

## International Journal of Innovative Research in Science, Engineering and Technology

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# Classification of Banana Leaf Disease Using ANFIS

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**ABSTRACT:** Identification and classification of banana leaf disease in earlier stage, so that it will not affect the plant growth. Banana leaf is highly exposed to diseases like Black Sigatoka, Yellow Sigatoka, Bunchy top virus. SVM (Support Vector Machine) Method is used to classify the disease in existing method. In proposed method we exploit ANFIS to classify the disease. Images of the infected leaf are captured by digital camera and processed using image processing, image segmentation techniques to detect infected parts of the particular plants. It involves image acquisition, image preprocessing, image segmentation, feature extraction and classification using ANFIS (Adaptive Neuro Fuzzy Interference System).

**KEYWORDS:** image acquisition, image preprocessing, image segmentation, feature extraction and ANFIS.

### I. INTRODUCTION

Banana is the most important fruit of the Asia and Pacific region. Cavendish clones are grown for the export market, but many indigenous cultivars are produced and consumed locally. Many problems affect banana agriculture. Plant diseases, which are generally caused by viruses, bacteria, fungi, nematode and nutrient deficiency, cause lots of damage to crops and its affects are – reduces the yield and quality of crops.

It also results in death of the plant, affects the income of the farmer and also increases the cost of production over the span of controlling them. Banana is the most vital fruit consumed, which are generally caused by viruses, bacteria, fungi, nematode and nutrient deficiency, cause lots of damage to crops and its affects are – reduces the yield and quality of crops. It also results in death of the plant, affects the income of the farmer and also increases the cost of production over the span of controlling them. The banana leaves are affected by many diseases such as Blackspot and sigatoka, Panama and Moko disease. In Blacksigatoka, a pale yellow/dark or brown/black streaks are present parallel to the vein of the leaf. These streaks enlarge to form characteristic spots having dark brownish to black color, linear-oblong areas with ill-defined border, often surrounded by yellow halo.

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## II. METHODOLOGY

The following are the steps for banana leaf disease detection and classification using image processing:

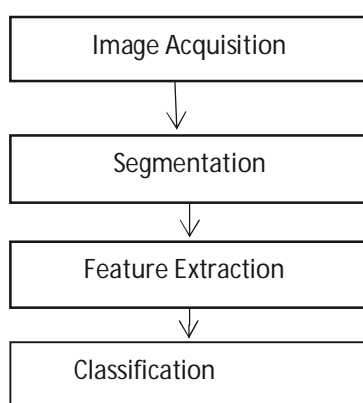
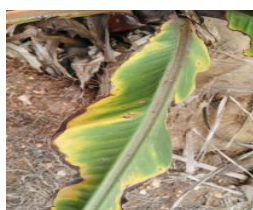


Fig.2 Block diagram of basic steps for banana disease detection and identification.

### 2.1 IMAGE ACQUISITION

Image acquisition involves capturing the images with the help of digital camera. It is defined as the action of retrieving an image from some source, usually a hardware-based source for processing. It is the first step in the work flow sequence because, without an image, no processing is possible.



a) panama disease



b) sigatoka disease

Fig.3 Image Acquisition.

### 2.2 IMAGE SEGMENTATION

This method is used for the conversion of digital image into various segments having some similarity. Image segmentation helps in the detection of objects and boundary line of the image. Segmentation is the technique of dividing or partitioning an image into parts, called segments. It is mostly useful for applications like image compression or object recognition, because for these types of applications, it is inefficient to process the whole image.

