CLASS : T.E. E&TE **SUBJECT: DIP**

EXPT. NO. : 6 **DATE:**

TITLE : PERFORM IMAGE SEGMENTATION OPERATION ON GRAY IMAGE

CO 1:	Apply the fundamentals of digital image processing to perform various image enhancement and image segmentation operations on gray scale image.

AIM:

1. Study of Image segmentation techniques
2. Implement Point detection
3. Implement Line detection
4. To apply Global Thresholding

SOFTWARES REQUIRED: Google Colaboratory / Jupyter Notebook

THEORY:

6.1 Point Detection:

The detection of isolated points in image is straight forward. Using the mask shown below, we can say that a point has been detected at the location on which mask is centered if

$$|R| > T$$

where T is non negative threshold and R is computed as sum of products of coefficients of mask with the grey level values of image encompassed by the mask.

-1	-1	-1
-1	8	-1
-1	-1	-1

6.2 Line Detection:

If the first mask were moved around an image, it would respond more strongly to lines (one pixel thick) oriented horizontally. A similar experiment would reveal that The second mask responds best to the lines oriented at 45^0; the third mask to vertical lines; and the fourth mask to line in the -45^0 direction.

-1	-1	-1
2	2	2
-1	-1	-1

Horizontal

-1	-1	2
-1	2	-1
2	-1	-1

+45

-1	2	-1
-1	2	-1
-1	2	-1

Vertical

2	-1	-1
-1	2	-1
-1	-1	2

-45^0

6.3 Thresholding:

Thresholding is one of the most important approaches to image segmentation.

It is the last step in image segmentation. Different types of thresholding are,

1. Global (depends on intensity value)
2. Adaptive (depends on intensity and local property)

3. Optimal (depends on intensity, position and local property)
4. Local Thresholding function is,

$T = [f(x, y), p(x, y), (x, y)]$

where $f(x, y)$ = intensity of pixel

$p(x, y)$ = local property (neighborhood)

(x, y) = position of pixel

- When T depends only on $f(x, y)$ → global threshold
- When T depends on both $f(x, y)$ and $p(x, y)$ → local threshold

6.3.1 Segmentation by thresholding

Thresholding is the simplest segmentation method.

The pixels are partitioned depending on their intensity value I. Global thresholding, using an appropriate threshold T:

$g(x, y) = 1$, if $f(x, y) > T$

$= 0$, if $f(x, y)$ _ T

Variable thresholding, if T can change over the image, Local or regional thresholding, if T depends on a neighborhood of (x, y). I adaptive thresholding, if T is a function of (x, y).

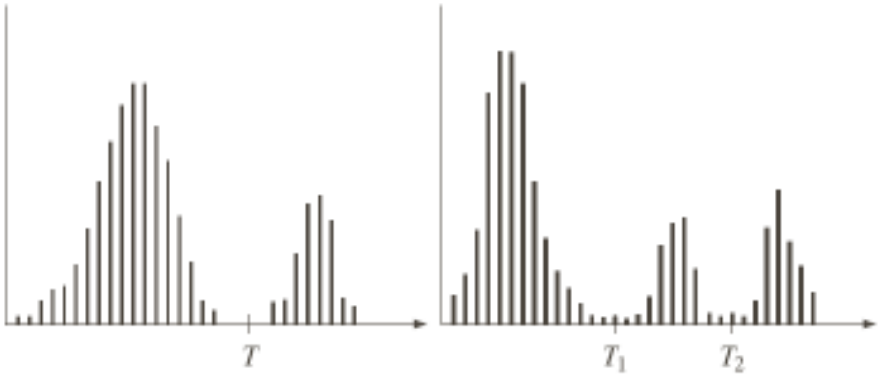
Multiple thresholding:

$g(x, y) = a$, if $f(x, y) > T_2$

$= b$, if $T_1 < f(x, y) < T_2$

$= c$, if $f(x, y) < T_1$

6.3.2 Choosing the thresholds



Peaks and valleys of the image histogram can help in choosing the appropriate value for the threshold(s). Some factors affect the suitability of the histogram for guiding the choice of the threshold:

- The separation between peaks;
- The noise content in the image;
- The relative size of objects and background;
- The uniformity of the illumination;
- The uniformity of the reflectance.

6.4 Global thresholding:

In practice global thresholding can be expected to be more successful in highly controlled environments such as industrial inspection application, where illumination control is feasible. Usually a successful segmentation is highly depends on the choice of thresholds.

Steps for Global Thresholding:

1) Initial estimate of T
2) Segmentation using T:
    - G_1, pixels brighter than T;
    - G_2, pixels darker than (or equal to) T.

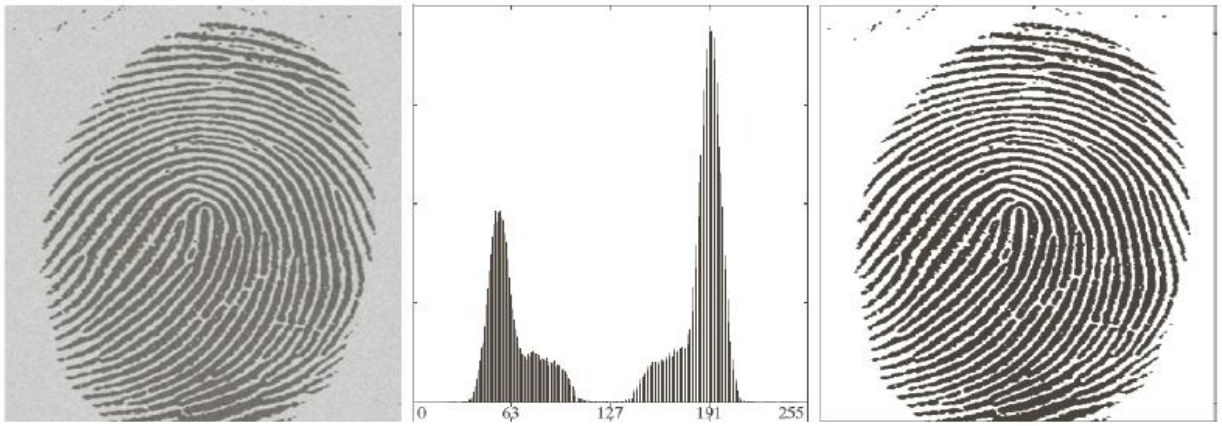
3) Computation of the average intensities m_1 and m_2 of G_1 and G_2.
4) New threshold value:

$$T_{new} = (m_1 + m_2)/ 2$$

5) If $|T - T_{new}| >=$ delta (T), back to step 2, otherwise stop.

This simple steps works well in situations where there is a reasonably clear valley between the modes of the histogram related to objects and background. Parameter delta(T) is used to control the number of iterations in situations where speed is important. This initial threshold must be chosen greater than the minimum and less than maximum intensity level in the image.

Global thresholding : An example



6.5 Algorithm:

6.6 Conclusion:

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6.7 References:

1." Digital Image Processing " , by Gonzalez and Woods.

2. "Digital Image Processing " , S. Jayaraman, S. Esakkirajan, T. Veerakumar.

3. Pictures taken from:

http://www.imageprocessingplace.com/root_files_V3/image_databases.html

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(Course Teacher)