Identification and Classification of Normal and Infected Apples using Neural Network

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Abstract: ***In this paper we have discuss apple recognition techniques of normal and infected. These techniques are, based upon entropy, shape of apple, color, and boundary attributes extraction. Different apple images may have same or different color and shape values, but the infected apples are some different features. Apple recognition system has been proposed, features analysis are color-based, entropy-based, shape based , size-based and boundary analysis in order to increase accuracy of recognition of normal and infected apples. I have used neural network pattern reorganization tool in image processing. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons. The toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. This work represents the MATLAB 7.8.0 software and the recognition of generated signals by artificial neural network technique. .The experimentally it is proved that image processing method for measuring normal and infected apple is accurate and strong practicability with small relative error.***

Index Terms: Artificial Neural Network, Digital image processing, features extraction, Pattern recognition.

1. Introduction

Apple diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Recognition Systems of normal and infected apple operations use computer vision strategies that consider features like color, shape and texture for recognition. In naked eye observation of experts is the main approach adopted in practice for detection and identification of normal and infected apple, but it is a very expensive and expert oriented and time consuming approach, which is not practical Always. Machine learning based on detection and recognition of apple and its diseases can provide clues to identify and treat the diseases in its early stages [1]. This paper suggests apple recognition system design that uses a neural network pattern reorganization classifier that two-layer feed-forward network, with sigmoid hidden and output neurons along with shape, color feature for efficient apple identification[2]. Apple disease is one of the dangerous causes that reduces quantity and degrades quality of the undeveloped products.. There are frequent characteristics and behaviors of such apple diseases in which many of them are noticeable [3]. Hence an intelligent decision supports system for Prevention process for human knowledge is required. Features extraction represents the roundness, shape, color values help for the identification of apple and its structure [4] .Pattern recognition system is a combination of different features together, including entropy, color, shape, and boundary size to perform sequential pattern classification [5]. This method can be applied as a useful image processing tool for other object classification and recognition of normal and infected fruit problems various fields, such as education, food packing image retrieval and plant science research. This paper is arranged in such an order that some of ,the important Basic feature Extraction of image Section II ,Neural Network framework section III and section IV proposed Method; the sections V conclude the works.

2. Basic feature Extraction of image

2.1 Image acquisition

Image acquisition: to acquire a digital image

2.2 Image pre-processing

Image pre-processing: to improve the image in ways that increases the chances for success of the other processes.

2.3 Feature extraction

Feature extraction : to extract features that result in some quantitative information of interest or features that are basic for differentiating one class of objects from another . Transforming the input data into the set of features is called feature extraction [6]. Proposed method classifies and recognizes apple images based on obtained features values by using two-layer feed-forward network, with sigmoid hidden and output neurons [7]. The image processing toolbox supports feed forward networks, radial basis networks, dynamic networks, self-organizing maps, and other proven network paradigms. The algorithm will crop the apple properties in different areas in order to obtain or extract the entropy color value, boundary finding the surface area of the input apple image. In order to obtain or compute the apple roundness value, the algorithm will analyze and extract the apple Region feature properties, thus the apple area and perimeter for apple shape roundness or metric value calculates [8]. Algorithm will compute the new area and perimeter values for the apple image the fruit area and perimeter are being chosen to represent the apple size features, which are needed as one of the features to distinguish one type of apple to another. The area and perimeter pixel values of apple are calculated and also find out the apple red, green, yellow pixels values.

3. Neural network framework Overview

Artificial neural networks and training them to solve certain tasks, like recognition, approximation, prediction, and neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements [9]. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. Such a situation is shown below. There, the network is adjusted, based on a comparison of the output and the target, until the network output matches the target [10]. A neural network is very important method for image classification they deal with uncertain or inadequate data. Typically many such input target pairs are used, in this supervised learning, to train a network [11]. ANN is an adaptive system that changes its formation based on external or internal information that flows through the network.

Let x1, x2, x3 …xm be the inputs and w1, w2, w3…wm.

