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Analysis of Apple Fruit Diseases using Neural Network.

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ABSTRACT

Diseases in fruits have become a major factor leading to less productivity as well as poor quality in agricultural sector. It has been a necessity to inspect the plant during its growth period as well as at the time of fertilization. In this paper, image processing techniques have been used for detection of diseases in fruits and classification has been performed using neural network pattern reorganization toolbox in MATLAB. The proposed method consists of K-Mean clustering for image segmentation and Speeded up Robust Features (SURF) for feature extraction. Three diseases of apple namely, Blotch, Rot and Scab have been selected here. Images are classified based on their feature analysis, namely, color, area, perimeter and boundary. Neural network classifies the images based on obtaining feature's value by using two-layer feed-forward network, with sigmoid hidden layer and output neurons. The results show 85% accurate performance of detection of diseases in the fruit.

Keywords: Image Processing, Neural Network, K-Means algorithm, SURF algorithm

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INTRODUCTION

The natural approach of detection and classification is done by the experts on the basis of the perception of the bald eye. In a few places, experts demand a huge sum of money and consume more time to identify the diseases in apple. It would be useful if the symptoms are identified during the development of the fruit and for this reason, automatic detection is needed. Diseases in apple generally lead to loss in yield as well as reduce the quality of fertilization. It is advisable to observe the control factors to avoid such losses. Few diseases affect the surrounding areas of the apple tree, thereby affecting the leaves, twigs, branches and the stem. Apple rot, apple blotch, apple scab are few common diseases in apple. Apple scab is identified by brown or gray corky spots. Apple rot is a kind of infection which gives rise to slightly sunken, circular black or gray spots. These spots make a hollow. Apple blotch is a fungal disease. It is identified by dark, lobed or irregular edges on the surface of the fruit.

A threshold approach is carried out to perform segmentation of the defective apple in majority of the works [1], [2]. Detection of diseases and fruit grading has been done using the features of images of the apple, mango and grapes. In this paper leaf has been used for the experiment. Diseases have been detected using color and morphology as compared to texture. Mango grading has been done[3] depends upon their weight. Han Zhengzhou et al [4] presents a multiple variable analysis approach for skin defects in citrus fruits. A method to remove spots on the basis of 'V' component dynamic threshold for grading in pear[5]. System was constructed both hardware and software. Features extracted in this work are shape, color and defect. Based on artificial neural network pears grading has been done and model has been created for the grading system. Kelvin et al [6] presents the local binary pattern histogram method for the classification of rotation invariant texture. Though this method is simple, it is considered to be efficient while defining local image patterns. It has given impressive outcomes of classification on the representative texture databases [7].

This paper proposes a method which experimentally validates the diseases in apple. A clustering technique is used for segmentation of diseases. In order to automatically detect and classify apples, the neural network recognition toolbox is used as a classifier. To validate this proposed method, three diseases of apple namely apple rot, scab and blotch are used.

METHODOLOGY

Image Acquisition

Images of different varieties of infected apples have been considered for this work. Figure 1 shows images of infected apples and three types of diseases have been considered for analysis.

Figure 1: Varieties of infected apples.

Image preprocessing

Various types of apple images have been gathered for analysis diseases of apple. Concerning the classification of fruit disease problem, segmentation has been done using K-Means based segmentation to identify the infected regions of apple fruit. Further features are extracted from the processed segment image and neural network is used for classification of diseases.

Suggested method consists of the following steps:
Step 1: Collecting data set for various images of apple fruit.

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Step 2: Image segmentation has been done by K-Means clustering algorithm.
Step 3: Extraction of Features from the segmented images.
Step 4: Training and testing using neural network.

Image Segmentation

Image segmentation is the process of segmenting infected apples for classification. K-Means based clustering has been done to identify the infected part. In this proposal, the images are grouped into 4 clusters. Within this clusters one cluster contains most of the diseased part. In this algorithm, objects are divided into 'K' number of classes which depend upon particular set of features. This is performed by decreasing the sum of the squares of the distance between the data objects and the corresponding clusters. Here, the square of the Euclidean distance is used. The steps necessary for clustering include reading the image, transforming them from RGB to L*a*b color space, classifying the colors using 'K' means clustering in a*b space, labeling the pixels one by one in the image using the results obtained from K-means, generating images followed by segmentation by color and finally selecting the segment containing diseases.

