Generalized Hough Transform

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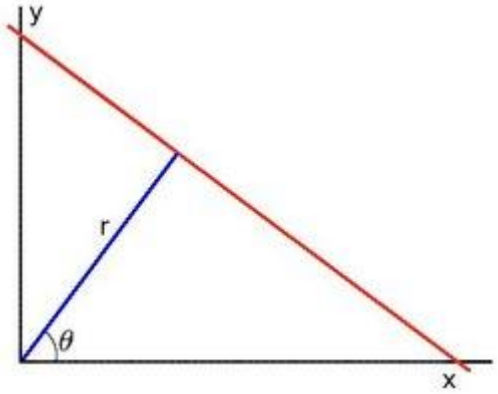
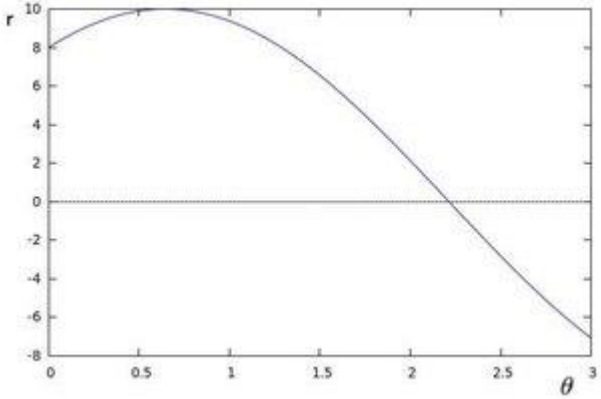
Hough Line Transform