Their corresponding weights, the total input to the next Neuron or the output neuron I is calculated by the Summation function using equation
I= x1 w1+ x2 w2+…….xm wm= $\sum_{i=1}^{m}$ xi wi

The result of the summation function, which is the weighted sum, is transformed to a working output through an algorithmic process called the activation function or the transfer function [12]. A network having multiple layers feed forward so we will use network architecture for training and testing. Specifically, we need to make a distinction between weights matrices that are connected to inputs and weight that are connected between layers. After extensive training, the network will eventually establish the input-output relationships through the adjusted weights on the network. After training the network, it is tested with the dataset used for testing .The library mainly allows creating two categories of artificial neural networks. First is feed forward neural networks with activation function. This type of networks is represented as by one layer, as by multi layer networks, which don't have recurrent connections - information flaws in these networks from inputs to outputs passing all layers of neural network only one time without doing loops [13]. Neurons of such networks calculate their output by calculating weighted sum of their inputs and passing it to activation function, which value becomes an output of neuron [14]. With the ability to set activation function to use in neural network and configure it size, it is possible to creates different type of networks for different tasks starting from simple perceptron (neuron with threshold activation function), which does classification of linearly separable data into two classes, and ending with complex multi layer networks, which are aimed for recognition, prediction, Second is one layer distance networks. Neurons of this type of networks calculate their output as distance value between neuron's inputs and its weight - sum of absolute differences.

4. Methodology

The proposed methodology in this paper, to perform the analysis for image features extract using steps

1. Select fruit image
2. Crop the fruit area
3. Compute mean for RGB components
4. Compute the boundary for shape component of image
5. Compute the entropy for roundness.
6. Compute the boundary min, max and median, mean value.
7. Compute geometrical properties (Area, perimeter)
8. Use NN (nprtool) and parameters in 3, 4, 5, and 6, 7 to classify the image

After that using the back propagation algorithm has been implemented using Mat lab's Neural Network Pattern Recognition Tool (nprtool). Our classifier uses two-layer feed-forward back propagation network. Two-layer feed forward network can be best defined as a network with sigmoid hidden and output neurons [15]. To train the network, the input data and target data need to be feed into the network. The extracted color, entropy and shape, range, boundary features give the input data and the class label of images gives the target data. The network then divide the input sample data into three different samples which are training, validation and testing samples. The fruit shape roundness or metric values can be computed after extract and estimate the area and perimeter of the fruit by using equation as below.
Shape=4π(Area/perimeter*perimeter)

The color, entropy shape, area and perimeter values for each type of fruit that have been stored during system training. These stored color values, shape roundness values, area and perimeter values are being used as standard feature values for comparison and classification of query or input fruit image to the system. Training these is presented to the network during training, and the network is adjusted according to its error. Validation these are used to measure network generalization, and to halt training when generalization stops improving. Testing these have no effect on training and so provide an independent measure of network performance during and after training.

4.1 Experimental Results

Neural Network Training For the recognition of partial discharge patterns the training of the neural network has to be done. As we know that the neural network learns from examples and this learning process is named as training of the neural network. The level of neural network training can be determined by examining the results shown in fig 1. For the training of the samples nprtool uses the two layer feed forward network with sigmoid hidden and output neurons. The network is trained with the scaled conjugate gradient back propagation algorithm. As the confusion matrix shows that a 50% training of the sample data network has been achieved, the 34% of the input data is used for the training, 8% of the input data is for the validation and the remaining 8%is for the testing of the network on the same time while training. This is the

training of the network, but for the task of recognition the testing of the network has to be done.

4.2 Figure captions

The neural network pattern recognition tool that depend on input and output data set of apple. Training a network, and evaluate its performance using mean square error and confusion matrices**.** Three sections that involved in this work are Training, validation and testing. For the recognition of partial discharge patterns the training of the neural network has to be done. As we know that the neural network learns from examples and this learning process is named as training of the neural network. Neural networks traing: is a way to model any input to output relations based.

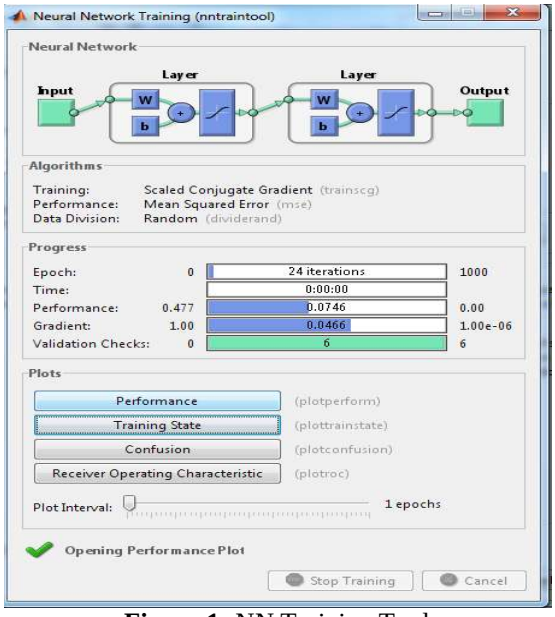

Figure 1: NN Training Tool

Results after training of Neural Network (NN)