**2.2.1 DISCRIMINATIVE CLUSTERING BASED SEGMENTATION** Our discriminative clustering framework is based on positive definite kernels. Since our  $k$ -dimensional features are all histograms, we consider a joint  $n \times n$  positive semi-definite kernel matrix  $K$  (defined for all pairs of all pixels from all images) based on the  $x^2$ -distance, with entries:

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$$K_{im} = \exp \left( -\lambda_h \sum_{d=1}^k \frac{(x_d^i - x_d^m)^2}{x_d^i + x_d^m} \right)$$

where  $\lambda_h > 0$ . In the experiments, we use  $\lambda_h = 0.1$ . Note that we do not use the positions  $\mathcal{P}^i$  to share information through images in order to be robust to object location. Considering a positive definite kernel such as the one used in Eq. (3.8) is equivalent to mapping each of our  $n$   $k$ -dimensional vectors  $x^i, i=1, \dots, n$  into a high dimensional Hilbert space  $\mathcal{F}$  through a feature map  $\Phi$ , so that  $K_{mi} = \Phi(x^m)^T \Phi(x^i)$ . Kernel methods then aim at learning a classifier which is an affine function of  $\Phi(x)$  through the minimization with respect to  $f \in \mathcal{F}$  and  $b \in \mathbb{R}$  of

$$\frac{1}{n} \sum_{j=1}^n \ell(y_j, f^T \Phi(x^j) + b) + \lambda_k \|f\|^2$$

where  $y_j \in \{-1, 1\}$  is the label associated with the  $j$ -th pixel and  $\ell$  is a loss function. In this paper, we consider the square loss  $\ell(s, t) = (s - t)^2$  but other losses such as the hinge loss could be considered. Given the kernel matrix  $K$  (which is known and fixed and the labels  $\mathcal{Y}$  (which are unknown), we denote by  $g(\mathcal{Y})$  the optimal solution of the supervised learning problem in Eq. (3.9) with the kernel matrix  $K$  and labels  $\mathcal{Y}$ . The optimal value  $g(\mathcal{Y})$  is a measure of the separability of the classes defined by  $\mathcal{Y} \in \{-1, 1\}^n$ . Following for the square loss, we can compute  $g(\mathcal{Y})$  in closed form as

$$g(\mathcal{Y}) = \mathcal{Y}^T A \mathcal{Y}$$

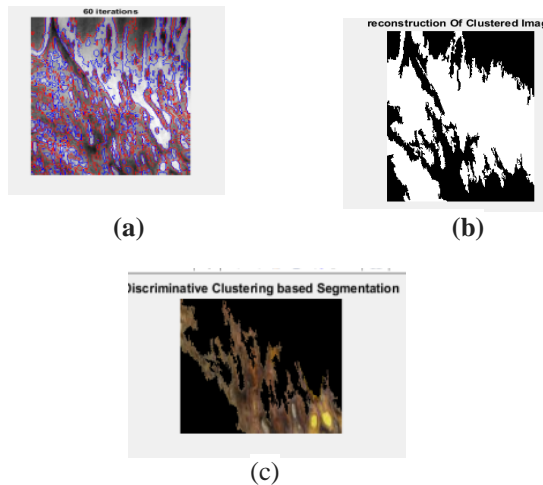


Fig.4 Image segmentation using discriminative clustering .

## 2.3 FEATURE EXTRACTION

In feature extraction method features such as color, texture, morphology and structure are used in plant disease detection. Color co-occurrence method is used in which the texture and color of the image are considered. The methods used in color co-occurrence are firstly the RGB image of the leaves are converted into HIS color space representation. For generation of color co-occurrence matrix each pixel map is applied which results into of H, S, I [1].

$$X = 0.5 \{ (R-G) + (R-B) \}$$

$$Y = \sqrt{(R-G)^2 + (R-B)(G-B)}$$

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$$H = \{0 \quad \text{if } B < G\}$$

Gray co-matrix creates an GLCM by calculating how often a pixel with grey level value (i) occurs horizontally adjacent to a pixel with value (j). Each element (i, j) in GLCM specifies the number of times that the pixel with value i occurred horizontally adjacent to a pixel with value j. The Table 4.2 shows the GLCM features values for the different maturity level of tomatoes and disease affected bananas

Parameter	Disease of Banana Leaves			
	Disease 1	Disease 2	Disease 3	Output
PCA Variance	0.0380	0.0157	0.0234	0.0012
Compactness	0.9035	0.8510	0.8990	0.7842
Color correction	0.7244	0.9189	0.9338	0.9561
Length width ratio	0.9668	0.5821	1.1648	1.6552
Circle area ratio	1.9644	1.1904	2.3304	3.2138
Square area ratio	10.004	6.0658	8.7537	5.9775
Triangle area ratio	1.2942	1.3026	1.2746	1.2367

Table 1: Gradient value for banana

In this paper Histogram Of Oriented Gradients(HOG) is used for feature extraction. The HOG is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image.

