## Thresholding:

Otsu method is followed for selecting the intensity threshold. It assumes bimodal histogram. This method tries to iterate through all possible thresholds (intensity values) and finds the spread of pixel levels on each side of the threshold. After iterating through all the possibilities it selects that threshold value for which the sum of pixels spread is minimum on both sides of it. In other words, it finds two classes such that their intra class variances is minimal and inter class variance is maximal. For each of the two classes it finds the probability of that class, mean and variances. It basically tries to fit 2 gaussians with above mentioned objective criteria.

For reg3.jpg the obtained threshold is 81
For reg4.jpg the obtained threshold is 81

## Connected Components Extraction:

I used simple Flood-fill method for finding the connected components. Whenever an object pixel is encountered it explores all the 8 directions (8 connectivity) recursively until it covers the entire connected component.

## Blob Statistics:

1. '0' is the object pixel and '1' is the background
2. I assumed x coordinates as columns and y coordinates as rows
3. I followed the method described here http://users.utcluj.ro/~rdanescu/PI-L6e.pdf for calculating the perimeter.
4. In the output, I plotted histogram, thresholded image. All the connected component images are written to the directory and their stats are written to the output file 'output.txt'.
5. From the blob stats of two images reg3.jpg and reg4.jpg we can make out that the features like area, parameter and elongation remains almost same for the corresponding connected components.

## Execution Instructions

Run objectRecog(img_file)
It will internally call Otsu's method, flood fill, perimeter and holes methods.

**Blob stats for reg3.jpg**

REGION 1
MBR coordinates = (15,165) (15,214) (95,214) (95,165)
Area = 2583
centroidX = 1.900790e+02 centroidY = 5.426171e+01
Perimeter = 202
Elongation = 1.579714e+01
Number of Holes = 0
Holes Area =

REGION 2
MBR coordinates = (46,113) (46,154) (101,154) (101,113)
Area = 905
centroidX = 1.357514e+02 centroidY = 7.304751e+01
Perimeter = 268
Elongation = 7.936354e+01
Number of Holes = 13
Holes Area = 9 Holes Area = 18 Holes Area = 1 Holes Area = 7 Holes Area = 12 Holes Area = 2
Holes Area = 3 Holes Area = 1 Holes Area = 2 Holes Area = 41 Holes Area = 2 Holes Area = 1
Holes Area = 2

REGION 3
MBR coordinates = (63,113) (63,113) (63,113) (63,113)
Area = 1
centroidX = 113 centroidY = 63
Perimeter = 1
Elongation = 1
Number of Holes = 0
Holes Area =

REGION 4
MBR coordinates = (72,74) (72,108) (168,108) (168,74)
Area = 2259
centroidX = 9.150155e+01 centroidY = 1.209907e+02
Perimeter = 228
Elongation = 2.301195e+01
Number of Holes = 1
Holes Area = 4

REGION 5
MBR coordinates = (99,134) (99,135) (99,135) (99,134)
Area = 2
centroidX = 1.345000e+02 centroidY = 99
Perimeter = 2
Elongation = 2

Number of Holes = 0
Holes Area =

REGION 6
MBR coordinates = (102,135) (102,135) (102,135) (102,135)
Area = 1
centroidX = 135 centroidY = 102
Perimeter = 1
Elongation = 1
Number of Holes = 0
Holes Area =

REGION 7
MBR coordinates = (118,168) (118,216) (148,216) (148,168)
Area = 868
centroidX = 1.940841e+02 centroidY = 1.334712e+02
Perimeter = 128
Elongation = 1.887558e+01
Number of Holes = 0
Holes Area =

REGION 8
MBR coordinates = (122,178) (122,179) (123,179) (123,178)
Area = 3
centroidX = 1.783333e+02 centroidY = 1.223333e+02
Perimeter = 3
Elongation = 3
Number of Holes = 0
Holes Area =

REGION 9
MBR coordinates = (135,109) (135,182) (217,182) (217,109)
Area = 3339
centroidX = 1.458002e+02 centroidY = 1.754582e+02
Perimeter = 229
Elongation = 1.570560e+01
Number of Holes = 1
Holes Area = 486

REGION 10
MBR coordinates = (157,185) (157,236) (208,236) (208,185)
Area = 2024
centroidX = 2.105573e+02 centroidY = 1.819644e+02
Perimeter = 166
Elongation = 1.361462e+01
Number of Holes = 0