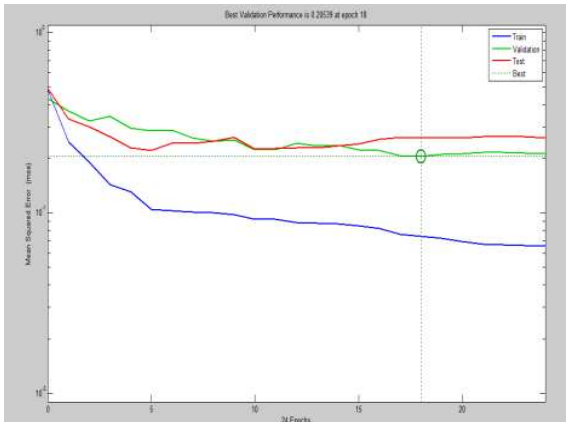

Figure 2: Performance graph

Confusion matrix: The next figure shows the confusion matrices for training, testing, and validation and the three kinds of data combined. The network's outputs are almost perfect, as you can see by the high numbers of correct responses in the green squares and the low numbers of incorrect responses in the red squares. The lower right blue squares illustrate the overall accuracies.

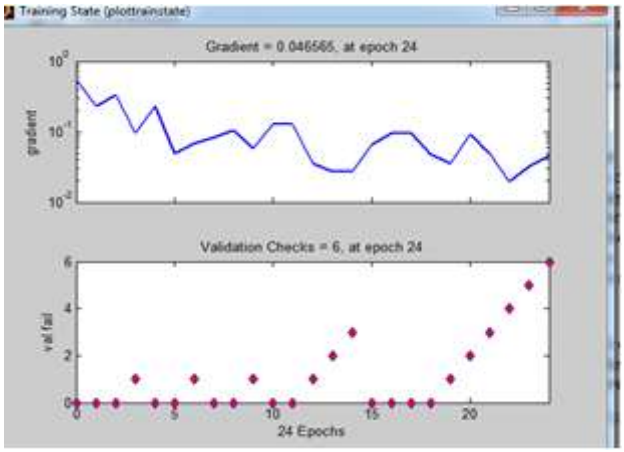

Figure 3: Training state plot

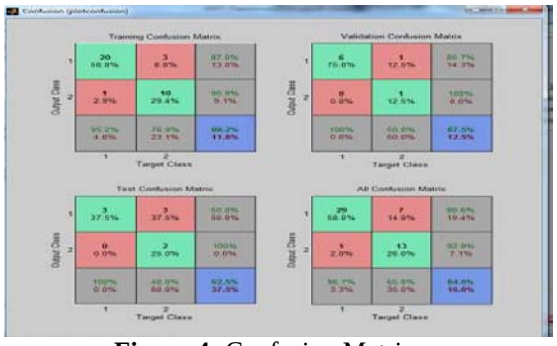

Figure 4: Confusion Matrixes

Receiver Operating Characteristic (ROC): The colored lines in each axis represent the ROC curves for each of the four categories of training, validation, and testing, false positive rate of simple test data set.

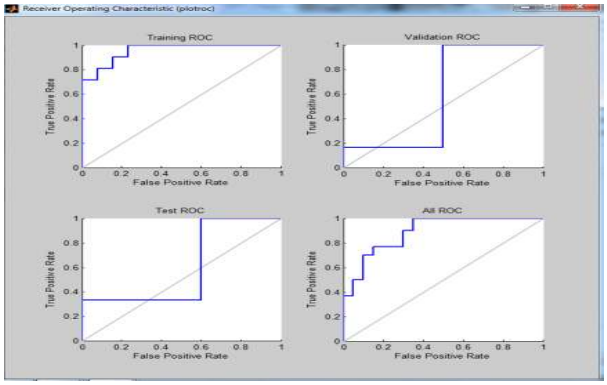

Figure 5: Receiver operating characteristics

5. Conclusion

The image processing techniques, which employ Artificial Neural Networks techniques and inference rules, and their role in extensive range of precision development applications such as feature extraction, agriculture produce grading, effective use of disease control infers that considering the level of classification accuracy, can be satisfactorily used for image classification. Method can process, analyze, classify and identify the fruits images, which are selected and sent into the system based on colour, shape and size-based and boundary, entropy features of the apple. The scope in doing research in this field is as follow: 1. There are two main characteristics of fruit disease detection using machine-learning methods

that must be achieved, they are: speed and accuracy.2. Work can be done for automatically estimating the severity of the detected disease. There are some future works should be implement on the Fruits Recognition System in order to improve and enhance the functionality and flexibility of the recognition system for more widely usage.

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