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Classification of Cotton Leaf Spot Disease Using Enhanced HPCDD Algorithm

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Abstract: Cotton is the most crucial commercial crop of India and all over the states. Cotton disease analysis using most probably of the environment has been utilizes significant techniques available in image processing , data mining and signal processing areas. The image is converted into pixels to detect the disease correctly and report it to the farmers. This work focusses on new algorithm named improved HPCDD (Homogeneous Pixel Counting Algorithm for Cotton Diseases Detection) (ie), feature extraction using PSO algorithm, which recognizes the features available in the affected image by matching the threshold values assigned to the RGB features. Finally performance evaluation is carried out 100 images and 500 images to check the accuracy of the algorithm, with other existing algorithms.

Keywords: Improved HPCDD Algorithm, Particle swarm optimization algorithm, Image processing, RGB best fitness function. Pest recommendation.

I. INTRODUCTION

The pixel plays the vital role of image processing techniques, in fact most probably pixel is called the color groups of the main object. In this work using improved HPCDD and PSO is used to identify the main optimum pixels matching of the diseases in ratio level of RGB features. It has been obtained the prediction and symptoms of the diseases. Finally pest recommendation provided to the farmers.

The particle swarm optimization (PSO) is a heuristic stochastic Optimization method based on the movement and Intelligence of swarms. PSO is the population-based search optimization algorithm based on simulation of the common performance of birds in a flock. It plays a vital role in solving the problem faced in optimization methods and also the feature selection method. PSO uses a number of color features that can be compared for the swarm moving around in the search space looking for the preeminent feature initialized randomly. A swarm consists of Number of color features, where each color feature represents a candidate solution moving around D- dimensional search space. Every one of the color features has a fitness value, which are evaluated by using a fitness function to be optimized, and have velocities which direct the movement of the pixels. The changes to a pixel within the swarm are influenced by the experience or information of its neighbors and every feature adjust its position according to two fitness value, pbest and gbest, to avoid being intent in a local optimum by fine-tuning the inertia weight. best is a local fitness value, whereas best constitutes a global fitness value. If the gbest value is itself intent in a local optimum, a search of every pixel boundary can be mathematically modeled.

A. Common Types of Diseases and Symptoms

The diseases on the cotton leaves are classified as

- 1) Fusarium wilt,
- 2) Verticillium wilt.
- 3) Root rot,
- 4) Boll rot,
- 5) Grey mildew,
- 6) Leaf blight,
- 7) Bacterial blight
- 8) Leaf curls.

Symptoms of Cotton leaf Spot Diseases are discussed below:

B. Grey Mildew (Areolate Mildew/ Dahiya) - Ramularia Areola

This disease [1] initially appears on older leaves as the plants reach maturity, in the form of irregularly angular, pale translucent spots, 1-10mm (usually 3-4 mm) in diameter and with a definite and irregular margin formed by the veins of the leaf (called

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areolate). The lesions are bright with yellowish green on the top surface. As the spots grow older, the leaf tissues turn yellowish brown while a whitish frosty growth appears chiefly on the under surface but occasionally also on the top surface. This is the conidial phase of the causal fungus. Lesions occur on the bracts subtending the bolls. As the leaf becomes chlorotic, the lesion turns reddish brown and defoliation takes place. Early and severe defoliation leads to premature boll opening and immature lint.

C. Bacterialblight (*Xanthomonas Axonopodis* Pv. *Malvacearum*)

Dark green, water soaked, angular lesions of 1 to 5 mm across the leaves and bracts, especially on the undersurface of leaves. Hence called angular leaf spot. Occasionally extensive dark green, water soaked lesions along the veins known as vein blight. Symptoms are usually more prevalent on lower leaves than on topper leaves. Lesions dry and darken with age and leaves may be shed prematurely resulting in extensive defoliation. Black lesions on the stem which girdle and spread along the stem or branch known as black arm. Dark green, water soaked, greasy, circular lesions of 2 to 10mm across the bolls, especially at the base of the boll under the calyx crown. As the boll matures the lesions dry out and prevent normal boll opening. This stage of symptom is called as "Boll rot".

D. Leaf Curl Virus Disease - Gemini Virus

The initial symptom is feature Small Vein Thickening (SVT) on young top leaves of plants. Later, growing curling of leaves occurs due to the not level growth of veinal tissues on the abaxial side of the leaves. Subsequently, the structure of the cup shaped or leaf laminar outgrowth called enations appear on the underside of the leaf. In severe cases and in plants affected at an early age, reduction of inter-nodal length leading to stunting and reduced flowering/fruitletting is observed.

