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NITROGEN DEFICIENCY CALCULATION OF LEAVES USING ARTIFICIAL NEURAL NETWORK

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1. ABSTRACT

In this proposed work, we are estimating the nitrogen content and calculating the nitrogen deficiency in pomegranate leaves. We collect different Nitrogen deficient leaves. We had measured the chlorophyll content of the collected leaves. We captured the images of collected leaves under the closed environment. These leaves are sent to the chemical analysis for the nitrogen estimation. Extracting the statistical features of images and creating the database. The captured images are compared with database and then find the nitrogen deficiency of leaf. For irrigated crops, plant analysis can be used as an aid in making decisions about nutrient applications such as nitrogen and some micronutrients. One example is petiole testing in irrigated potatoes. Nitrate nitrogen levels in the potato petiole are determined weekly, and the information is used to help make nitrogen fertilization decisions all season long. Plant analysis is also used in fruit and vegetable crops as a guide for nutrient application during the season.

Keywords:- *Neural network, Chlorophyll, nitrogen estimation, crops, micronutrients*

INTRODUCTION

Plants, like all other living things, need food for theirgrowth and development. Plants require 16 essentialelements. Carbon, hydrogen, and oxygen are derivedfrom the atmosphere and soil water. The remaining13 essential elements (nitrogen, phosphorus, potassium,calcium, magnesium, sulfur, iron, zinc, manganese,copper, boron, molybdenum, and chlorine) aresupplied either from soil minerals and soil organicmatter or by organic or inorganic fertilizers.For plants to utilize these nutrients efficiently, light,heat, and water must be adequately supplied. Culturalpractices and control of diseases and insects also playimportant roles in crop productionPlant diseases pose a great threat to agricultural sector reducing the life of plants. With the increased plant diseases, it became quite difficult and expensive to relay on pure naked eye observation to detect and classify plant diseases. Various image processing tools and techniques were widely used in order to identify and detect various plant diseases. These techniques helped farmers and agriculture scientist to identify the various diseases that caused the reduction of life cycle of the plants; also they helped farmers to take proper measure in order to prevent the plants from diseases. In this paper various techniques have been formulated, that can be used to identify and classify the various plant diseases. Various techniques like thresholding, K-means clustering, segmentation, neural network, RGB color model, fuzzy logic etc. were identified.

Different nitrogen estimation method:

1. Kjeldahl Method:

The Kjeldahl method was used for quantitative determination of nitrogen in chemical substances developed by Johan Kjeldahl. First step of kjeldahl method is a leaf sample was oven dried for 72 hours and then properly crushed. After that sample is mixed with 5ml H2SO4 in presence of K2SO4 and CuSO4 and then heated in digestion flask on the heater for 4 hours. Then heating the substance with sulphuric acid decomposes the organic nitrogen to ammonium sulphate.

In this step potassium sulphate is added in order to increase the boiling point of the medium (from 3370 C to 3730 C). Next step is chemical decomposition of sample is supposed to be complete after medium (initially very dark) become clear and colorless. The solution is distilled with sodium hydroxide (approximately 10 ml) to convert ammonium salt in ammonia. The amount of ammonia present (hence the amount of nitrogen present in sample) is determine by black titration. The end of condenser is dipped into solution of hydrochloric acid or sulphuric acid of precisely known concentration (generally 0.2 to 0.4 N). The ammonia reacted with acid and remainder of acid is

then titrate with sodium carbonate solution with methyl orange PH indicator.
%Nitrogen=(0.014×Volume of H2SO4)Sample weight of the collected Leaves **--------- (1)**

Basics
The Kjeldahl method is the standard method of nitrogen determination dating back to its development in the late 1800's. The method consists of three basic steps: 1) digestion of the sample in sulfuric acid with a catalyst, which results in conversion of nitrogen to ammonia; 2) distillation of the ammonia into a trapping solution; and 3) quantification of the ammonia by titration with a standard solution.

