Feature extraction methods for the classification of grape leaves

TECHNICAL UNIVERSITY OF CLUJ-NAPOCA ROMANIA

Author: Stefania BARBURICEANU

I. Introduction

Humans process visual information faster and easier than they process text - the field of image processing has evolved in the last years and now it is successfully used in different domains**:** medical imaging, industrial inspection, remote sensing. Regardless of the specific domain or application, the **supervised image classification** includes two steps: training and actual classification, both involving two techniques: feature extraction and machine learning classification.

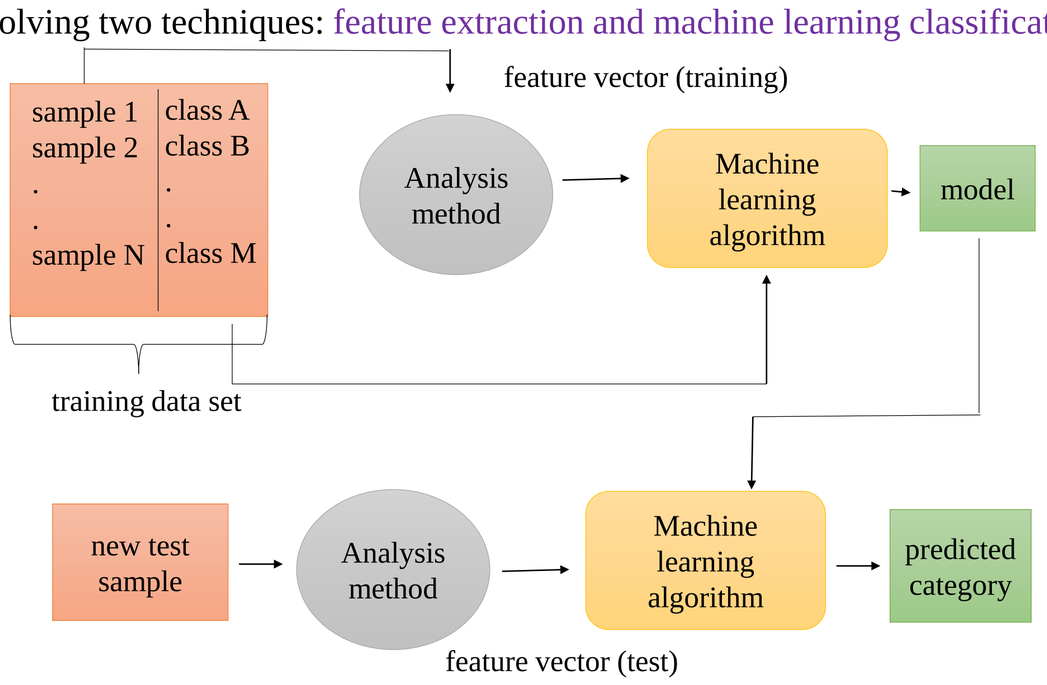


Figure 1. Supervised image classification block scheme

II. Proposed method

Gray-level images: use textural information

- Apply the MRELBP (Median Robust Extended Local Binary Patterns) technique for the classification of grape leaves diseases;
- Use the proposed operator: BM3DELBP (Block Matching and 3D Filtering Extended Local Binary Pattern) for obtaining better noise robustness.

Aim:

- Develop new feature extraction methods that work in the RGB colour space;
- Study the potential contribution of colour information for increasing the accuracy for the classification of grape leaf diseases.

RGB images: use texture and colour information

- Extension of the proposed methods to colour;
- New operators are labelled: **OCMRELBP** (Opponent Colour MRELBP) and **OCCBM3DELBP** (Opponent Colour Colour-Block Matching and 3D filtering Extended LBP).

