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Experiment 01: – Study of Point Processing Operations

Date: _____

1. **Aim :** To perform following Point Processing Operation on Gray scale images
   a. Image Negative
   b. Power law transform.
   c. Log transform
   d. Bit Plane Slicing
   e. Contrast stretching

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2. **Requirements:** Python

3. **Pre-Experiment Exercise**
   3.1 Brief Theory

   i. Image Negative:
   The negative of an image with gray levels in the range [0, L-1] is obtained by using the negative transformation as shown in Fig. 1, formula which is given by the expression s = L – 1 – r, where s is the output gray level, r is the input gray level and L = 2^k where k is the number of bits per pixel used in the image.

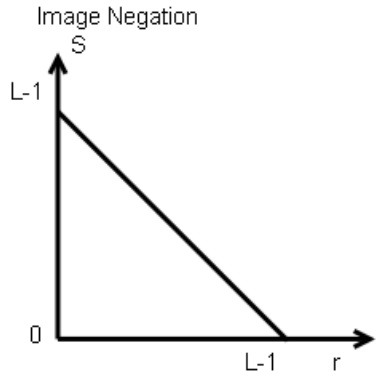

Fig 1. Image Negative

Reversing the intensity levels of an image in this manner produces the equivalent of a photographic negative. This type of processing is particularly suited for enhancing white or gray detail embedded in dark regions of an image, especially when the black areas are dominant in size.

ii. Log Transformations
The general form of the log transformation shown in Fig. 2 is

$$s = c \log (1 + r)$$

where c is a constant, and it is assumed that r ≥ 0.The shape of the log curve in Fig 2 shows that this transformation maps a narrow range of low gray-level values in the input image into a wider range of output levels. The opposite is true of higher values of input levels. We would use a transformation of this type to expand the values of dark pixels in an image

while compressing the higher-level values. The opposite is true of the inverse log transformation.

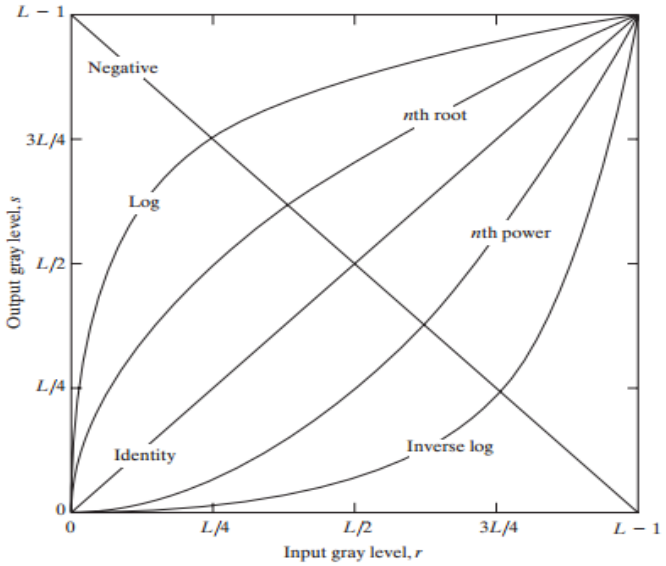

Fig. 2. Log transformation, Power law & Image Negative

The log function has the important characteristic that it compresses the dynamic range of images with large variations in pixel values.

iii. Power Law transformation

Power-law transformations have the basic form

$$S = c\, r^{\gamma}$$

Where c and γ are positive constants. Plots of s versus r for various values of γ are shown in Fig. 2. As in the case of the log transformation, power-law curves with fractional values of γ map a narrow range of dark input values into a wider range of output values, with the opposite being true for higher values of input levels. Unlike the log function, however, we notice here a family of possible transformation curves obtained simply by varying γ. As expected, we see in Fig.6 that curves generated with values of $\gamma > 1$ have exactly the opposite effect as those generated with values of $\gamma < 1$. Finally, we note that reduces to the identity transformation when c = g = 1.

iv. Bit Plane slicing

Bit plane slicing is the conversion of image into multilevel binary image. These binary images are then compressed using different algorithm. With this technique, the valid bits from gray scale images can be separated, and it will be useful for processing these data in very less time complexity. The gray level of each pixel in a digital image is stored as one or more bytes in a computer. For an 8-bit image, 0 is encoded as 00000000 and 255 is encoded as 11111111. Any number between 0 t0 255 is encoded as one byte. The bit in the far left side is referred as the Most Significant Bit (MSB) because a change in that bit would significantly change the value encoded by the byte. The bit in the far right is referred as the Least Significant Bit (LSB), because a change in this bit does not change the encoded gray value much.

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v. Contrast Stretching

Contrast stretching is an Image Enhancement method which attempts to improve an image by stretching the range of intensity values. It stretch the minimum and maximum intensity values present to the possible minimum and maximum intensity values.

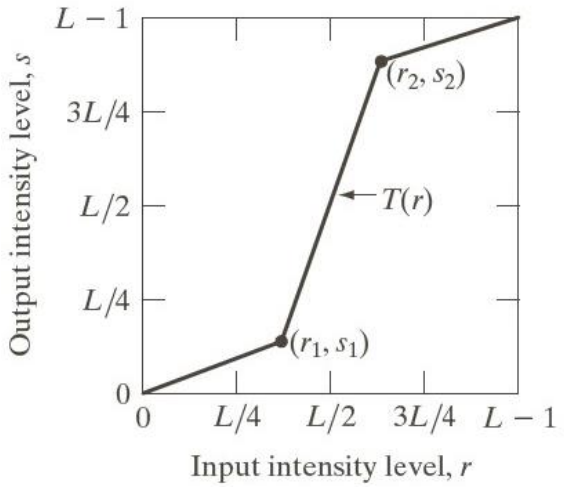

Fig. 3. Transformation Function of Contrast Stretching

Fig. 3 shows a typical transformation used for contrast stretching. The locations of points (r1,s1) and (r2, s2) control the shape of transformation function. If r1 = s1 and r2 = s2 the transformation is a linear function and produces no changes

4. Laboratory Exercise

4.1 Algorithm for Point Processing Operations on Gray scale images:

Write a program in python to implement all above five point processing image enhancement techniques and show the corresponding output enhanced image along with input image.

5. Post Experiment Exercise:

5.1 Conclusion:

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5.2 Questions:

1. What is meant by image enhancement? What are the different types of image enhancement techniques?
2. What are the applications of bit-plane & power law transformation?
3. Explain dynamic rage compression techniques with applications