Here, L*a*b color space has been used since the color information is stored in two channels and it has lesser processing time for segmenting the images. The input image is divided into four segments. It has been observed from empirical consideration that a good segmentation outcome is obtained by using three or four clusters.Figure2 shows the outcomes of K-Means clustering for an apple fruit which are affected with apple rot, apple blotch and apple scab disease.

(i) **(ii)** **(iii)**

Figure 2: K-Mean clustering for an apple fruit infected with (i) apple rot, (ii) apple scab and(iii) apple blotch

Feature Extraction

Feature extraction is one of the major supplements in image processing, machine learning and pattern recognition. Firstly, derived values have been built using an initial set of data and are measured subsequently. These values are expected to be non-redundant, informative and facilitating subsequent learning. Feature extraction method is more often linked with dimensionality reduction. Area, perimeter, color and roundness values have been taken after feature extraction. Area of objects has calculated in binary image. Color of object has been calculated by reading the image which will form the matrix. Roundness has been calculated by using the gray and binary images. Shape of the fruits has been evaluated using the equation shown below:

$$Shape=4pi\ (Area/Perimeter)\ldots\ldots\ldots (1)$$

Training and Classification

Artificial Neural Network has been a motivating methodology for training and classification purposes. In this work Neural Network Pattern recognition toolbox has been used and implemented in MATLAB for classification of apple diseases. Network function is known by large connections between the elements. The architecture of the neural network is shown in Figure 5 which consists of three layers namely input, hidden and output layer.

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The color, area, perimeter and roundness values for each fruit have been stocked at the time of training. These stored values of color, area, perimeter and roundness are usually used as feature values for comparison and segregation of input fruit image to the system. The training has been carried out using the stored values. The network has been fixed based on the extracted mean square error values. In order to measure the generalization of the network, validation has been done.

Architecture of neural networks

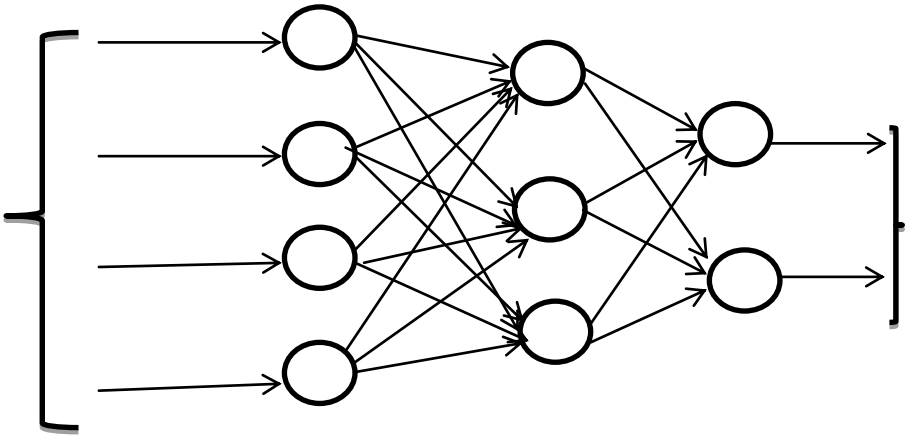

Figure 3: Architecture of neural network

EXPERIMENTAL RESULTS AND DISCUSSION

Sixty four fruit images have been gathered for making this experiment. Forty fruits have been used for training purpose; twelve fruits have been used for validation and twelve more for testing purpose. The Table1 shows the details of color, area, and perimeter and roundness value for each fruit present in the system when they are trained. These stocked area values, color values, parameter values and roundness values are typical feature values for classification of input fruit images to the system.