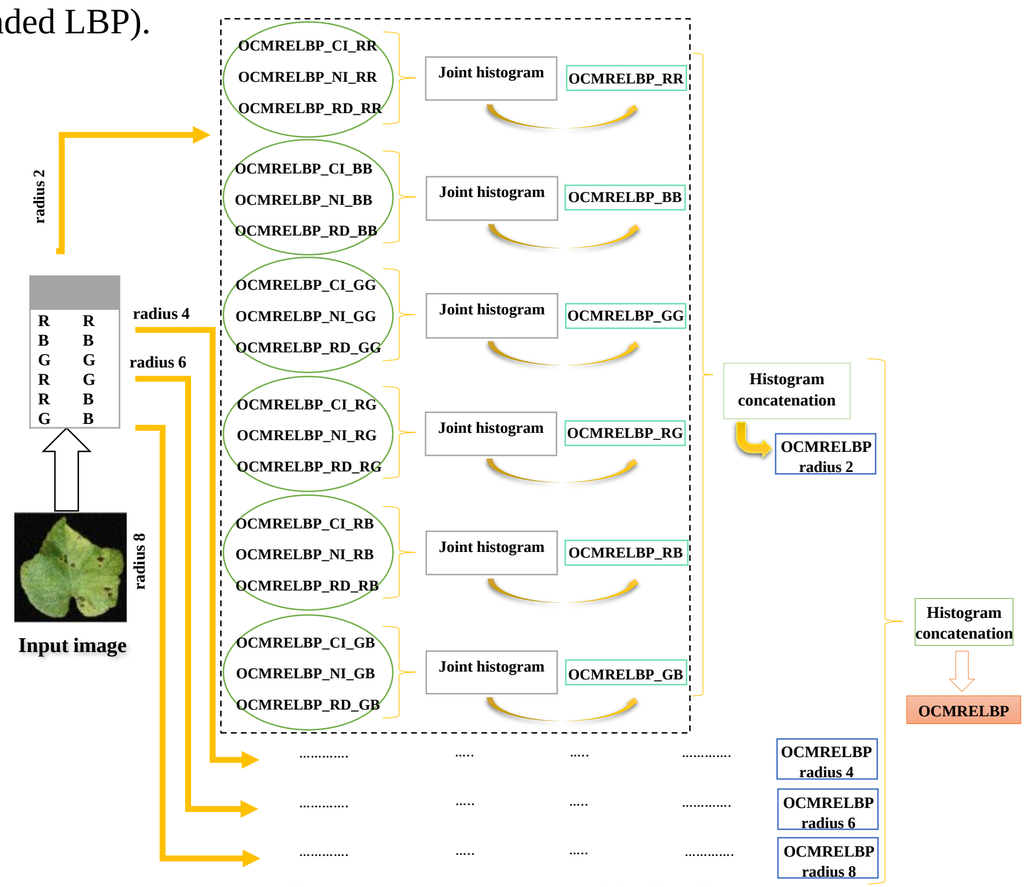


Figure 4. The OCMRELBP operator block scheme

III. Experimental results

1. Database used

- Images of healthy and diseased grape leaves;
- Different illumination conditions, rotations;
- 70% of the samples – training and 30% - testing;
- 40 tests corresponding to random partitions of the training and test sets.

2. Results

Table I. Classification accuracy [%] for noise-free images

Operator	Average accuracy
MRELBP	93.19±0.65
BM3DELBP	93.66±0.52
OCMRELBP	98.18±0.37
OCCBM3DELBP	**98.32±0.43**

Table II. Classification accuracy [%] for noisy images

Operator	Average accuracy
MRELBP	89.30±0.75
BM3DELBP	92.25±0.64
OCCBM3DELBP	**97.76±0.37**

IV. Conclusions

- Promising results;
- Textural information is relevant for this classification problem;
- Colour information brings improvements in the classification accuracy.

Feature extraction:

- Is used in almost all machine-learning algorithms;
- Involves extracting information from raw data;
- Has a strong influence on the performance of the classification system;

The extracted features:

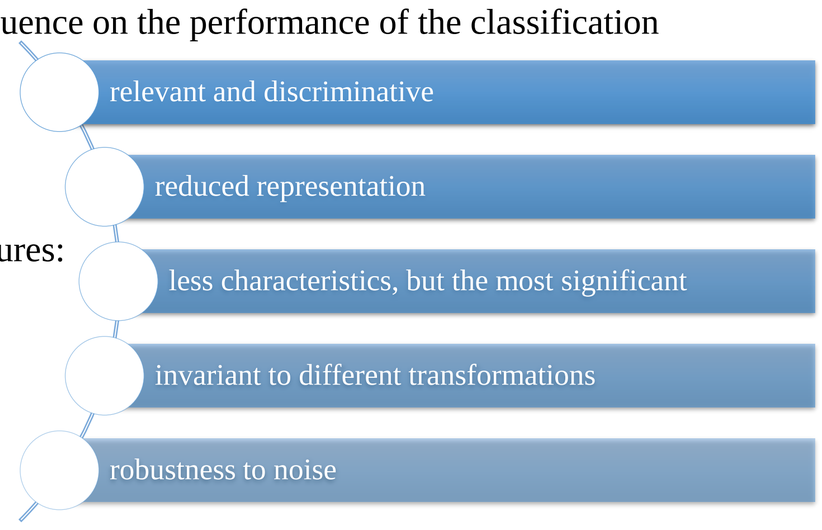
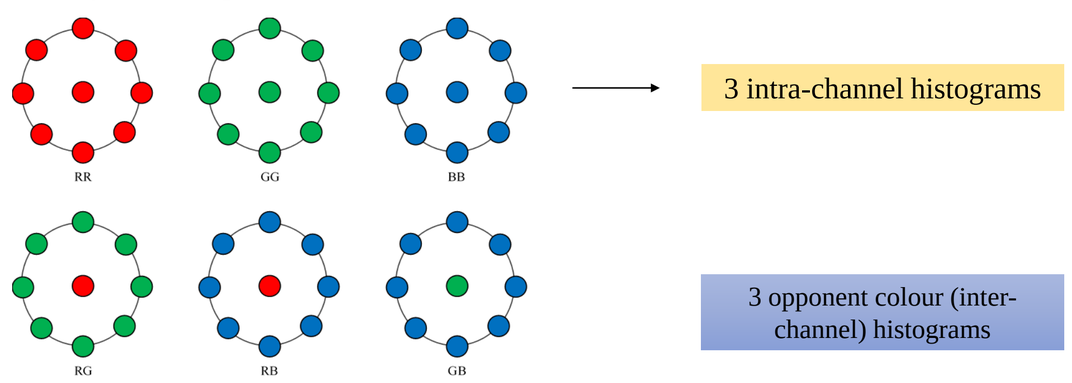