E. Alternaria Leaf Spot - *Alternaria Macrospora*, *A. Alternata*

Alternaria macrospora causes brown, gray brown or tan lesions 3–10mm in diameter, especially on lower leaves. Sometimes with dark or purple margins and with concentric zones. . Affected leaves develop an abscission layer, sense and drop to the ground. Circular dry brown lesions up to 10mm across may also be seen on the bolls. *A. alternata* causes usually purple specks or small lesions with purple margins on leaves and bolls.

F. The Structural design of this Paper

A rest of this paper organized as follows as provided section 1. Introduction, Section 2. The related work, Section 3. Motivation , Section 4. Material and methods (presents the two Proposed algorithms namely, HPCCDD Algorithm and Improved HPCCDD and PSO algorithms). Section 5. Results and discussion (Present and analyzes the Performance results of effective proposed algorithms). Section 6. Some final concluding remarks and future study directions are given.

II. RELATED WORK

The proposed work describes to diagnosis based on the cotton leaves using different approaches are suggesting the variety of implementation ways as illustrated and discussed below. [3] Internet-Based Intelligent Diagnosis System for Cotton Diseases Control has been developed in a Back propagation neural network as a decision-making system to establish an intelligent diagnosis model. [4] Proposed work discussed the focus for classification of cotton diseases used Wavelet transform energy has been used for feature extraction while SVM has been used for classification. [5] Proposed work describes in the features could be extracted using SOM together with a back-propagation neural network is used to recognize the color of the image. [6] Discussed the fuzzy feature selection approach fuzzy curve and Fuzzy surfaces are implemented to select features of cotton disease leaves an image. [7] Previous work discussed the CMYK based image cleaning technique to remove shadows, hands and other impurities from images. After using other two methods RPM and Dis Bin and compared with the classical PCA based method. [8] Proposed work discussed the cotton leaf disease segmentation is performed using modified self organizing feature map with genetic algorithms for optimization and SVM used for classification. [9] Some other earlier work describes the various crops work based on the rice a digital image has been taken by digital camera, which is further analyzed by taking RGB feature of that image and then classified using the Fuzzy C-Mean Clustering algorithm. [10] Early work described the applications of K-means clustering and Neural Networks (NNs) have been formulated for clustering and classification of diseases that affect on plant leaves. [11] Proposed work describes the image processing methodology to address one of the core issues of plant pathology i.e. disease identification and its grading. [12] proposed work has been used the unsupervised diseases pattern recognition and classification algorithm that is based on a modified Hierarchical Dynamic Artificial Neural Network. [13] Previous research discussed the color co-occurrence method (CCM) to determine whether texture based hue, saturation, and intensity (HSI) color features in conjunction with statistical

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classification algorithms could be used to identify diseases.[14]Early study discussed the mainly owing on concepts of data mining such as Classification, Decision Trees, and Neural Networks.[15] Proposed study discussed the threshold and Triangle threshold methods are used to segment the leaf area and lesion region area respectively. [16] Proposed study discussed the features were then used as inputs to a (SVM) classifier and tests were performed to identify the best classification model. [18] Current work discussed the cotton leaves diseases analysis used in the Eigen features are regularized in a dissimilar way. Hole spacing feature extraction or dimensionality reduction in this work. [19] Previous work discussed the Cotton leaf curl virus analysis used in means ad compared with Duncan’s new multiple range (DMR) test at 0.05-level of significance.

A. Evaluation of Existing Work

Table1: The Evaluation of existing algorithms Accuracy

Author	Paper Title	Methodology	Diseases	Accuracy
Viraj A. Gulhane, Ajay A. Gurjar	Detection of Diseases on Cotton Leaves and Its Possible Diagnosis	Self organizing feature map together with a back-propagation neural Network And PCA and eigen Feature	1.Foliar leaf spot on cotton 2.CurlGeminivirus, 3.Bacterial Blight, 4.Cerco Spora-leaf Spot Cerco Spora, 5.Altemaria Leaf Spot-altemaria Macro Spora	90%
Syed A. Hayat , Ahsan Abdullah , Muhammad A. Chaudarya, Yasir J. Malik a and Waseem Gillani	Automatic Cleansing and Classification of Cotton Leaves, Bolls and Flower Images using CMYK Colour Splitting	RPM and Dis bin CYMK Components	1. Cotton Leaf Curl Virus, 2. Bacterial Blight	83%
Hui Li, Ronghua Ji, Jianhua Zhang, Xue Yuan, Kaiqun Hu and Lijun Qi	WEB-Based Intelligent Diagnosis System for Cotton Diseases Control	BP Neural Network	Eight main diseases	89.5%
A. A. Bernardes, J. G. Rogeri, N. Marranghello and A. S. Pereira, A.F. Araujo and João Manuel R. S. Tavares”	Identification of Foliar Diseases in Cotton Crop	Wavelet transforms and Support Vector Machine has	1. Bacterial Blight 2. Ramularia 3. Ascochyta Blight	90%

