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COLOUR AND TEXTURE FEATURES FOR IMAGE

Feature Extraction is a method of capturing visual content of images for indexing & retrieval.

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately.

Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy.

Texture analysis aims in finding a unique way of representing the underlying characteristics of textures and represent them in some simpler but unique form, so that they can be used for robust, accurate classification and segmentation of objects.

The derived features are called the **raw features**, and are quite different between the **abnormality segmentation** and the **diagnosis decision** making problem

The feature extraction in the field of image processing that is useful in **classification** and **recognition** of images.

The texture is recognizable in both **tactile** and **optical (color)** ways.

- **Tactile texture** (Texture feature) refers to the tangible feel of a surface.
- **visual texture** (Color feature) refers to see the shape or contents of the image.

In the other word: Image features can be either general features, such as extraction of **color**, **texture and shape** or domain specific features.

In the image processing, the texture can be defined as a function of spatial variation of the brightness intensity of the pixels.

Texture analysis:

- Texture shape.
- Texture synthesis
- Texture segmentation
- Texture classification

Texture Shape Extraction: the objective is to extract 3D images which are covered in a picture with a specific texture. This field studies the structure and shape of the elements in the image by analyzing their textual properties and the spatial relationship each with each other.

Texture Synthesis: is to produce images that have the same texture as the input texture. Applications of this field are creation of graphic images and computer games. Eliminate of a part of the image and stow it with the background texture, creation of a scene with lighting and a different viewing angle, creation of artistic effects on images like embossed textures are other applications of this field.

Texture Segmentation: is to divide an image into distinct areas, each of which is different in terms of texture. The boundaries of different textures are determined in the texture segmentation. In other words, in texture segmentation, the features of the boundaries and areas are compared and if their texture characteristics are sufficiently different, the boundary range has been found.

Texture classification is one of the important areas in the context of texture analysis whose main purpose is to provide descriptors for categorizing textural images. Texture classification means assigning an unknown sample image to one of the predefined texture classes. The key issues in the analysis of texture are texture classification.

Feature Extraction Methods for Categorizing Textures:

The texture classification means assignment of a sample image to a previously defined texture group. This classification usually involves a two-step process:

A) **First stage**, the **feature extraction phase**:

Textural properties are extracted. The goal is to create a model for each one of the textures that exist in the training platform. Extractive features at this stage can be numerical, discrete histograms, empirical distributions, texture features such as contrast, spatial structure, direction, etc. Among the most common ones, they can be divided into **four** main groups:

- **Statistical methods**
- **Structural methods (geometric methods)**
- **Model-based methods**
- **Transform methods (frequency based methods)**

Each of these methods extracts the various features of the texture. See table 1.

B) **Second stage**, the **classification phase**: In this phase, the test sample image texture is first analyzed using the same technique used in the previous step and then, extraction features of the test image are compared with the train imagery and its class is determined using a classification algorithm, is based on the use of machine learning algorithms with monitoring or classification algorithms. the estimated classes for testing with their actual class are adapted and the recognition rate is calculated which indicates the efficiency of the implemented method which the recognition rate of each algorithm is used to compare the efficiency of its algorithm with other available methods.

$$Classification\ accuracy = \frac{(Number\ of\ correct\ Matches)}{(\text{Total Number of test images})} \text{X } 100\% \ldots\ldots(1)$$

The general flowchart of methods for the texture images classification is indicated in figure 1 based on the two preceding phases.