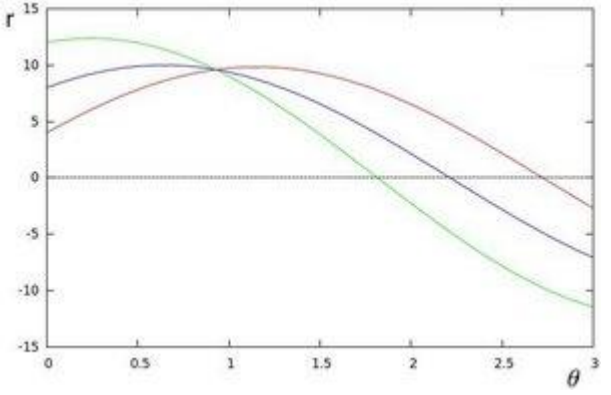
$$r = x\cos\theta + y\sin\theta$$



$$r_\theta = x_0 \cdot \cos\theta + y_0 \cdot \sin\theta$$

$$r > 0$$

$$0 < \theta < 2\pi$$



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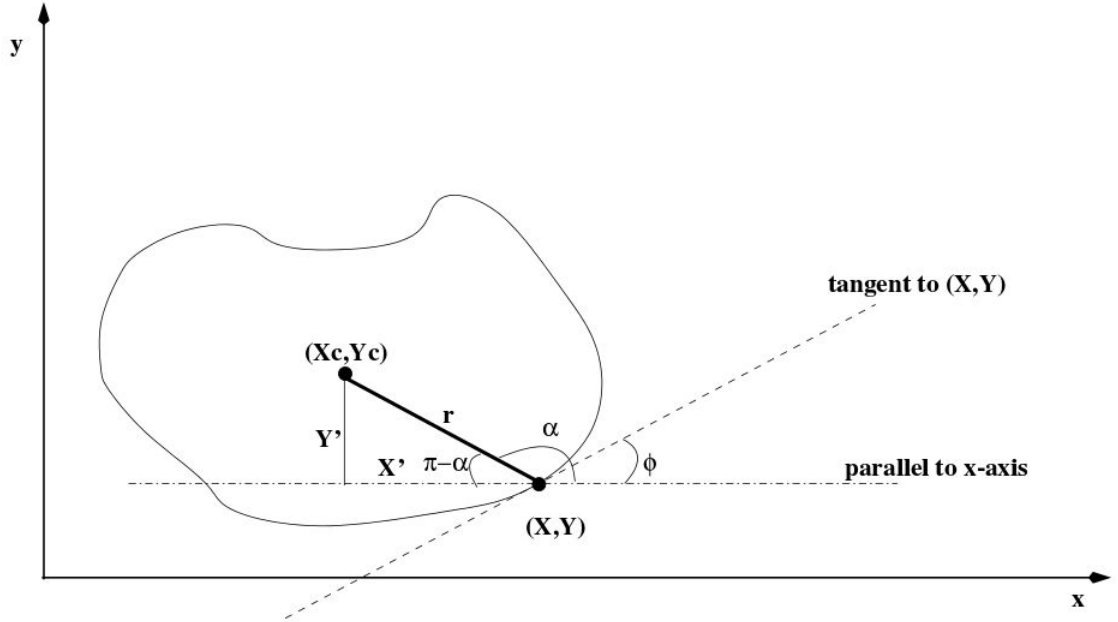
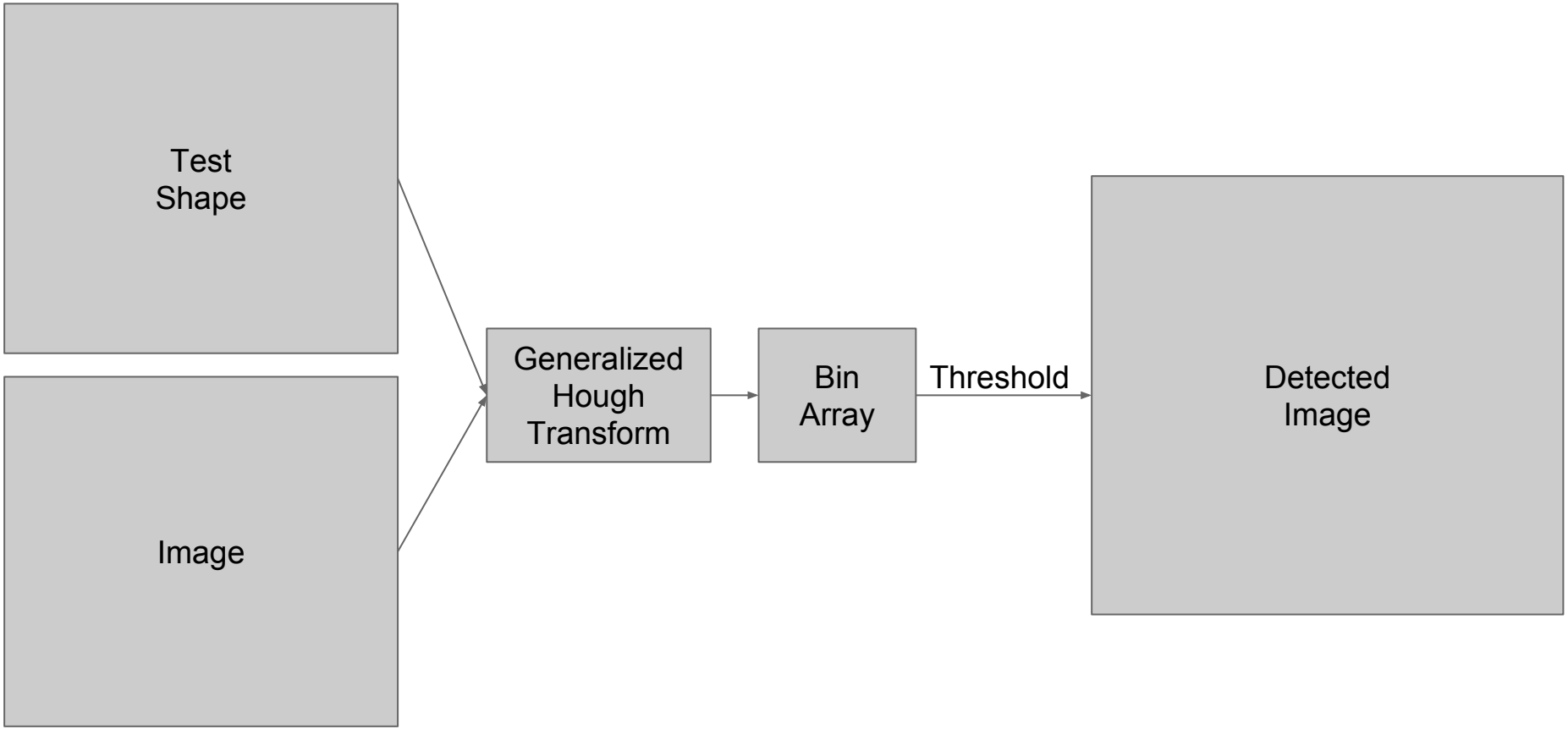