Table 1: Represent the evaluation of the previous algorithms based on its accuracy in detecting cotton leaf spot diseases. Here Gulhane .V. A et al., and Gujar.A.A (2011), Detection of Diseases on Cotton Leaves and Its Possible Diagnosis, In this paper used SOM and back-propagation neural network techniques achieved an overall accuracy 90% identified the cotton leaf spot diseases. Syed A. Heath et al., Automatic Cleaning and classification of Cotton leaves, bolls and flowers using CMYK color splitting, in this work described this technology are CMYK based image cleaning technique to remove shadows, hands and other impurities from images,and using other two techniques RPM and Dis Bin and compared with the classical PCA based technique. Hui Li, 2011. WEB-Based Intelligent Diagnosis System for Cotton Diseases Control in this paper exposed Back- propagation techniques used to control eight types of the cotton diseases and accuracy was 89.5%. Bernardes. A. A. et al., proposed in this paper focus identification of Foliar Diseases in Cotton crops capitalized wavelet transforms and Support Vector machine has been used to identify three types of cotton diseases.

B. Objective

In this work the input image is captured and the disease is identified using the proposed Image processing techniques is to identify the disease and symptoms and pest recommendation is the final output of result (SMS) based.

The main contribution of this work is to identify the disease correctly, which will help the farmer correct decision to take and minimize their yield loss and increases the economic status of our country, protection of their life.

III. MOTIVATION

This Research work presents an effort of using intelligent computing technology (ICT) to overcome the information gap by[2]:

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- A. Creating a complicated agricultural environment to support the farmers to easily identify the disease and get control of it (Pest Recommendation).
- B. Attempting to automate disease identification process using Advance color image processing.
- C. Increase the revenue and security of the farmers life and condense their burden.
- D. Time consuming(less).
- E. Increase the economic status of our nation.

IV. MATERIAL AND METHODS

The Proposed Structural Design of HPCDD Algorithm

A. *Classification Process was divided into two Phases*

- 1) *First Phase: Proposed HPCDD Algorithm*
- 2) *Second Phase: Proposed Improved HPCDD algorithm*

B. *HPCDD Algorithm works follow us*

This algorithm is the combination of algorithms various like:

- 1) Proposed Homogeneous Pixel Counting Algorithm for Cotton Diseases Detection (HPCDD)
- 2) Homogeneous Segmentation Based Edge Detection (HSBED) Method
- 3) Statistical Analysis based Pixel Ranging Algorithm (SAPR)

