iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** V **Month of publication:** May 2016

DOI:

www.ijraset.com

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Volume 4 Issue V, May 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Hybrid Approach of Neural Network and Genetic Algorithm to Recognize Black Mold Disease in Tomato

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Abstract: ***Tomato is the eatable and red berry type fruit which belongs to the nightshade family, Solanaceae. Scientific name of tomato is Solanum lycopersicum, which is most popularly and widely grown vegetable around the world [1]. Tomatoes suffer from number of diseases which is caused by fungi, bacteria, viruses etc [2]. Black Mold disease occurs due to the fungus Alternaria Alternata and in High Plains this disease is commonly found. Black Mold affects the tomato fruit which is exposed to free moisture, heavy rain or excess of irrigation. Black mold symptoms appear on ripe fruit, although infection may occur on green fruit also [3]. The proposed work is a hybrid approach of genetic algorithm and neural network to recognize Black Mold disease in tomato. Initially tomato image is acquired with the help of good quality digital camera. Preprocessing will be performed to remove noises, resizing and cropping. Then Region growing segmentation algorithm is applied to segment the images. Color and texture features are extracted from the segmented image. These features are forwarded to the BackPropagation Neural Network (BPN).Genetic algorithm (GA) is applied for optimized feature selection. These optimized features are applied to BPN. Lastly, comparison of both the classifier will be done on the basis of accuracy and then optimized classifier will be obtained for detecting the Black Mold disease in tomato.***
Keywords— Black Mold Disease, Image Processing, BackPropagation Neural Network, Genetic Algorithm.

I. INTRODUCTION

Tomato (Lycopersicon esculentum) belongs to the genus Lycopersicon under Solanaceae family [4]. It is mainly grown in the countries, namely, Peru, South America, Spain, Morocco, Mexico, Turkey, India, and Italy etc. Tomato is grown in all states of India. It is a good source of Vitamin C and A. Production of tomato is sensitive to temperature and yielding readily to many infections. Tomato used in different ways as an ingredient in many dishes, sauces, salads, and drinks etc [1]. Production of tomato is sensitive to temperature and yielding readily to many infections. Diseases are transmitted through the soil, water supply, air; infected tools, animals, and gardeners. Diseases affect four areas on the plant: leaves, stems, the crown and fruit [2].

A. List of Tomato Diseases

1) *Fungus Based Tomato Plant Diseases*: This disease caused in tomato due to fungi [2]. This disease is easily transmitted through air or physical contact. Following are some diseases which come under this:

a) *Black Mold:* This disease is caused due to Alternaria alternata. It impacts usually on the ripe tomato which is placed to free moisture and it may also infect to green tomato [3]. Fig.1 this disease is shown.

b) *Anthracnose:* Anthracnose disease in tomato is caused by the fungus Colletotrichum coccodes. The characteristic of this disease is dark circular sunken spots appear on fruit [5]. Fig.2 shows the image of this disease

Fig.1 Black Mold

Fig.2 Anthracnose

2) *Bacterial Based Tomato Plant Diseases:* This disease caused due to bacteria. Here some diseases are listed below which come under this category:

a) *Bacterial speck:* Symptoms is tiny black spot which can be embedded or sometimes raised on the fruit [6]. In Fig.3 this disease is shown.
b) *Bacterial spot:* Symptoms are small, brown, scabby, sunken or slightly raised spots on the fruit [6].Fig.4 show this disease.

Fig. 3 Bacterial speck

Fig. 4 Bacterial spot

3) *Virus Based Diseases of Tomato Plants*: This disease caused in tomato due to viruses.
a) *Alfalfa mosaic virus:* Mosaic virus cause stunted growth, deformed fruit and leaves mottled with colors in grey, brown, green, and yellow [6]. In Fig.5, this disease is shown.

Fig.5 Alfalfa mosaic virus

4) *Black Mold Disease in Tomato:* This disease is occurs in tomato due to Alternaria Alternata fungus and is commonly found on the High Plains areas. This disease is generally occurs in and around wounds on fruit. Symptoms can be found on ripe as well as green fruit also. The characteristics of this disease are vary from small, superficial, brown flecks to large, sunken, black lesions on fruit [3].
5) *Image Processing:* For analysis in various fields, image processing is an effective tool for it [7]. Image processing is used to improve the pictures (i.e. enhancement, restoration),information extraction (analysis, recognition), and change their structure (composition, image editing). Processing of images can be done by optical, photographic, and electronic means, but image processing is performed by digital computers which is the most commonly used method because digital methods are fast, flexible, and precise[8].

