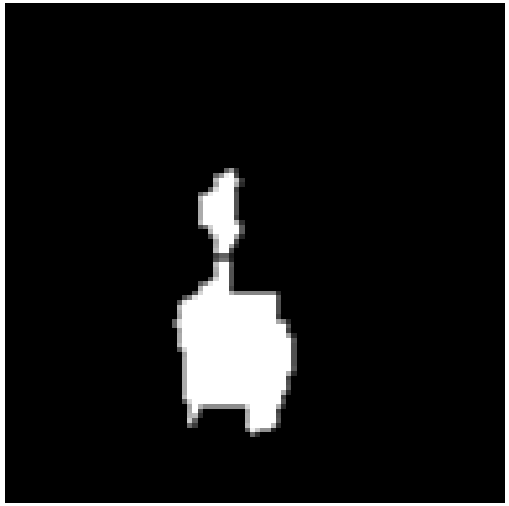
Separated

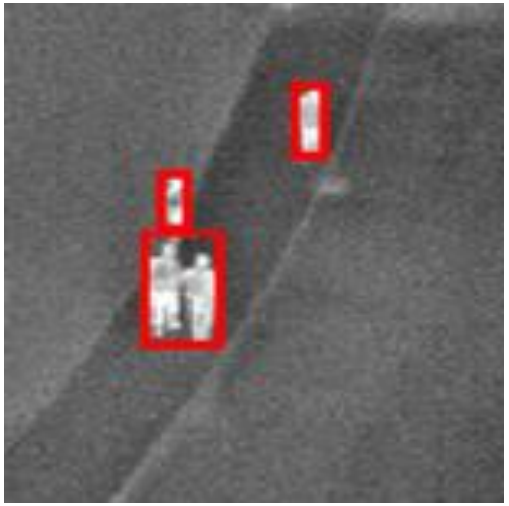


Sticky objects



But..for three or more objects stuck together, the results are poor!





Morphological refining- How did I do it?

- The sticky objects are counted as one objects, we don't want that!
- After many trial of other object separating methods like erosion by for loop, watershed segmentation, the morphological based operations works better!
- The other two methods results in over segmentation and object separation problem.
- Initially the sticky object is separated from the other objects using area based filtering.

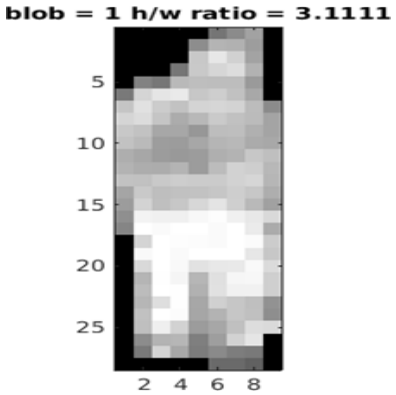
Morphological refining- How did I do it?...(Continuation)

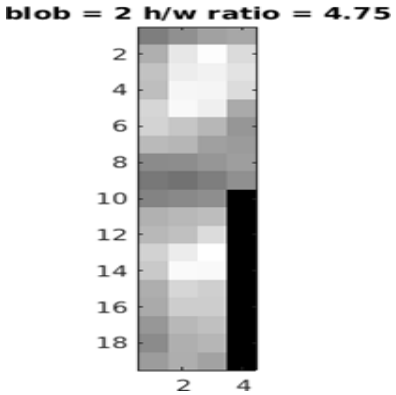
- The area is the number of the pixels within a labeled object. For this case, the area range is above 250.
- We continue the process if there are any sticky objects otherwise the image from the height width ratio filtering is the final segmented image.
- If any object in, then we start with masking as we need the original intensity value and again we threshold.
- Then area opening is performed using rectangular of dimension 6x 3 as structuring element and further dilation is performed for minor shape adjustment.
- Thus we get the sticky objects separated.

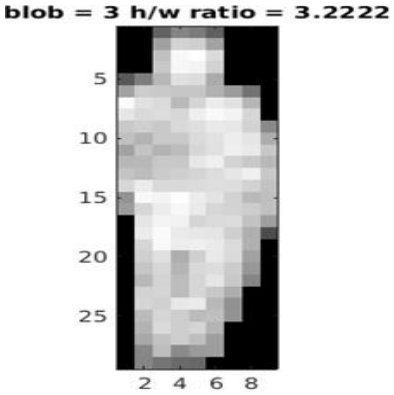
Segmented output

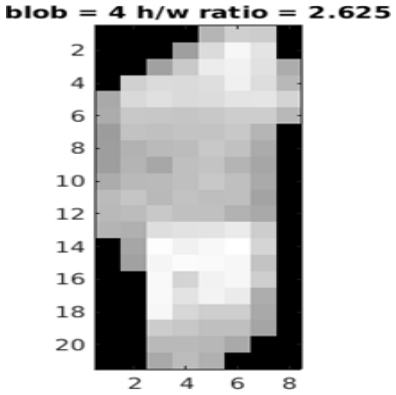
- The separated objects are added to the height width ratio filtered image (if any sticky objects) .