Equipment:
Kjeldahl flasks, 500 to 800 mL Kjeldahl digestion unit with fume removal manifold Kjeldahl distillation apparatus - Kjeldahl flask connected to distillation trap by rubber stopper. Distillation trap is connected to condenser with low-sulfur tubing. Outlet of condenser should be less than 4 mm diameter. Erlenmeyer flask, 500 mL Analytical balance, sensitive to 0.1 mg

Reagents:
Sulfuric acid, concentrated, 95-98%, reagent grade Sodium hydroxide, pellets, flakes, or 45% solution with specific gravity ≥1.36 (low N) dissolve 450 g in cool water and dilute to 1 L Potassium sulfate (K2SO4), anhydrous Copper sulfate (CuSO4), anhydrous Titanium dioxide (TiO2) Alundum, boiling stones, 8-14 mesh Pumice Methyl red indicator dissolve 1 g methyl red (sodium salt) in 100 mL methanol or ethanol Tributyl citrate (for antifoam) or paraffin or antifoam A or equivalent Lysine monohydrochloride, reagent grade, dried at 110OC for four hr Hydrochloric acid standard solution, 0.5 N Prepare by diluting 430.1 mL 36.5 to 38% HCl to 10 L with distilled water and standardize by method Sodium hydroxide standard solution Prepare 0.1 N sodium hydroxide (NaOH) solution and standardize by method. After standardizing hydrochloric acid and sodium hydroxide, check one against the other by titrating one with the other and calculating normality.

Safety Precautions:

- Handle acid safely: use acid resistant fumehood. Always add acid to water unless otherwise directed in method. Wear face shield and heavy gloves to protect against splashes. If acids are spilled on skin, immediately wash with large amounts of water.
- Sulfuric acid and sodium hydroxide can burn skin, eyes and respiratory tract severely. Wear heavy rubber gloves and face shield to protect against concentrated acid or alkali. Use effective fume removal device to protect against acid fumes or alkali dusts or vapors. Always add concentrated sulfuric acid or sodium hydroxide pellets to water, not vice versa. Concentrated sodium hydroxide can quickly and easily cause blindness. If splashed on skin or in eyes, flush with copious amounts of water and seek medical attention.
- Keep baking soda and vinegar handy in case of chemical spills.
- The sulfur oxide fumes produced during digestion are hazardous to breathe. Do not inhale.
- Digests must be cool before dilution water is added to avoid a violent reaction during which the acid can shoot out of the flask. Likewise, the diluted digest must be cool before sodium hydroxide is added to avoid a similarly violent reaction.

Procedure: Digestion

1. Weigh approximately 1 g ground sample into digestion flask, recording weight (W) to nearest 0.1 mg. Include reagent blank and high purity lysine HCl as check of correctness of digestion parameters. Weigh a second subsample for laboratory dry matter determination.
2. Add 15 g potassium sulfate, 0.04 g anhydrous copper sulfate, 0.5 to 1.0 g alundum granules, or add 16.7 g K2SO4, 0.01 g anhydrous copper sulfate, 0.6 g TiO2 and 0.3 g pumice. Then add 20 mL sulfuric acid. (Add additional 1.0 mL sulfuric acid for each 0.1 g fat or 0.2 g other organic matter if sample weight is greater than 1 g.)
3. Place flask on preheated burner (adjusted to bring 250 mL water at 25oC to rolling boil in 5 min).
4. Heat until white fumes clear bulb of flask, swirl gently, and continue heating for 90 min for copper catalyst or 40 min for CuSO4/TiO2 mixed catalyst.
5. Cool, cautiously add 250 mL distilled water and cool to room temperature (less than 25oC). Note: If bumping occurs during distillation, volume of water may be increased to ca. 275 mL.