Table 1: Area, Color, Perimeter and Roundness values

Fruit Name	Area	Perimeter	Color	Roundness
Green	23527	602.26	216	490.899
Red	13.26	896	223	0.186
Fully red	96288.26	871.6569	255	1.388e+03
Rot	28918.5	1536.99	254	847.1864
Blotch	11639	428.95	213	340.9721
Scab	31624	191.6812	279	2.0625e+03

Figure Inscription

The input and output data sets are the two major entities in the neural network pattern recognition toolbox. The network is trained and it is used for classification. It is a known factor that neural networks learn from examples which is referred as training of the neural network. Training, validation and testing are covered in this work.

Figure 4 shows NPR Training Tool used for train the neural network. It consists of three layers namely: input layer, hidden layer and output layer. The data set has given to the toolbox for training purpose. Figure 5 shows the graph of performance after training. Here, green color lines show the validation data, red color line shows the tested data and blue color line shows the trained data. The dotted line shows the best performance of the graph.

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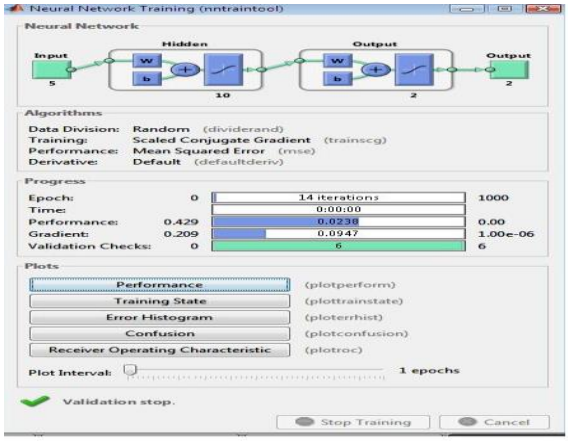

Figure 4: NPR Training Tool

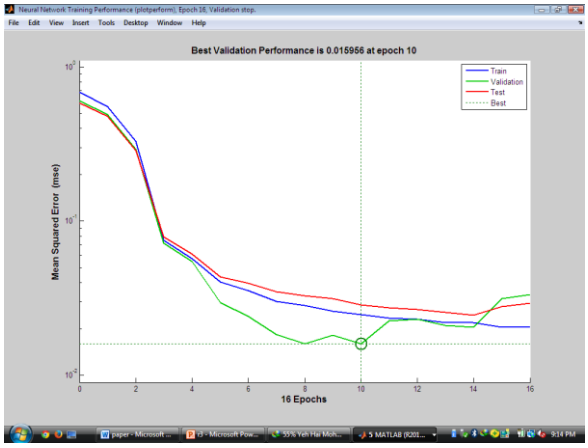

Figure 5: Graph depicting the performance analysis

Figure 6 shows the plot of the training stage. Two plots are available in the graph blue color plot is showing the gradient of the data and pink and dotted plot are checking the validation of the data. Figure 7 shows the training confusion matrix, test confusion matrix, validation confusion matrix and all confusion matrixes. Large numbers of accurate responses are shown in green squares while small numbers are shown in red squares. The blue squares present in the lower right side indicate the total accuracy.

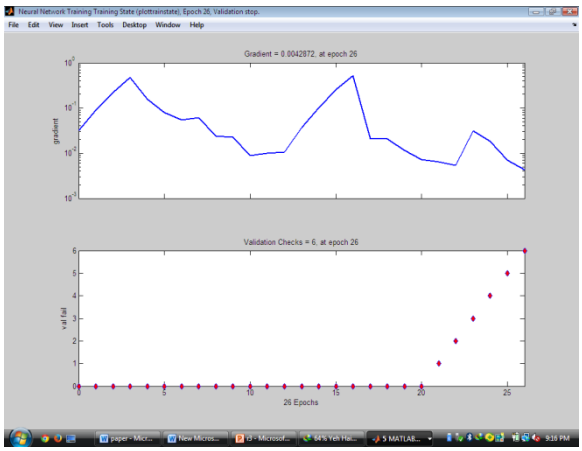

Figure 6: Plots of the training states

Figure 7: Confusion Matrices

CONCLUSION

In this paper, image processing technique has been used for identifying the diseases in apple fruit and classifying them further as Apple Rot, Blotch and Scab. The images are segmented using K-means clustering followed by extraction of features. Finally, training and classification is realized using neural network. Depending on experiments, it is found that non-infected apples are easily detectable than the infected apples. The Neural Network Pattern Recognition Tool shows more exact results for the analysis of apple fruit diseases and accomplishes greater than 85% grade efficiency.