B. Soft Computing

Soft Computing is a set of methodologies which aims to utilize endure for imprecision, uncertainty and partial truth to accomplish tractability, robustness and low solution cost. Solutions of Soft Computing are unpredictable, uncertain and between 0 and 1.Components of Soft Computing are Neural Network, Genetic Algorithm, and Fuzzy Logic etc [9].

II. RELATED WORK

[Rahat Yasir et al.](2014)[10] proposed a computer vision based method for Dermatological disease detection using image processing and artificial neural network. Method consists of two phases, pre-processed the color skin images for extracting the significant features in first phase and in second phase based on these features identified the diseases. Result shows the 9 different types of dermatological skin diseases with an accuracy of 90%.

[John William ORILLO et al.](2013)[11] aims to identify the disease in rice plant (Oryza Sativa) using Back Propagation Neural Network. MATLAB software was used for image processing methods such as image enhancement, image segmentation and feature extraction. For enhancing the accuracy and performance BPN network was used. The result shows that through 100% accuracy diseases are identified.

[S.Janardhana et al.](2013)[12] proposed a technique for detection of suspicious region in medical images using genetic algorithm. This technique consists of four steps. In first step image was acquired and preprocessing was done in second step. And in last two stages frequency noise component are removed and segmentation performed using Genetic Algorithm (GA) and performance

evaluation was done.

[Haiguang Wang et al](2012a)[13] aimed to classify four fungal diseases. Two diseases of wheat crop i.e. stripe rust, leaf rust and two of grape i.e.downey mildew, powdery mildew. The median filter applied to denoised images. After that, image segmentation performed using k-means clustering. The total 50 features extracted that are color 21, shape 4 and texture 25. The four classification techniques applied and tested: Multilayer Perceptron (MLP), Radial Basis Function (RBF), Generalized Regression, and Probabilistic for classification. The result stated that all kinds of neural networks achieved pleasant identification and classification, and quite fitting accuracy for each feature group. In his another work[Wang et al.](2012b)[14], the feature extraction is done using the same technique proposed in their previous paper[Wang et al.] (2012a)[13]. On the same dataset principal component analysis (PCA) applied to features summarization. The four classifiers i.e. back propagation (BP) networks, radial basis function (RBF)] neural networks, generalized regression networks (GRNNs) and probabilistic neural networks (PNNs) performed the final identification.

[Nor Azura Husin et al.](2012)[15] the aim of this paper is to design a more promising model for predicting dengue outbreak by using a hybrid model based on genetic algorithm for the determination of weight in neural network model. To obtain optimal prediction performance various model architectures are designed and parameters are adjusted. Result shows that hybrid model gives better prediction as compared to standalone model.

[M.K. Osman et al.](2010)[16] proposed a method for automated Mycobacterium tuberculosis detection in tissues using image processing and genetic algorithm-neural network (GA-NN).For inspection initially Ziehl-Neelsen stained tissues slides images are acquired through digital camera. For segmentation C-Y color information is applied on K-mean clustering algorithm. To represent the bacilli seven Hu's moment invariants are extracted.GA-NN approach classified into two classes i.e. 'true tuberculosis' and 'possible tuberculosis'.Results shows that GA-NN approach produces better performances for fewer input features as compared to NN approach.

[Libo Liu et al.](2009)[17] aims to determine the brown spot on the rice leaves by using image processing and Back Propagation Neural Network based on color features. For inspection images of rice leaves are collected from the northern part of Ningxia Hui Autonomous region. Result shows that the method is feasible to identify the brown spot disease on rice leaves.

III. PROBLEM IDENTIFICATION

Black Mold disease is a serious disease found in tomato fruit. This fungus affects the tomato fruit which are kept to free moisture, heavy rain or excess of irrigation. Symptoms are generally shown in ripe fruit but infection may found on green fruit also[3].

For detection of diseases on fruits or vegetables various methodologies was applied. Generally, many researchers have work done on the leaves, stem and etc of the plant. For identification of the diseases various classifiers were applied and their performance has been evaluated by the different researchers to find the better result[24][25]. But still there is no research work has been done on the tomato fruit. In this research work, we proposed the methodology for detecting the Black Mold disease on tomato in an optimized way.