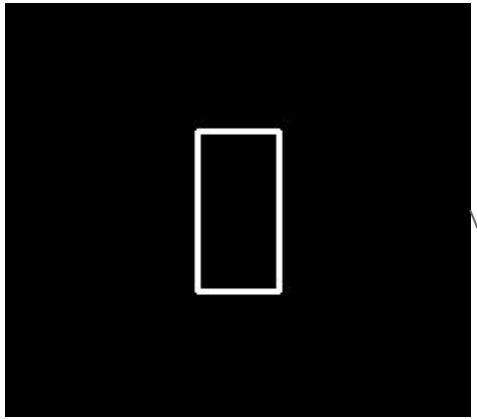
Algorithm

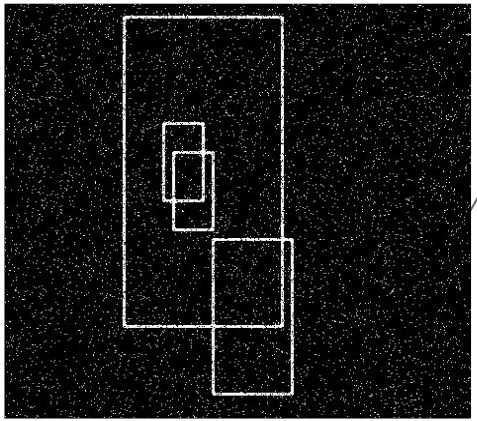
- Pick a reference point and for all points on the arbitrary test shape, store them in form of table as denoted below
  $\theta_i \rightarrow (x_c - x_i, y_c - y_i)_1, (x_c - x_i, y_c - y_i)_2 ...$
- For a given image for pattern recognition, find its edge map and threshold it to obtain binary image
- Create a bin for voting and for each point (x,y) in the image, obtain the gradient and hence possible set of reference point corresponding to that pixel
  $(\widetilde{x_c}, \widetilde{y_c})$
- Increment counter for the corresponding reference point in bin
  $\widetilde{x_c} = x + (x_c - x_i) \qquad \widetilde{y_c} = y + (y_c - y_i)$
- In order to accommodate scaled feature recognition, increment counters for scaled displacement
  $\widetilde{x_c} = x + scale * (x_c - x_i) \qquad \widetilde{y_c} = y + scale * (y_c - y_i)$
  for some quantized values of scale
- Threshold the bin to obtain reference points for the feature

Block Diagram



Result





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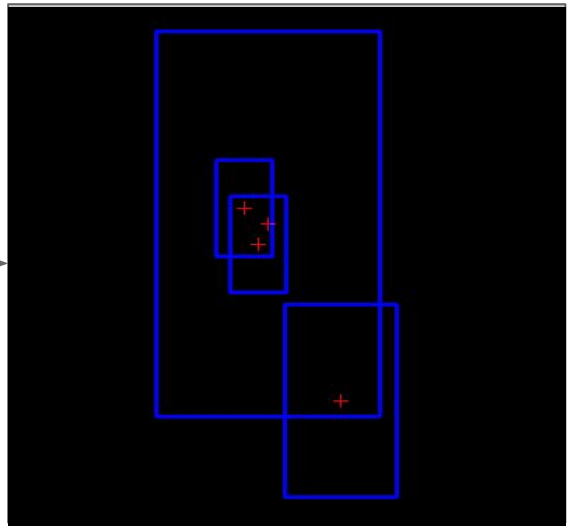
Bin Array

Threshold



Future Work

- Threshold estimation
- Skewed scaling along x and y direction
- Rotation invariant hough transform
- Pattern recognition for real world scenes

Reference

1. http://docs.opencv.org/2.4/doc/tutorials/imgproc/imgtrans/hough_lines/hough_lines.html
2. Generalizing the Hough transform to detect arbitrary shape, DH Ballard (1981)
3. http://www.cse.iitd.ernet.in/~pkalra/csl783/GHT-notes.pdf