REFERENCES

[1] Shiv Ram Dubey, and Anand Singh Jalal, "Detection and Classification of Apple Fruit Diseases using Complete Local Binary Patterns," Third International Conference on Computer and Communication Technology 2012.

[2] VaniAshok, Dr.D.S.Vinod, "Automatic Quality Evaluation of Fruit Using Probabilistic Neural Network Approach," International Conference on Contemporary Computing and Informatics (IC31)-2014.

[3] Monika Jhuria, Ashwani kumar, "Image Processing for Smart Farming: Detection of Diseases and Fruit Grading," IEEE Second International Conference on Image Information Processing (ICIIP-2013).

[4] Han Zhongzhi, Liu Jing,Zhao Yougang, Li Yanzhao, " Grading System of Pear's Appearance Quality Based on Computer Vision," International Conference on System and Informatics(ICSAI-2012).
[5] Fernando Lopez-Garcia, Gabriela Andreu-Garcia, Jose Blasco, Nuria Aleixos, Jose-Miguel Valiente, Automatic detection of skin defects in citrus fruits using a multivariate image analysis approach ,"Computer and Electronics in Agriculture71in 2010.
[6] Kleynen O, Leemans V and Destain MF. "Development of a multi-spectral vision system for the detection of defects on apples," Journal of Food Engineering, 2005;69:41–49.
[7] Bindu Tiger, Toran verma, "Identification and Classification of Normal and Infected Apples using Neural network," Internation journal of Science and research (IJSR).
[8] R.Pydipati, T.F.Burks, W.S.Lee, "Statistical and Neural Network Classifiers for citrus diseases detection using Machine Vision" American society of Agriculture Engineers ISSN, 2014;48(5).
[9] Tina Gebreyohannes and dong-Yoon Kim, "Adaptive noise Reduction scheme For salt and paper " IEEE-2010.
[10] J.P.D amato, C.G. Bauza and G. Boroni, "Color based fruit Classification Using GPU" IEEE American Transaction, 2011;.9(3).
[11] Niraj P.Doshi and Gerald Schaefer, "Compact multi-dimensional LBP features for improved texture retrieval" Second International conference on Robot, Vision and Signal processing 2013.
[12] MacQueen J. Some methods for classification and analysis of multivariate observations, In L. M. LeCam and J. Neyman, editors, Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability, University of California Press, 1967; 1:281—297
[13] Xiaowei Huang, Zhaohui Jiang, Lili Lu, Chunjie Tan, Jun Jiao, "The study Of Illumination Compensation Correction Algorithm" IEEE- 2011.
[14] ZHAO ping, LI Yongkui, "Grain counting method based On image processing", IEEE-2009.
[15] Zulkifli Bin Husin, Abdul Hallis Bin Abdul azix, Ali Yeon Bin Md Shakaff, Rohani Binti S Mohamed Frook, Feasibility Study on Plant Chili Disease Detection Using image Processing Techniques, Third international conference on Intelligent systems modeling and Simulation-2012.
[16] Salem Saleh AL-amri, N.V.Kalyanakar, khamitkar SD. A Comparative study of removal Noise from remote sensing image. International Journal of Computer science Issue, Vol. 7, 2010.
[17] Pragati Ninawe, Mrs.Shikha Pandey. "A Completion on Fruit Recognition System Using K-Nearest Neighbors Algorithm," International Journal of Advanced Research inComputer Engineering & Technology (IJARCET) 2014;3(7).