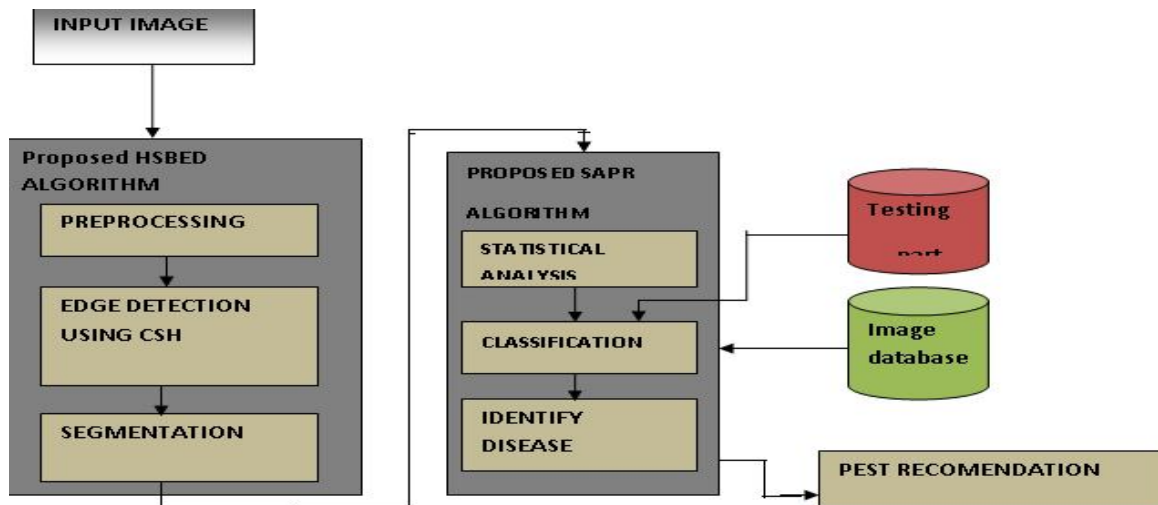


Figure 1: The Architecture diagram of HPCDD

C. *Proposed Homogeneous Pixel Counting Algorithm for Cotton Diseases Detection (HPCDD)*

- 1) RGB image acquires
- 2) Create the Color transformation construction
- 3) Convert the Color values in RGB to the space specified in the Color transformation model.
- 4) Apply Color Filter
- 5) Masking green-pixels (damaged part of the leaf)
- 6) Eliminate the masked cells inside the boundaries of the infected cluster
- 7) Find Edge detection using (Canny with Sobel homogeneous techniques of HSBED)
- 8) Calling the Pixel Ranging method to calculate the RGB features (every disease dissimilar)
- 9) Texture Statistics Analyze (using SAPR method)]\
- 10) Configuring Disease Reorganization and Pest Recommendation.

D. *Homogeneous Segmentation Based Edge Detection (HSBED) Method*

The other edge detectors presented so far can detect edges on dissimilar size objects. The homogeneity operator can take the dissimilarity of the center pixel and a pixel that is two or three pixels away. The difference edge detector can take the difference of opposite pixels in a 5x5 or 7x7 parts instead of a 3x3 [17] area. he Homogeneity-based edge detector takes the result of any edge

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detector and divides it by the normal value of the part. This division removes the effect of not level lighting in the image. The normal value of a part is available by convolving the part with a mask containing all ones and dividing by the size of the part.

- 1) *Input:* A example Image from Segmentation
- 2) *Output:* Detected Edges
 - a) Agree the input image
 - b) Apply mask G_x , G_y to the input image
 - c) Apply Sobel and Canny edge detection algorithm and the gradient (Homogeneous)
 - d) Masks manipulation of G_x , G_y separately on the input image
 - e) Results combined to find the absolute magnitude of the gradient

$$|G| = \sqrt{(G_x^2 + G_y^2)}$$

E. Statistical Analysis based Pixel Ranging Algorithm (SAPR)

- 1) *Input:* Edge Detected Image, Segmented Image
- 2) *Output:* Percentage of damaged area
 - a) Get the Color Range from segmentation using an edge detected image
 - b) Check the Pixel values which fall on the disease pixel range
 - c) If the pixel value falls on the range increment a count value by 1
 - d) Repeat the step 2 & 3 for all edges detected in the image.
 - e) Find the percentage from the count value
 - f) Repeat the percentage.

First Call Function starts Analysis. It has two parameter images, disease color.

F. Second Phase Proposed Improved HPCCDD Algorithm (PSO_HPCCDD)

- 1) Bitmaps (Resize Image), Edge Detection from Segmentation (Invert Image)
- 2) PSO Algorithm used for Best feature selection and HPCCDD used for Classification (Identification of disease and symptoms of disease, Pest Recommendation).