Distillation

1. Prepare titration flask by adding appropriate volume (VHCl) accurately measured acid standard solution to amount of water so that condenser tip is immersed (try 15 mL acid and 70 mL water if undecided). For reagent blank, pipet 1 mL of acid and add approximately 85 mL water. Add 3 to 4 drops methyl red indicator solution.
2. Add 2 to 3 drops of tributyl citrate or other antifoam agent to digestion flask to reduce foaming.
3. Add another 0.5 to 1.0 g alundum granules.
4. Slowly down side of flask, add sufficient 45% sodium hydroxide solution (approximately 80 mL) to make mixture strongly alkali. (Do not

mix until after flask is connected to distillation apparatus or ammonia will be lost.)

5. Immediately connect flask to distillation apparatus and distill at about 7.5 boil rate (temperature set to bring 250 mL water at 25oC to boil in 7.5 min) until at least 150 mL distillate is collected in titrating flask.
6. Remove digestion flask and titrating flask from unit, rinsing the condenser tube with distilled water as the flask is being removed.

Titration

1. Titrate excess acid with standard sodium hydroxide solution to orange endpoint (color change from red to orange to yellow) and record volume to nearest 0.01 mL (VNaOH). Titrate the reagent blank (B) similarly.

Comments:

- Reagent proportions, heat input and digestion time are critical factors - do not change.
- Ratio of salt to acid (wt:vol) should be 1:1 at end of digestion for proper temperature control. Digestion may be incomplete at lower ratio; nitrogen may be lost at higher ratio. Each gram of fat consumes 10 mL sulfuric acid and each gram of carbohydrate consumes 4 mL sulfuric acid during digestion.
- Catalyst mixtures are commercially available in powdered or tablet form. Dispensers are available for convenient delivery of powdered catalyst mixtures.
- Check with local authorities for proper disposal procedures of copper containing waste solution.
- Include a reagent blank and at least one sample of high purity lysine hydrochloride in each day's run as check of correctness of digestion parameters. If digestion is not complete, make appropriate adjustments. A standard, such as NIST Standard Reference Material No. 194, ammonium phosphate (NH4H2PO4), certified 12.15%N should also be included

2 Regression Model

The estimation of nitrogen content from leaves determine by regression model. Regression models are developed on the bases of statistical process among the variables. The image features are extracted from MATLAB software and plant nitrogen contents are estimated from the chemical analysis between this two process the regression is developed. After preprocessing of an image the R, G, B image is separated into normalized 'r', normalized 'g' and normalized 'b'. By plotting histogram the statistical features are Image Analysis of Pomegranates Leaves to Determine Nitrogen Deficiency Using MATLAB

3 Artificial Neural Network (ANN):

Artificial means made by human, neurons is similar to Human brain and networks means any interconnected groups Artificial Neural Network are relatively crude electronic models based on the neural structure of brain. There are many nodes which are denoted by Links. This network gives massive parallelism, adaptively. It has low energy consumption. This network is similar to human brain which is work like neurons. There are m no. of inputs and n no. of outputs. In this network hidden layer also present. The Artificial Neural Network is used for corn plant this gives accuracy about 75%. To estimate the nitrogen contents we are using regression analysis. By using regression analysis we will get maximum accuracy. Regression analysis is a statistical tool for the investigation of relationships between variables.

2.4 Applied Method:

In above three methods Kjeldahl method it gives accurate results but this method is time consuming method. By using artificial neural network the time required for the Nitrogen estimation is less but accuracy is very low. We are using regression analysis for the estimation of Nitrogen content because it requires not only less time but also it gives better accuracy than that of ANN.

Regression analysis is a statistical tool for the investigation of relationships between variables. To estimate the nitrogen contents we are using regression analysis. By using regression analysis we will get maximum accuracy and use of chemicals are reduced. Image Analysis Of Pomegranates Leaves To Determine Nitrogen Deficiency Using MATLAB

The regression models are developed between extracted statistical feature and nitrogen contents estimated in laboratory. There are different statistical features such as mean, variance, energy, entropy. But in this project for the regression model development we have considered only mean and variance.