IV. METHODOLOGY

According to literature review, as we find out the scope for the proposed work and we set goal which is mentioned in problem identification.

Details of each block are explained below:

A. Image Acquisition

Images of the tomato are captured through any digital camera [21].

B. Image Preprocessing

Preprocessing involves image resizing, cropping, enhancement and etc [21]. In this proposed work, we have done resizing and cropping of the digital images.

C. Image Segmentation

Segmentation means partitioning of image into various parts of same features or having some similarity. In this proposed work region growing segmentation is applied. The basic idea of region growing segmentation is that it is start with a group of "seed" points and the region grows by adding the neighboring pixel to each "seed" points which have similar predefined property.

Volume 4 Issue V, May 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Procedure of selecting one or more "seed" points or starting points is depends on the characteristics of the problem [21].

D. Feature Extraction

Feature extraction plays an important role for identification of an object. Color, texture, morphology, edges etc. are the features which can be extracted from the segmented image for disease detection. In this proposed work, texture and color features are extracted [21].

E. Back Propagation Neural Network (BPNN)

It is a learning method which adjusted the weights of NN by propagating the weight changes backward from the output nodes to input nodes. It is simple to understand and easily applicable. It is also known as generalized delta rule [21].

F. Genetic Algorithm (GA)

GA is a type of adaptive heuristic search algorithm. It is a part of evolutionary computing. It is being suggested by Darwin's theory regarding evolution-"survival of the fittest". It provides the ways of solving problems by imitating processes i.e. selection, crossover, mutation and accepting [22][23].

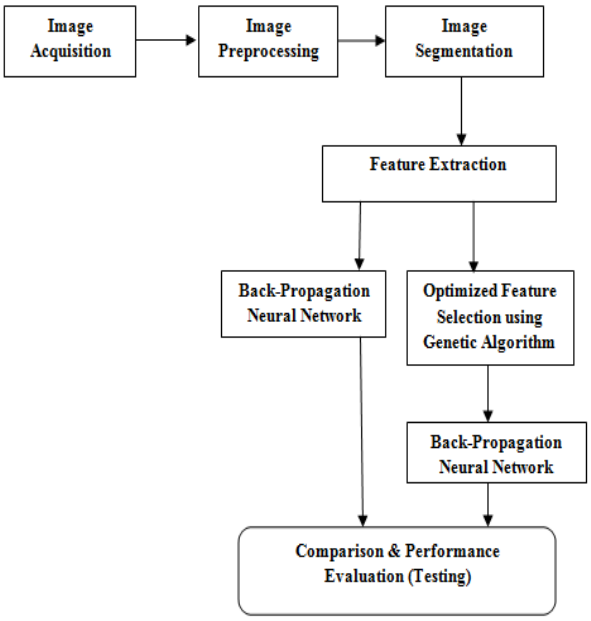

Fig. 6 Block Diagram for the proposed Black Mold Disease identification in Tomato.

G. Comparison & Performance Evaluating

In this step, comparison of BPNN is done with BPNN with GA classifier. Performances of both the classifiers are evaluated on the basis of accuracy. The optimized classifier will be obtained for detection of Black Mold disease in tomato.

V. RESULT AND CONCLUSIONS

In this research work, we have used 212 digital images of tomato for dataset. We have resized the images into 130 × 130 pixel. Then image is cropped into 120×85 pixel. After that we separate it into two folders, in which one folder contains the Black Mold disease affected images and non-disease images respectively. Then segmentation and feature extraction step is performed. Total 31 features are extracted in which 22 & 9 are texture and color features respectively. Then total 31 features applied to BackPropagation NN. Total 25 optimized features are forwarded to BPNN-GA classifier.

Fig.7(a) shows the confusion matrix of BackPropagation NN.Fig.7(b) shows the performance plot of BackPropagation NN.Fig.8(a) shows the confusion matrix of BackPropagation NN with GeneticAlgorithm (BPNN-GA).Fig.8(b) shows the performance of BackPropagation NN with GeneticAlgorithm (BPNN-GA).

The efficiency of BackPropagation NN and BackPropagation NN with GeneticAlgorithm (BPNN-GA) for identification of Black Mold disease in tomato is 83.2% and 87.4% respectively. Therefore, BPNN-GA is the optimized classifier as compared to BPNN.