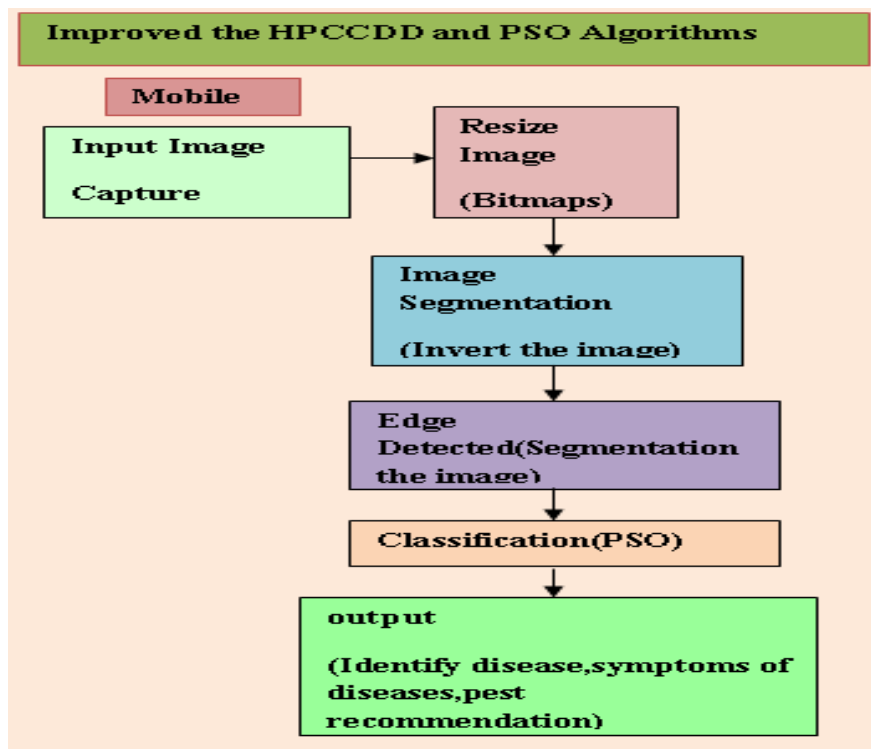


Fig 2. Architecture Diagram of Improved HPCCDD Algorithm

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Proposed Improved HPCCDD Algorithm Steps

Pseudocode for the proposed improved HPCCDD algorithm

- 1) *Input*: Mobile captured image
- 2) *Output*: disease name, disease symptoms, pest recommendation
- 3) *Process*: Classification using PSO-HPCCDD Feature selection using PSO
 - a) Initialize the particle's best known position to its initial position: $\mathbf{p}_i \leftarrow \mathbf{x}_i$
 - b) Initialization of the particle's position with input feature results from the color variance and edge variance
 - c) Parameter selection
 - d) For each particle evaluate the fitness value
 - e) If $(f(\mathbf{p}_i) < f(\mathbf{g}))$ update the swarm's best known position: $\mathbf{g} \leftarrow \mathbf{p}_i$
 - f) Set pbest as gbest
 - g) Update particle values
 - h) Update the particle's velocity: $v_{i,d} \leftarrow \omega v_{i,d} + \varphi_p r_p (p_{i,d} - x_{i,d}) + \varphi_g r_g (g_{d} - x_{i,d})$
 - i) Update the particle's position: $x_i \leftarrow x_i + v_i$
 - j) If $(f(x_i) < f(p_i))$ do:
 - k) Update the particle's best known position: $\mathbf{p}_i \leftarrow \mathbf{x}_i$
 - l) If $(f(\mathbf{p}_i) < f(\mathbf{g}))$ update the swarm's best known position: $\mathbf{g} \leftarrow \mathbf{p}_i$
 - m) Now \mathbf{g} holds the best found solution.
 - n) Get gbest as optimal solute
 - o) Obtain optimized parameters and feature selecti
 - p) Else
 - q) Goto step i

Figure2: Represent the process adopted in our proposed Improved HPCCDD algorithm is illustrated below:

G. Proposed PSO_HPCCDD

In this PSO-HPCCDD classification the feature extraction is performed by splitting the input image into pixels values, then set the color variance and quantization value of edge detector. But in existing method we performed only the canny edge detector and color splitting only not check the individual pixel wise or block wise color variance, text variance. Simple edge detection is carried out and blocks with edge pixels inside are judged into the structural category. Then, color variance is calculated in the remaining blocks. Find the variation across the edge with canny edge detector and color splitting methods. Variations in the gray level in a region in the neighborhood of a pixel is a measure of the texture. Here we calculate the feature level fusion to combine the color and texture feature sets after normalization in order to yield a joint feature vector (JFV). Instead of using GA for selection of the best features in the feature vector we use PSO-HPCCDD and selection of the best parameters for both global and local features results. In this algorithm the feature as input to classify the features and finally display the result. Initially select the feature vectors for training, HPCCDD classification algorithm the input file is read by the system, we define the decision function $f(K)$ to classify the feature vectors W , based on decision function only we classify the training samples into -1 or +1. If the objective or decision function $f(K)$ is greater than zero then we define the class label as +1 otherwise it is considered as class label of -1. Finally the Regions classified by the HPCCDD Prediction step as output.

H Economical Benefit

This work assists farmers, to take decision immediately, and they will get the best solution to diseases and suitable pest recommendation in different languages like Tamil, English, Hindi. Through which Production can be improved, Further the yield loss can also be reduced. The farmers get the ultimate solution and it increases the economic status of the country. The significance of this research work has been protect the life of the crops and reduce the farmers' burden.