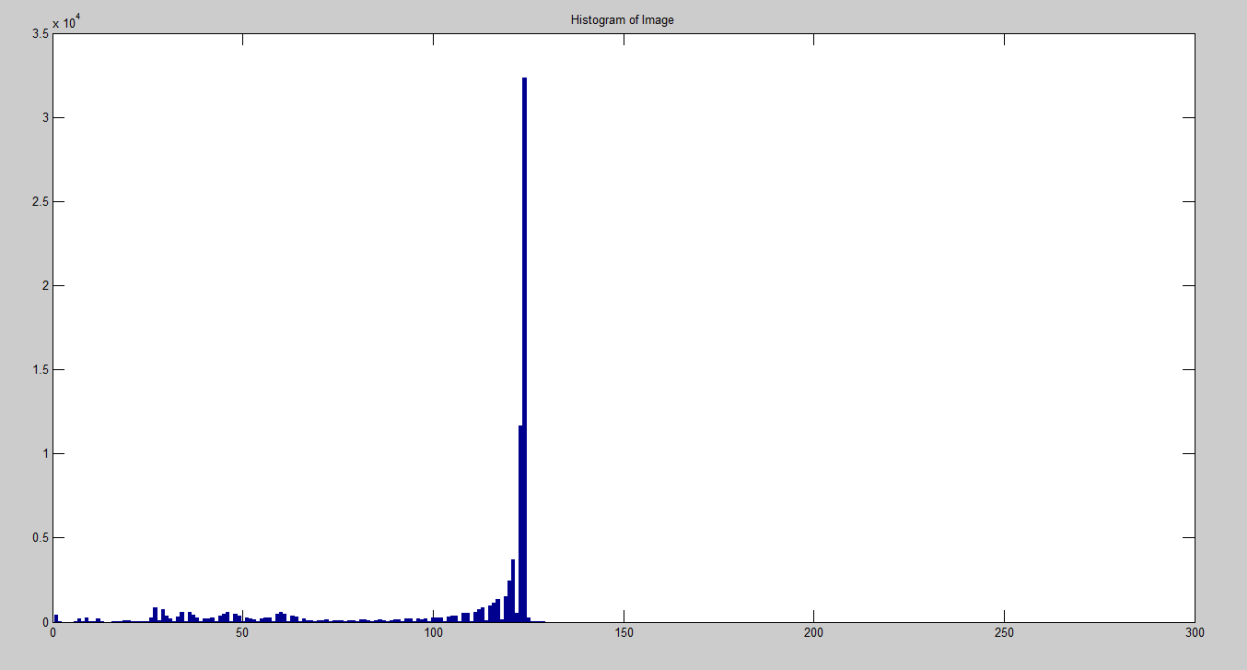
Holes Area =

REGION 11
MBR coordinates = (182,102) (182,118) (197,118) (197,102)
Area = 212
centroidX = 1.102170e+02 centroidY = 1.893821e+02
Perimeter = 45
Elongation = 9.551887e+00
Number of Holes = 0
Holes Area =

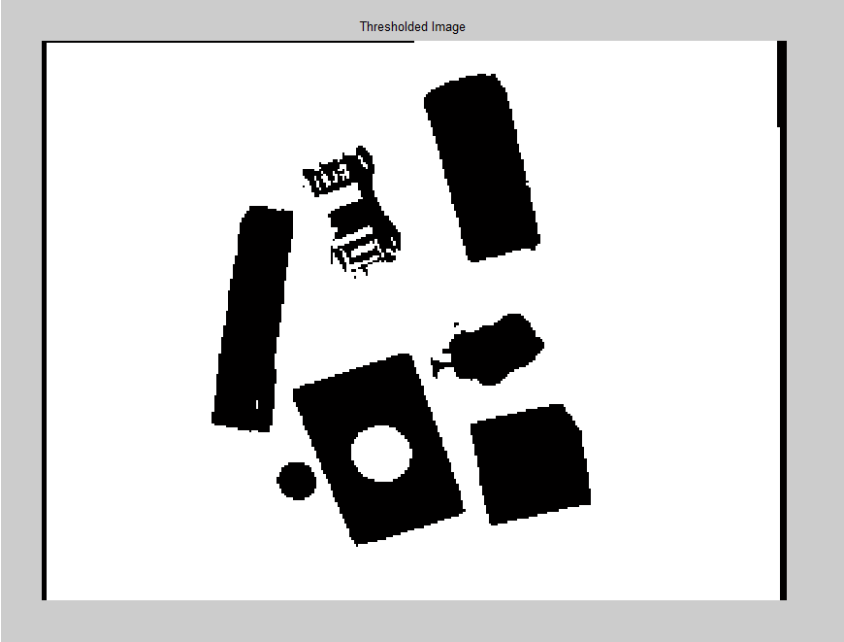
**Results**

**Results for reg3.jpg**

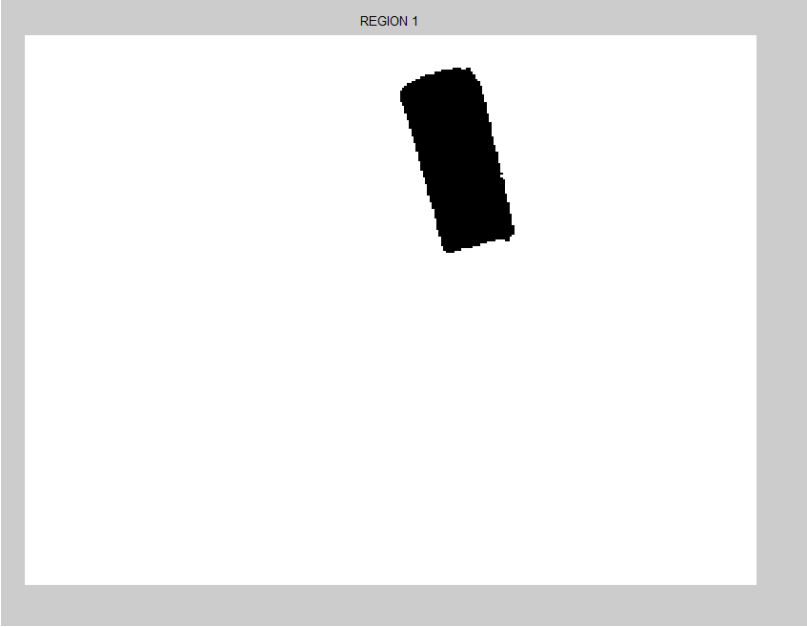
Histogram



Thresholded Image




Major Connected Components



REGION 2

REGION 4

REGION 7

REGION 9

REGION 10

REGION 11

MBR and centroid