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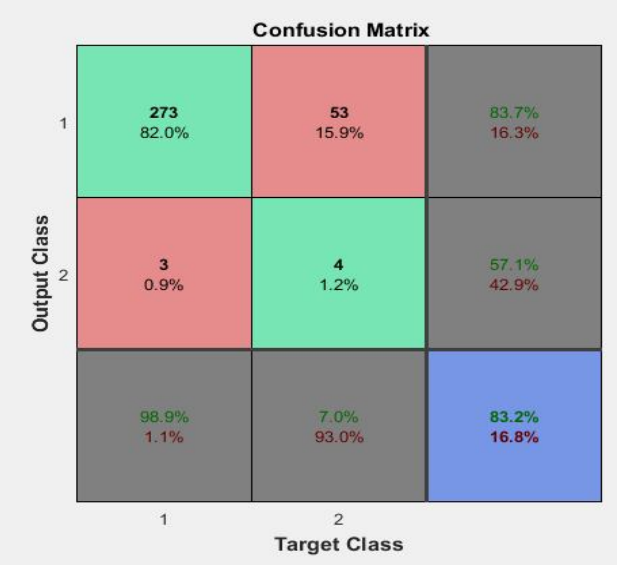

Fig. 7(a) Confusion Matrix of BackPropagation NN

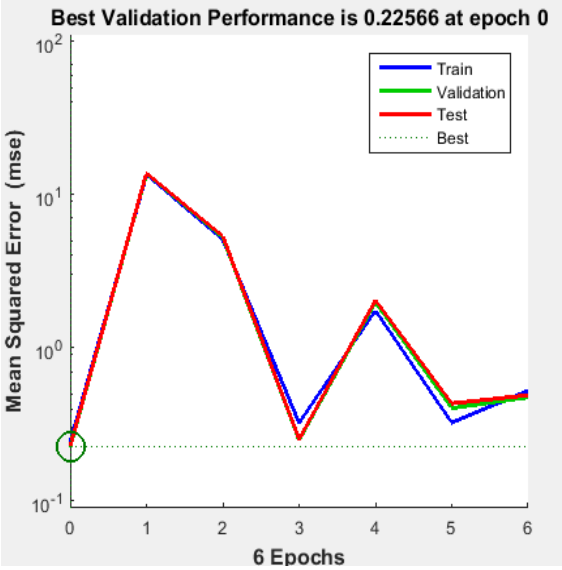

Fig. 7(b) Performance Plot of BackPropagtion NN

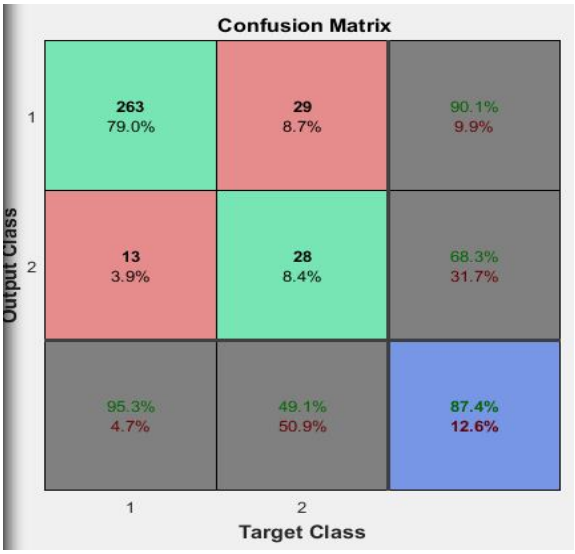