Advantage of Artificial Neural network:

ANN is nonlinear model that is easy to use and understand compared to statistical methods. ANN is non-parametric model while most of statistical methods are parametric model that need higher background of statistic. ANN with Back propagation (BP) learning algorithm is widely used in solving various classification and forecasting problems. Even though BP convergence is slow but it is guaranteed. However, ANN is black box learning approach, cannot interpreted relationship between input and output and cannot deal with uncertainties. To overcome this several approaches have been combined with ANN such as feature selection and etc.

Meanwhile Fuzzy is quite good in handling uncertainties and can interpreted relationship between i/o by producing rules. Therefore, to increase the

capability of Fuzzy and ANN, hybridization of ANN and fuzzy is usually implemented.

ANALYSIS

The Eigen features from the cotton leaf image. On the basis of regularized Eigen features Eigen spectrum is modeled. Now the comparison of these features with the features that are extracted from the healthy leaf results into disease identification.

For extracting the Eigen features from the cotton leaf image scatter matrix is used in the proposedwork by the researchers. Classification method when used with Support Vector Machine (SVM), Back Propagation Network (BPN), and Fuzzy like Bacterial leaf blight, Red Leaf Blight, Black Spot, Fungus, and Anthracnose can be diagnose with the help of the method provided in the paper, So that appropriate treatment for the disease can be provided.

In the proposed method researchers have beenpresented the method to find the nitrogen deficiency in the soya bean plant. As the Nitrogen is one of the most important nutrient in the plant. In the proposed method first the input image of diseased leaf has been captured. Now image has been converted using different edge detection operators. Then comparison of normal image and edge detected image is done and pixel variation in both the image is noted. Now the comparison between pixel variation of diseased leaf image and normal image has been compared with gives the deficiency.

Edge Detection:

In the proposed method different edge detection operators like Sobel operator, Kirsch operator andhomogeneity operators are described for edge detection. Sobel filter gives the best result for this method. The described technique is fast and accurate technique for nitrogen deficiency detection in Soya bean plant.

In this paper Researchers have been proposed an approach fordisease detection in soya bean plant using segmentation based on edge detection. Image is captured and a filter is applied to remove noise. After that histogram has been created and normalized. Then image has been segmented using various edge detection methods and each pixel of image has been labeled. Comparison of the image will gives the diseased area of the leaf.

Sobel operator, Prewitt operator and Canny edge detector operators aredescribed for edge detection. Canny Edge detector operator gives the better result for edge detection for this method than the Sobel and Prewitt operator. Labeling of each pixel has been done using k-means clustering. K-means clustering is used because it gives the best result for the detection purpose.

In the proposed research technique is defined to find the bacterial infection detection ontomato and crape jasmine leaves as brown-black color spot and centre becomes dry. The developed method consists of six steps: Image Acquisition, Colour Transformation, Filtering, Segmentation, Feature Extraction and Classification. Final step provides the bacterial infection detail of the plant.

In the proposed research image is captured in RGB Format and convert it into YIQ color format andmedian filter is applied to remove the noise and preserve the sharp high frequency details. Now the image has been segmented into various segments on the basis of thresholding. So the resultant value of any pixel in the image is 1 if it is having the value more than threshold and Zero otherwise. After thresholding grey level histogram is acquired. Now features are extracted using Grey Level Co - occurrence matrix (GLCM). Finally classification is done using SCG, Backpropogation, logistic, AD Tree, Pegasus, naïve bays and multilayer perception algorithms. For this proposed method, SCG provides the best results and highest accuracy of more than 86% on both the tomato and jasmine plants.

The mean values for all the sample leaves are computed and calculated values are compared withnormal and infected leaves. By doing analysis of the entire graph, as compared to low resolution images, rate of disease reorganization is increased with high resolution images.