- Bounding boxes are calculated for each individual objects.









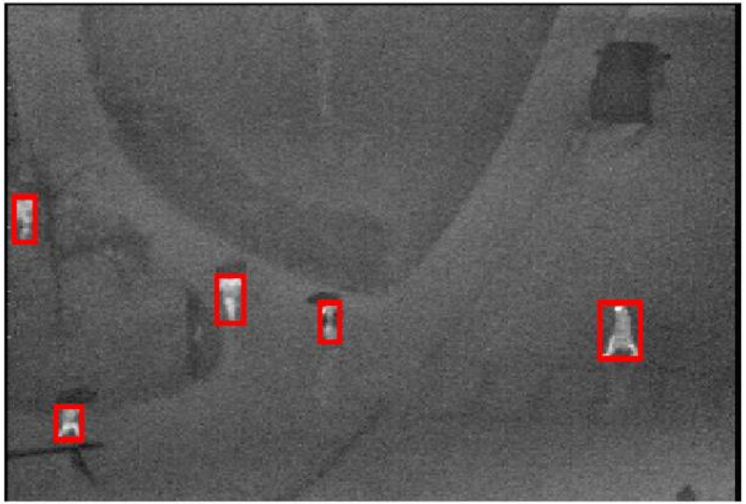
Segmented output

Result and conclusion

Applying the algorithm for the testing set

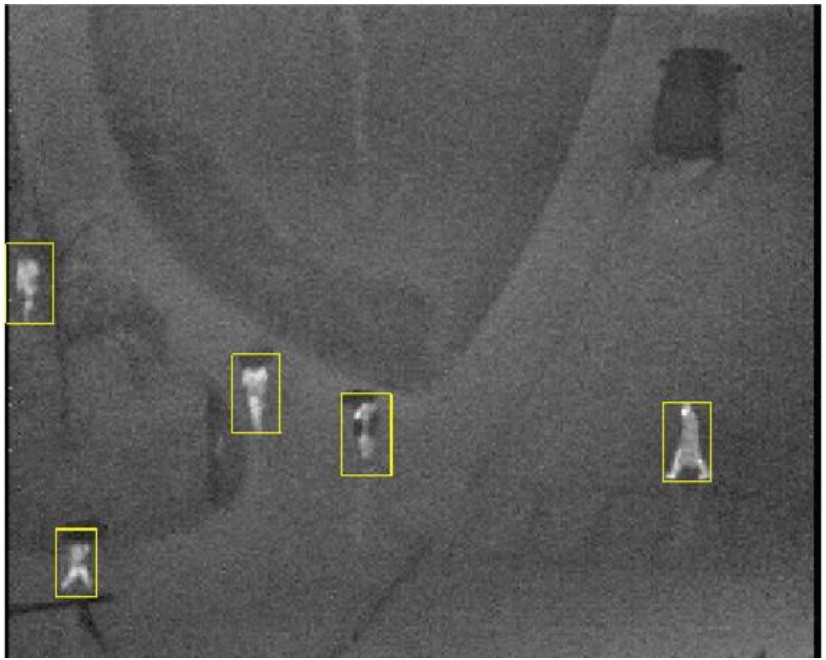
Test input image

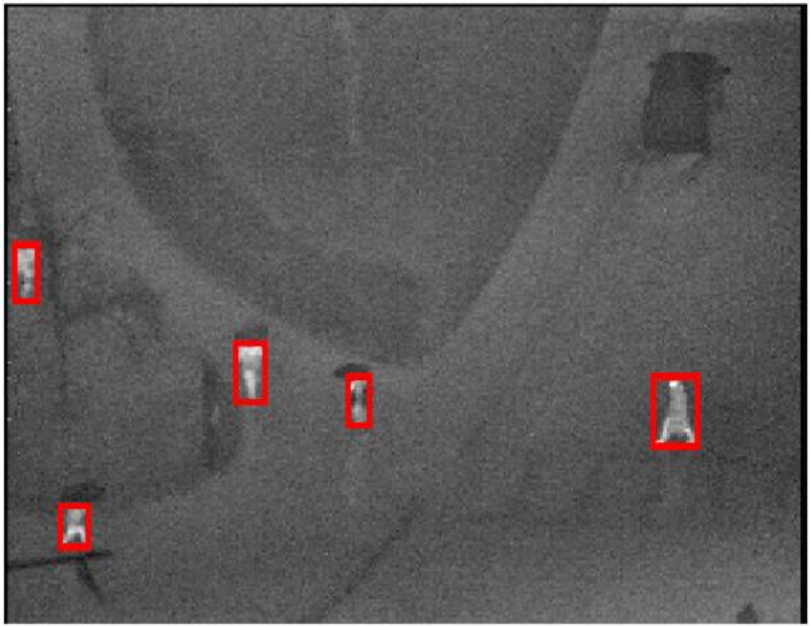
Segmented output image



Result and conclusion (Continuation)

After analyzing with ground truth using get_ground_truth_data_octbvs.m by comparing the center of each bounding box in the two resultant images.





