**Texture Analysis**

**Local Binary Pattern (LBP) & Local Derivative Pattern (LDP)**

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**Image Texture:** a feature used to partition images into regions of interest and to classify those regions, Image Texture gives us information about the spatial arrangement of color or intensities in an image or selected region of an image.

**Local Binary Pattern (LBP) Definition:** it is a nonparametric descriptor, used to summarize the local structures of images. In recent years, it has aroused increasing interest in many areas of image processing and computer vision and has shown its effectiveness in several applications, in particular for facial image analysis, including tasks as diverse as face detection, face recognition, facial expression analysis, and demographic classification. Derived from a general definition of texture in a local neighborhood, LBP is defined as a grayscale invariant texture measure and is a useful tool to model texture images. LBP later has shown excellent performance in many comparative studies, in terms of both speed and discrimination performance. The original LBP operator labels the pixels of an image by thresholding the 3 x 3 neighborhood of each pixel with the value of the central pixel and concatenating the results binomially to form a number. An LBP can also be considered as the concatenation of the binary gradient directions and is called a micropattern. The histograms of these micropatterns contain information on the distribution of the edges, spots, and other local features in an image. LBP has been successfully used for face recognition. Different from statistic learning methods tuning a large number of parameters, the LBP method is very efficient due to its easy-to-compute feature extraction operation and simple matching strategy.

**LBP Mathematical Formulation:** The original LBP operator labels the pixels of an image by thresholding the 3 x 3 neighborhood of each pixel with the value of the central pixel and concatenating the results binomially to form a number. The thresholding function for the basic LBP can be formally represented as

where ic and iP are, respectively, gray-level values of the central pixel and P surrounding pixels in the circle neighborhood with a radius R, and function s(x) is defined as

**LBP Algorithm:**

* Input: image.
* Output: LBP matrix of the image.
* Steps:
  + Convert image into grid of pixels, represented by a matrix.
  + Select a center pixel and examine its neighboring pixels.
  + Set threshold value as center pixel value.
  + Compare threshold value with each neighboring pixels and assign
  + binary number according to the above function.
  + Read the binary values in clockwise or anti-clockwise order and convert the 8-bit binary number into decimal number.
  + Replace the center pixel value by the decimal number.
  + Repeat the above steps for every pixel.