Researchers have been proposed a diagnosis technique forbanana bacterial wilt disease and black sigatoka disease. In this method first image is acquired and different feature extraction techniques have been applied use for texture analysis for banana leaves. Color transform has been applied in order to find morphological features which give the disease details.

To implement the proposed method image should be cropped and background should be removed asit is very difficult to work with images with background. And for color transformation RGB to HSV transformation have been used. And at last for disease classification support vector machine (SVM) or randomized trees have been used. . Randomized tree yields very high score and gives the better performance than the other classifiers for the proposed method.

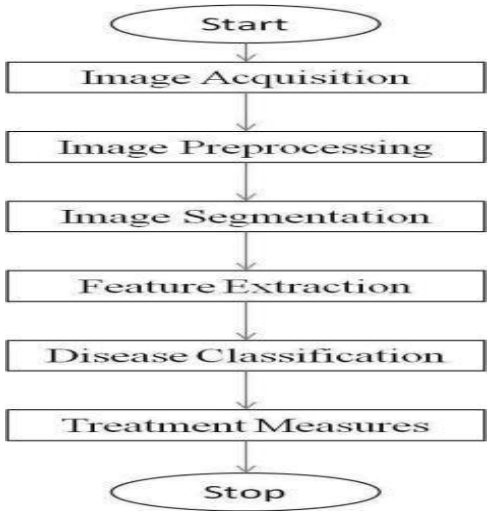

Fig. 2 system flow diagram

Importance of Nutrients:

Importance of N and K (Major Nutrients):

N & K are the most important nutrients for fruit trees including pomegranate trees in Florida. An adequate level of N is required for vegetative growth, flowering, and fruit yield. K also plays an important role in determining yield, fruit size, and quality. Use 1:1 N to K2O ratio. However, a ratio of 1:1.25 is recommended for high pH or calcareous soils and heavy producing trees.

Nitrogen Rates:

Numerous N rates and timing were recommended for pomegranate trees. They vary with location, tree age, tree size, soil conditions, fruit yield, and other cultural practices Image Analysis of Pomegranates Leaves to Determine Nitrogen Deficiency Using MATLAB

Variable rate technology for fertilizer application has been developed to reduce environmental risks and increase fertilizer use efficiency. For application of this technology, it requires online determination of plant nutrient status in the field. The Kjeldahl method was used for quantitative determination of nitrogen in chemical substances developed by Johan Kjeldahl. In this method various types of chemicals are used. In Kjeldahl method there are wide range of samples are required to estimate the nitrogen content from pomegranate leaves. Chlorophyll meter is also used for nitrogen estimation of pomegranate leaves.

There are different methods for estimating the nitrogen content of pomegranate leaves.

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Visual Analysis

Analyzing the plant visually is oldest method to detect disease and nutrient deficiency in plants. And so this is no different in case of cotton plant. As describe earlier, cotton plant is one of the oldest crop grown by people. So farmers were known to facts about how leaves change their shape and colour when some defect occurs. We have methods to identify deficiency of nutrients in cotton plant. In their paper of IOWA State University [1], author has suggested various visible methods to detect nutrient deficiency in plants. The properties are given for corn plant, but these symptoms are generally common in each plant. For example, Nitrogen deficiency causes pale, yellowish-green plants with spindly stalks. Symptoms appear on leaves as a v-shaped yellowing, starting at the tip and progressing down the midrib toward the leaf base. Like Nitrogen, deficiency of other nutrients like Phosphorous, Potassium, Calcium, Iron, Boron, Molybdenum etc. can be detected too. In their module of Montana State University [2], they also have given visual ways to detect deficiency of nutrients mentioned above. This is techniques doesn't vary largely. Additionally, they have given ways to diagnose these deficiencies.