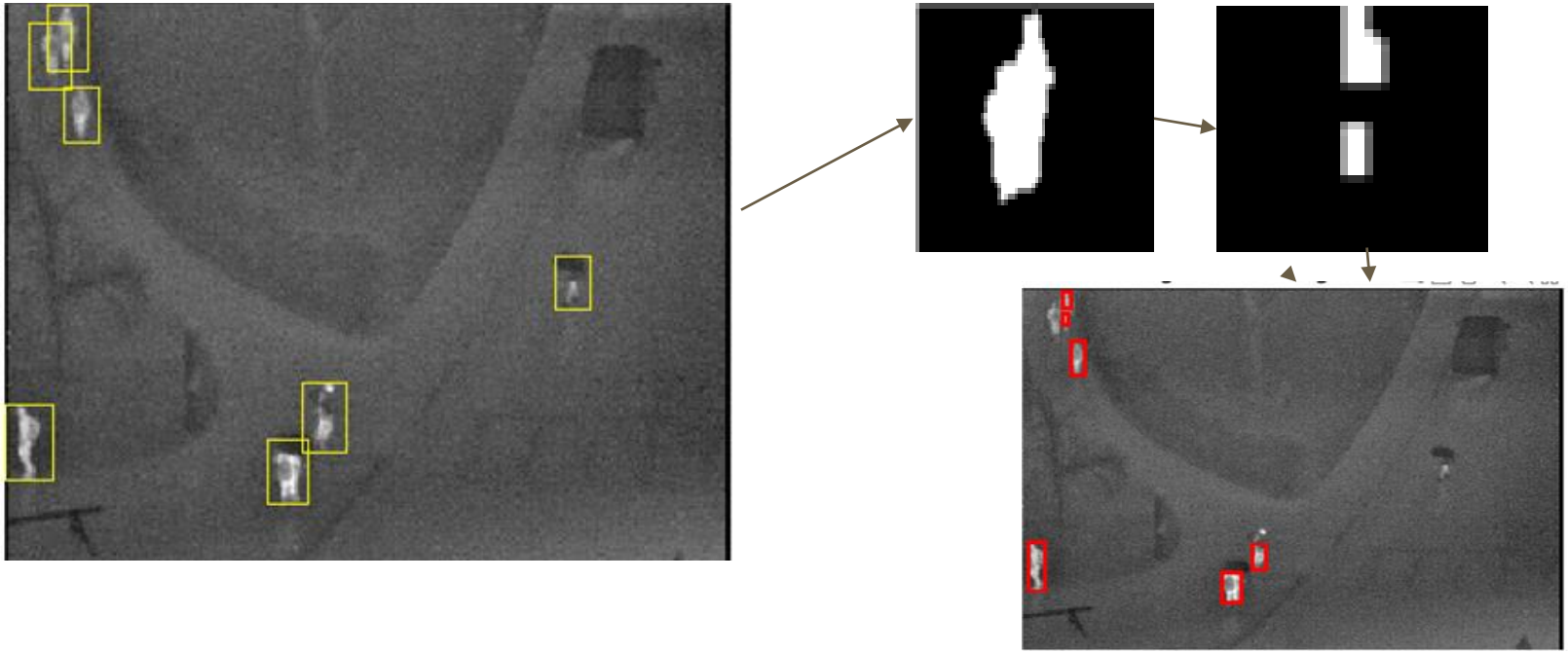
Result and conclusion (Continuation)

- Total test Images: 31

  Total objects: 90
- The confusion matrix obtained is:

	OBJECTS	**CLUTTERS**
OBJECTS	81	9
CLUTTERS	4	-

Result and conclusion (Continuation): Cause of missed objects and false alarm (Improper segregation and black object absorption):



Result and conclusion (Continuation)

- The segmentation algorithm uses series for morphological operations and this can be reduced by performing cascaded morphological operations in one step.
- Can come up with good sticky objects separating algorithm such as modified watershed segmentation or segmentation algorithm based on edges as this seems to be subjective!
- For the black absorbed region inverse thresholding can be applied to extract just the darker objects like the black umbrella and black coat!
- Adaptive thresholding can be done using otsu method!

References

1.http://vcipl-okstate.org/pbvs/bench/

2. https://en.wikipedia.org/wiki/Image_\egmentation

3.https://scikit-image.org/docs/dev/auto_examples/applications/plot_morphology.html#:~:text=Morphological%20closing%20on%20an%20image,and%20connect%20small%20bright%20cracks.&text=Since%20closing%20an%20image%20starts,the%20structuring%20element%20are%20removed.

4.https://en.wikipedia.org/wiki/Opening_(morphology)#:~:text=Opening%20removes%20small%20objects%20from,specific%20shapes%20in%20an%20image.

5.https://www.mathworks.com/help/images/structuring-elements.html#:~:text=A%20structuring%20element%20is%20a,process%20in%20the%20input%20image.

Questions?

Feedbacks?