V. RESULTS AND DISCUSSION

A. Description of Dataset

Cotton leaf image data sets have been collected from Tamil Nadu Agricultural University in Department of Cotton. Overall 500 datasets captured through using Nokia Mobile Camera Phone. Front End using C# programming language and Back End using SQL2000. In this data set analyzed, the most probably affected diseases are like verse 1. Alternaria leaf blight type-1, 2. Leaf curl 3.

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Fusarium wilt, 4. Root Rot, 5. Boll rot, 6. Leaf spot, 7. Brown Leaf spot, 8. Grey mildew.

Performance Evaluation

Algorithm	No.of Images	Sensitivity (%)	Specificity (%)	Accuracy (%)
Proposed HPCCDD	100	98.0144	57.69	98

Figure 3: Performance Evaluation of HPCCDD Algorithm

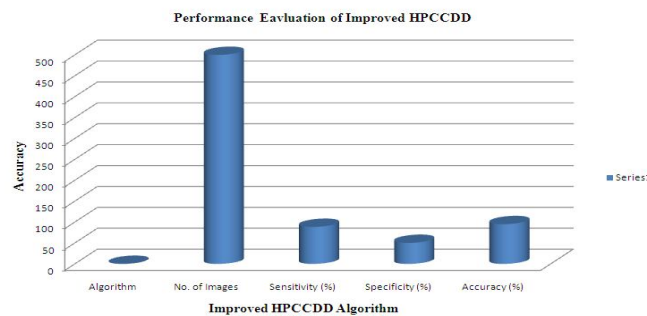


Table 2: Shows the performance evaluation of proposed HPCCDD algorithm

Table 2: Shows the Performance evaluation of Proposed HPCCDD algorithm has been carried out only 100 images obtained the Sensitivity, Specificity, Accuracy. Figure 3: Represent the Performance Evaluation of HPCCDD Algorithm.

B. Proposed HPCCDD Algorithm Results

Fusarium Wilt



Figure (4a1) Input Image



Figure (4a2) Gray scale Image

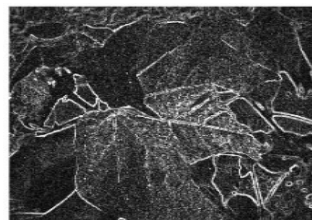


Figure (4a3) Invert Image



Figure (4a4) Output Image

Fig (4a1) shows the Normal input Image of One type of Cotton disease, FusariumWilt image is inverted into a grayscale image Fig (4a2). After that Fig (4a3) shows that using homogeneous edge detection techniques (Canny and Sobel with homogeneous operator) and getting white lightning edges identifies the disease boundary of the leaf spot, Fig (4a4) shows that the color filter applied and

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owes the dark color of the part is disease affected the leaf image is output.

C. *Verticillium Wilt*



Figure (5b1) Input Image



Figure (5b2) Gray scale Image

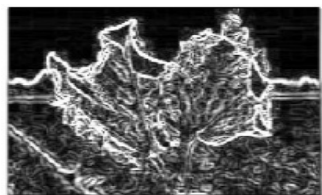


Figure (5b3) Invert Image



Figure (5b4) Output Image

Fig (5b1) shows Normal input Image of another type of Cotton disease, Verticillium Wilt. The image is inverted into a grayscale image Fig (5b2). Fig (5b3) shows that using homogeneous edge detection techniques and getting white lightning identifies the disease boundary of the leaf spot. Fig (5b4) shows that applied the color filter and owes the dark color of the part is disease affected the leaf image is output.