Figure 2. Properties of the extacted features

Plant disease detection and classification:

- Diseases cause a decrease in productivity and quality of agricultural products;
- It is necessary to detect diseases in order to take the best measures;
- Machine learning methods can prove to be helpful for the classification and identification of plant diseases.

Opponent colour idea: Application of the operator on each colour channel independently and on pairs of colour channels



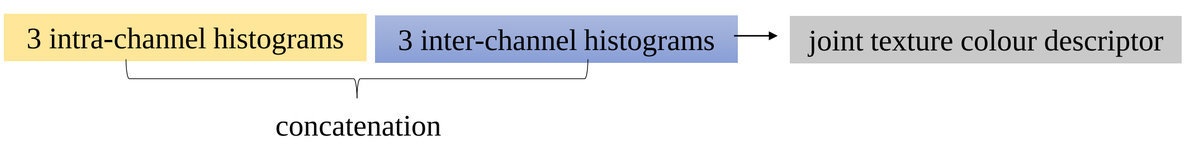


Figure 3. Opponent colour idea

- Three components are calculated for each channel pair combination: OCMRELBP_CI, OCMRELBP_NI and OCMRELBP_RD;
- For each colour channel a joint histogram is built by combining the codes obtained from the three components; the resulting joint histograms are then concatenated;
- These steps were considered for all scales of interest (radii 2,4,6 and 8);
- To extend the BM3DELBP operator to colour images, the colour version of the BM3D filter is used and the opponent colour approach is applied in the same manner.

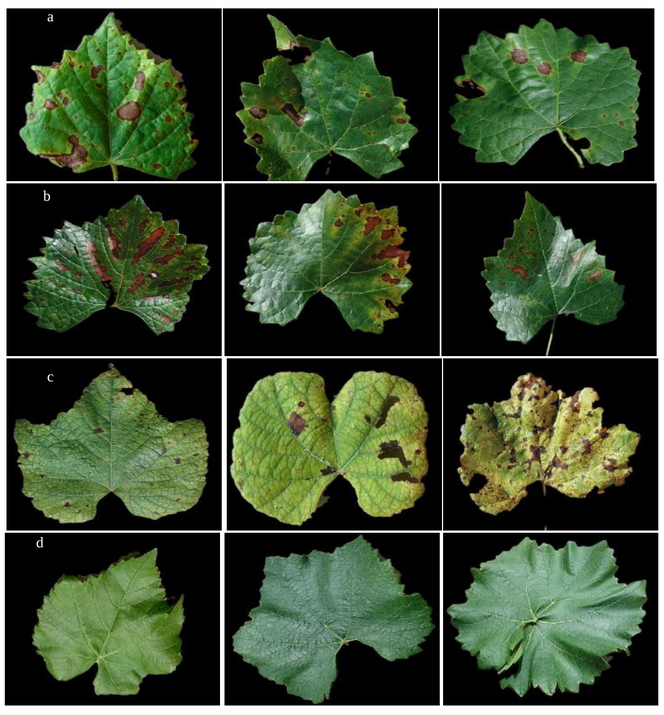


Figure 5. Examples of grape leaves: a) affected by Black Rot b) affected by Black Measles c) affected by Isariopsis d) healthy

Class	Number of samples
Grape leaves affected by Black Rot	1180
Grape leaves affected by Black Measles - Esca	1384
Grape leaves affected by Isariopsis Leaf Spot – Leaf blight	1076
Healthy grape leaves	423

Acknowledgment

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