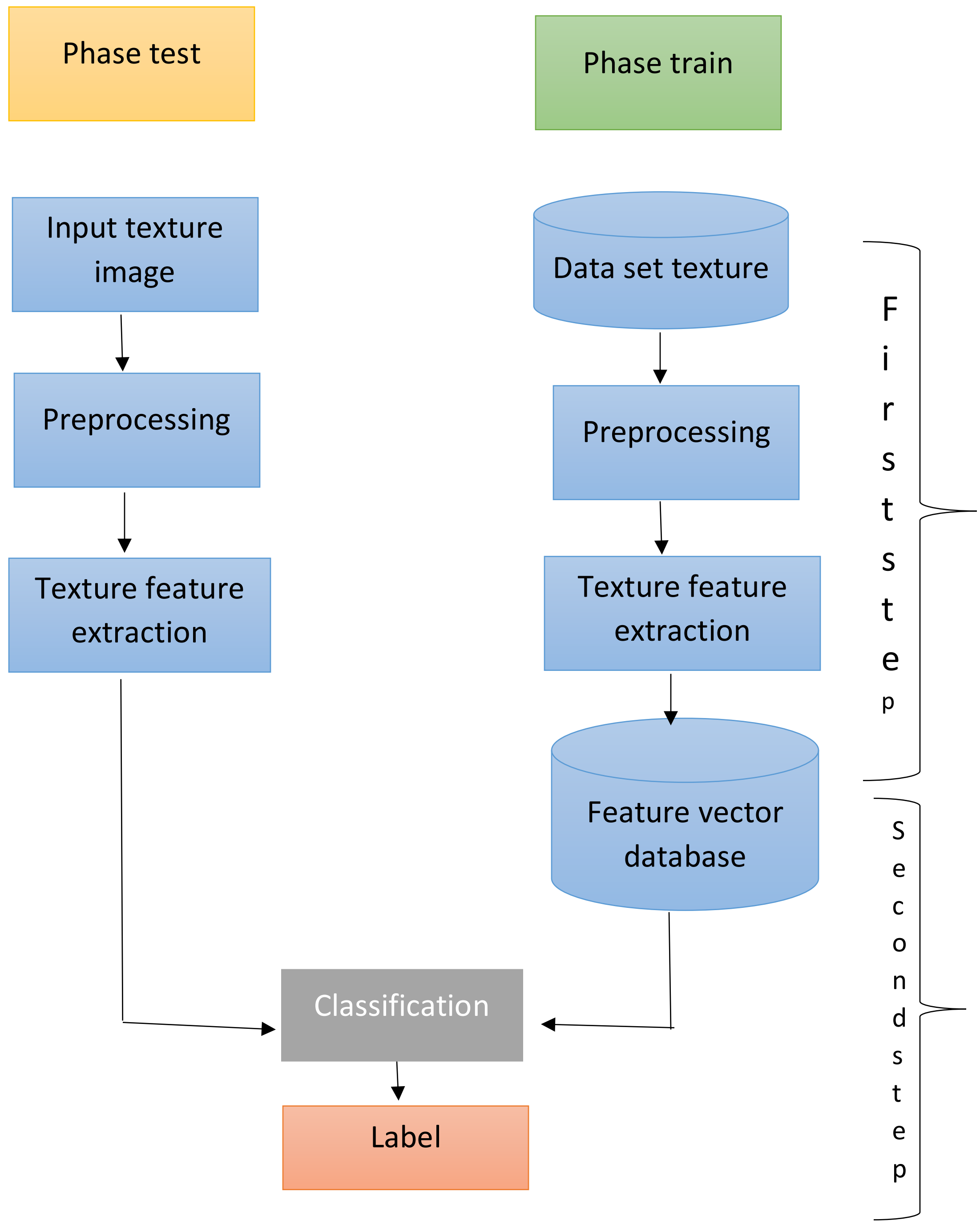

Figure 1. The popular flowchart of the texture images classification process.

Texture Analysis Application:

Texture analysis in most areas of image processing, especially in the process of learning and extracting the feature is being discussed when we want to compare the images such as:

- Face Detection
- Tracking Objects in Videos
- Product Quality Diagnostics
- Medical image analysis
- Remote Sensing
- Vegetation

Texture Classification Methods:

There are several ways to deal with it. Table 1.

Table 1: Categorization of texture classification methods.

Categories	Categories Sub-categories	Methods
Statistical	Histogram Properties	• Binary Gabor pattern • GLCM and Gabor filters • Gabor and LBP • wavelet transform and GLCM • local binary patterns and significant point's selection • Energy variation • Combination of primitive pattern units and statistical features • Hybrid color local binary patterns
	Co-occurrence Matrix	
	Local Binary Descriptors	
	Registration- based	
	Laws Texture Energy	
Structural	Primitive Measurement	• Energy variation • Edge-based texture granularity detection • Morphological filter • Skeleton primitive and wavelets
	Edge Features	
	Skeleton Representation	
	Morphological Operations	
	SIFT	
Model-based	Autoregressive (AR) model	• Multifractal Analysis in Multi-orientation Wavelet • Markov Random Field Texture Models • simultaneous autoregressive models
	Fractal models	
	Random Field Model	
	Texem Model	
Transform based	Spectral	• Binary Gabor Pattern • wavelet channel combining and LL channel filter bank • GLCM and Gabor Filters • Gabor and LBP • wavelet transform and GLCM • SVD and DWT domains • Skeleton primitive and wavelets
	Gabor	
	Wavelet	
	Curvelet Transform	

Statistical Methods:

The first, second and higher level statistical characteristics are among these methods.

The difference between these type of three features is that the:

First- level single-pixel specification is calculated without taking into account the interaction between pixels of the image. While in a **Second-level and higher- level** statistical characteristic, the specification is calculated taking into account the dependence of two or more pixels. The **Co-Occurrence Matrix** that is known as the second-level histogram is one of the methods to be included in this group.

In general, this approach is easier to compute and is more widely used, since natural textures are made of patterns of irregular sub elements.

Histogram Features and Specifications:

The first- level statistical indexes are derived from the calculation of the statistical moments of the histogram of the image.

The image histogram is a two-dimensional representation of how the gray levels are dispersed in the image? Simply, histogram is a graphical representation

Each point in the several color spaces has been used for color representation, and they are based on the perceptual concepts. There are a number of fundamental color descriptors.

Color **Moments** is one of the simplest yet very active features.

The color features are the **means, Variation, and skewness, etc.**

The **mean** in the equation

$$\mu_i = \frac{1}{N} \sum_{j}^{N} f_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

The **variance** is a measure of contrast severity, which can be used to create descriptors of relative smoothness. in the equation

$$\sigma^2_i = \frac{1}{N} \sum_{j}^{N} (f_{ij} - \mu_i)^2 \quad \ldots\ldots\ldots\ldots..(3)$$

The **skewness**: A criterion for the histogram symmetry degree in the equation

$$Y_i = \left(\frac{1}{N} \sum_{j}^{N} (f_{ij} - \mu_i)^3\right)^{1/3} \quad \ldots\ldots\ldots\ldots(4)$$

Sometimes we need to convert the R G B color map into H S V color map or another color space or only band from RGB in order to compute the color feature according to the type of diagnosis.

References:

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