D. *Leaf Blight*



Figure (6c1) Input image



Figure (6c2) Gray scale Image

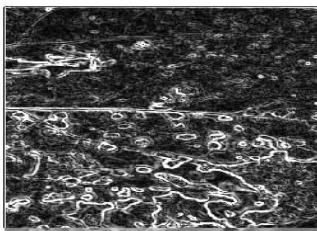


Figure (6c3) Invert Image

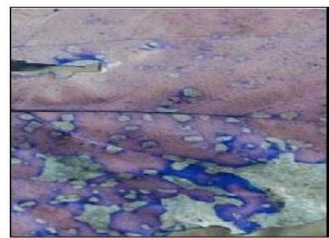


Figure (6c4) Output Image

Fig (6c1) shows Normal input Image of another type of cotton disease, Leaf Blight. The image is inverted into a grayscale image Fig (6c2). Fig (6c3) shows that using homogeneous edge detection techniques and getting white lightning identifies the disease boundary of the leaf spot. Fig (6c4) shows that applied the color filter and owes the dark color of the part is disease affected the leaf image is output. This work is analyzed with eight types of disease in cotton leaves. The above figures show the example for edge detected the disease. Results found the three types of cotton leaves. The figure 6a1. Shows Fusarium Wilt and Fig 6b1. Shows Verticillium Wilt, Fig 6c1. Shows Leaf Blight is shown the disease are recognized. Figs 4a3,5b3&6c3 shows the using homogenous edge detection techniques are shown in fair light part is disease affected that part. Fig 4a4,5b4,6c4 shows the coloring

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dark is disease affected part.

E. Proposed Improved HPCCDD Algorithm

The proposed Improved HPCCDD algorithm analyzes the cotton leaf diseases more accurately than other previous algorithms.

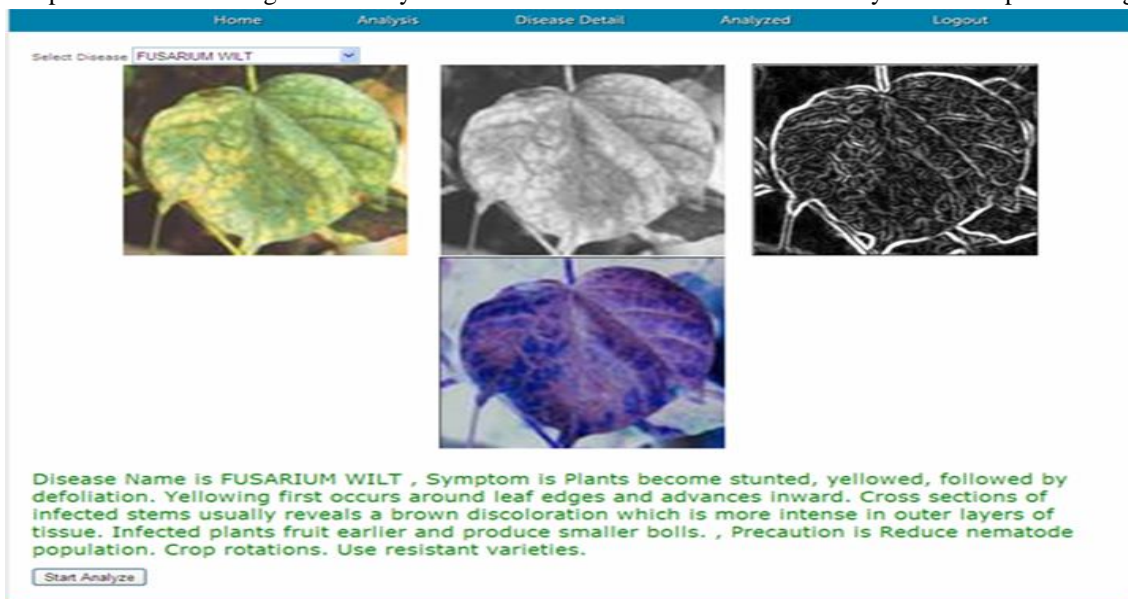


Fig 7: Report of Farmer and diseases Description

Figure 7: As shown above the output results obtained to the farmers final SMS of Diseases name and symptoms of the disease,precaution of the pest recommendations details help to the farmers (Precaution the disease awareness).

Algorithms	Accuracy (%)
SOM+ BPNN	90
RPM and Dis bin CYMK Components	83
BP Neural Network	89.5
Wavelet transforms and SVM	90
Proposed HPCCDD	79
Proposed Improved HPCCDD Algorithm	95

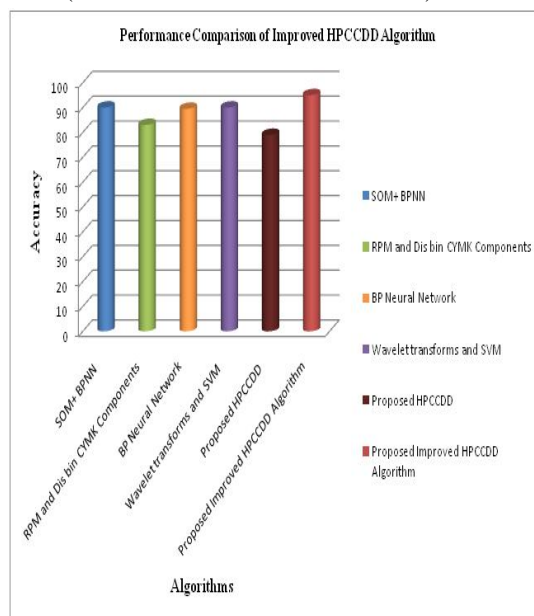


Table 2: Performance Comparison of Improved HPCCDD Algorithm Figure 8 : Performance Comparison chart of Improved HPCCDD Algorithms