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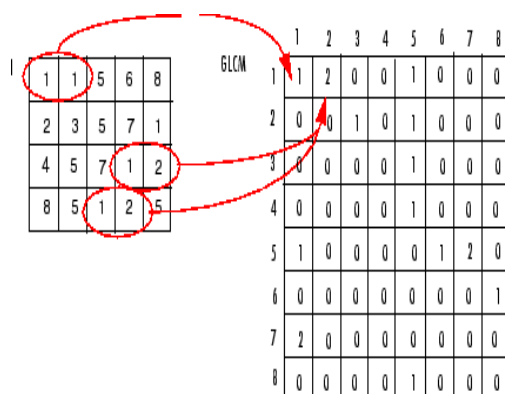


Fig.5 Calculation of GLCM

## 2.4 CLASSIFICATION

Classification is used in the interpretation of the extracted diseased region in an image which helps in the identification of the type of disease infection in leaves. In this paper ANFIS classification method is used to classify the disease.

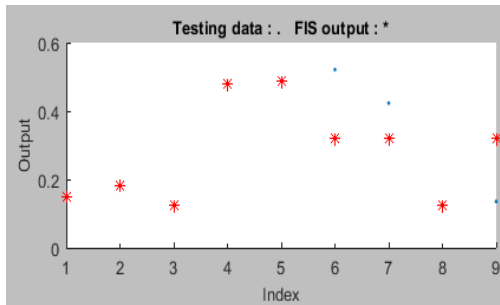


Fig.5 Testing Data

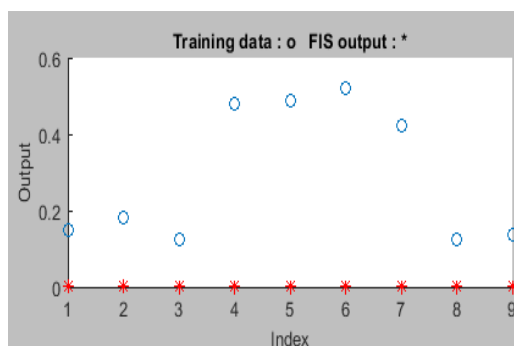


Fig.6 Training Data

An adaptive neuro-fuzzy inference system or adaptive network-based fuzzy inference system (ANFIS) is a kind of artificial neural network that is based on Takagi–Sugeno fuzzy inference system. The technique was developed in the early 1990s.

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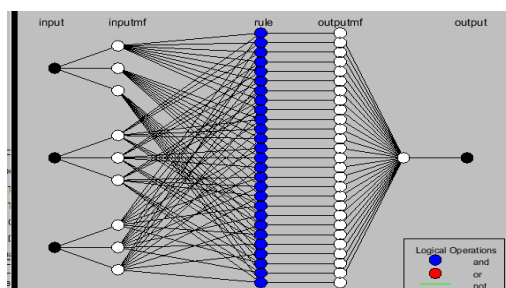


Fig.6 ANFIS Architecture

### III. FUTURE WORK

Many different adaptation, tests, experiments have been left for the future due to lack of time. Future work concerns deeper analysis of particular mechanism, new proposals to try different methods or simple curiosity. It can be implemented in hardware and also can be developed as an application in usual android mobile phones. Then it will be easy to analyse the diseases in banana leaves.

### IV. CONCLUSION

The image processing techniques such as image acquisition, segmentation, feature extraction and classifier for the detection of different types of maturities and diseases in banana leaves. This paper also explains the importance of pattern classification for better disease classification. This reduces the time consumption and cost. Implementation of better and accurate object recognition and classification algorithms will have a higher impact.

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