Fig. 8(a) Confusion Matrix of BackPropagation NN with GeneticAlgorithm

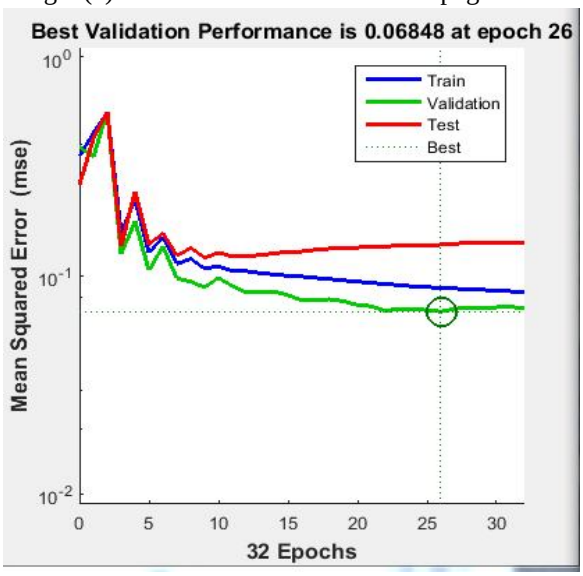

Fig. 8(b) Performance of BackPropagation NN with Genetic Algorithm

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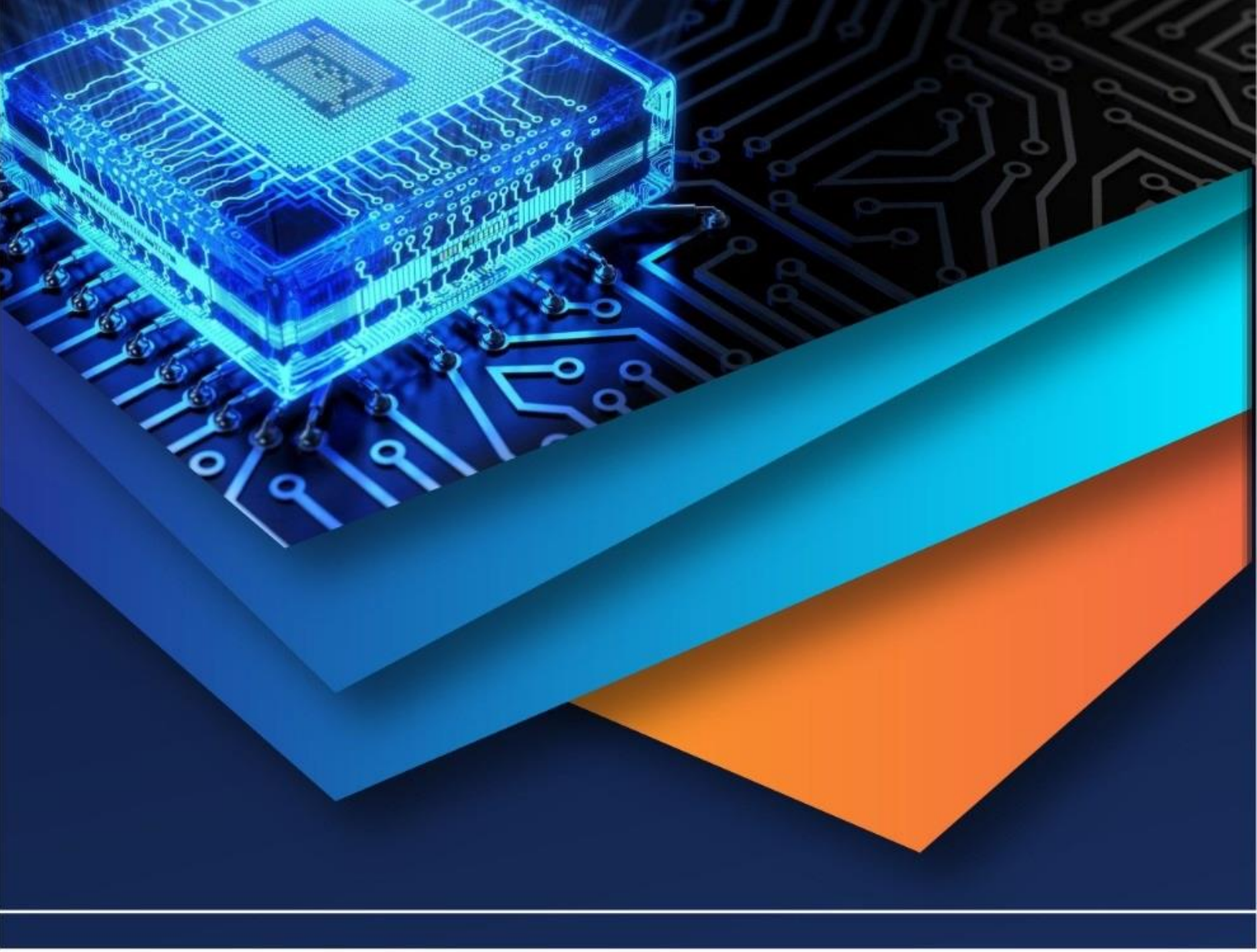

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