Table 2 and Figure 8:As Shown above the Proposed Improved HPCCDD algorithm is found to have 1.94% higher accuracy than SOM+ BPNN,1.87% than RPM and Disbin CYMK Components, 1.94% than BP Neural Network, 1.94% than Wavelet transforms + SVM, 1.83% than Proposed HPCCDD. Here Improved HPCCDD accuracy rate is better than other existing Algorithms.

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Algorithm	No. of Images	Sensitivity (%)	Specificity (%)	Accuracy (%)
Improved HPCDD	500	88.52	50.25	95

Table 3: Performance Evaluation of Improved HPCDD Algorithm

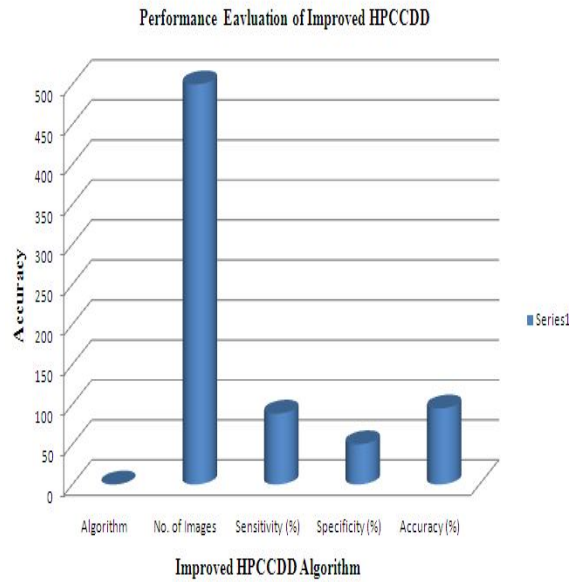


Figure 9: Performance Evaluation of Improved HPCDD Algorithm

Table 3 and Figure 9 : Shows the above results are obtained as above shown the Performance Evaluation of Improved HPCDD Algorithm in this work used a number of images. Finally carried out the accuracy, sensitivity, specificity of the diseases leaf images.

S.No	Diseases Names	Accuracy
1	Alternaria leaf blight type-1	95.15
2	Leaf curl	68.5
3	Root-rot	74.24
4	Fusarium Wilt	85.02
5	Boll rots	75.06
6	Leaf spot	87.38
7	Brown leaf spot	73.76
8	Grew mildew	89.25
9	No disease	13.4
Overall accuracy		94.54

Table 4 .Performance Evaluation of Eight types of diseases

Table 4: Shows the performance Evaluation results of eight types of diseases has been used by Improved HPCDD Algorithm, here Alternaria leaf blight type-1 disease has been owing the 95.15% precision rate, Leaf Curl disease has been owing 68.5 precision rate, Root rot disease has been owing 74.24% precision rate, Fasarium Wilt disease has been owing 85.02 precision rate, Boll rots disease has been owing 75.06% precision rate, Leaf spot disease is owing 87.38% precision rate, Brown Leaf spot disease has been owing 73.76% precision rate, Grew Mildew disease has been 89.25% precision rate and No disease has been owing 13.4% precision rate. Finally obtained the performance evaluation of overall system has accuracy rate 94.54%.

VI. CONCLUSION

The proposed algorithm is a computerized online to help the farmers to recognize the disease in the early stage and recover from it. The proposed Improved HPCDD algorithm analysis and classifies the disease in various stages using Proposed feature extraction PSO Algorithm. The Proposed Improved HPCDD algorithm is found to have 1.94% higher accuracy than SOM+ BPNN , 1.87% than RPM and Disbin CYMK Components, 1.94% than BP Neural Network, 1.94% than Wavelet transforms + SVM, 1.83% than

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Proposed HPCCDD. The Proposed Improved HPCCDD has the overall 95% accuracy(500images). The proposed algorithm is suitable to detect the disease accurately. Endly the performance evaluation of Improved HPCCDD has been obtained the accuracy rate is better than other existing classifiers.

VII.ACKNOWLEDGMENT

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