There is specific time period until which this analysis should have been made. And there may be a chance where our prediction may get wrong which can be very harmful. We need deep technical knowledge to detect nutrient deficiency and also that there are limited time during which detection is possible. As a diagnostic tool, visual observation can be limited by various factors, including hidden hunger and pseudo deficiencies, and soil or plant testing will be required to verify nutrient stress. There is not much scope of research in this method. "What s there is there for permanently" is a way visually analysis works. Nonetheless, the evaluation of visual symptoms in the field is an inexpensive and quick method for detecting potential nutrient deficiencies or toxicities in crops So we need a reliable and easy method for this.

Nutrient functions

• N is biologically combined with C, H, O, and S to create amino acids, which are the building blocks of proteins. Amino acids are used in forming protoplasm, the site for cell division and thus for plant growth and development.

• Since all plant enzymes are made of proteins, N is needed for all of the enzymatic reactions in a plant.

• N is a major part of the chlorophyll molecule and is therefore necessary for photosynthesis.

• N is a necessary component of several vitamins.

• N improves the quality and quantity of dry matter in leafy vegetables and protein in grain crops

Deficiency symptoms

• Stunted growth may occur because of reduction in cell division.

• Pale green to light yellow color (chlorosis) appearing first on older leaves, usually starting at the tips. Depending on the severity of deficiency, the chlorosis could result in the death and/or dropping of the older leaves. This is caused by the translocation of N from the older to the younger tissues.

• Reduced N lowers the protein content of seeds and vegetative parts. In severe cases, flowering is greatly reduced.

• N deficiency causes early maturity in some crops, which results in a significant reduction in yield and quality

III. CONCLUSION AND FUTURE SCOPE

Reviews on various techniques have been done in order to identify and classify the various plant diseases. Various techniques like K-Mean Clustering, Histogram Analysis, and Segmentation for feature extraction, Fuzzy Logic, Threshold, Feature Extraction, Image Processing, MATLAB tools have been used. Limitations and advantages of these techniques are reviewed.

The main aim of this review paper was to identify and detect various plant diseases that affect the life span of plants. We have observed there are various techniques that are very useful, and detect the various plant diseases with at most 94-95% accuracy. Apart from that each technique has their own accuracy in finding out the particular diseases. Also it has been observed that these techniques can also be used in detecting, identifying various other diseases apart from the disease for that it has been proposed.

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REFERENCES

[1] SachinDigambarDhavhan, A.S.Dudhe "An efficient disease diagnostic and treatment system for cotton plant using digital image processing" ,(2015), international journal of advanced research in computer science and applications, Volume 3, ISSN 2321-872x online ISSN 2321-8932.

[2] Snehal M. Kalmegh, S. V. Dhopte," Determination of Nitrogen Deficiency in Soya Bean Using Edge Detection", (2015), international journal of mechanical engineering and information technology ,volume.03,Page No.1376-1382//ISSN-2348-196x.

[3] Ravi C.Shinde, Jibu Mathew C and Prof. C. Y. Patil," Segmentation Technique for Soybean Leaves Disease Detection",(2015) INTERNATIONAL JOURNAL OF ADVANCED RESEARCH , VOLUME 3, issue 5, 522-528.

[4] AradhanaShuklaa, PoojaTripathia and KomalPriyaa," Application of Modern Technology in Agriculture",
(2015), International Journal of Innovative and Emerging Research in Engineering, VOLUME 2, e-ISSN: 2394-3343,p-ISSN: 2394-5494.

[5] R. Revathy, R. Roselin," Digital Image Processing Techniques for Bacterial Infection Detection on Tomato and Crape Jasmine Leaves",(2015), International Journal of Scientific & Engineering Research,VOLUME 6,ISSN
2229-5518.

[6] S. S. Sannakki, V. S. Rajpurohit, „An Approach for Detection and Classification of Leaf Spot Diseases Affecting Pomegranate Crop", (2015), International Journal of Advance Foundation and Research in Computer
(IJAFRC), VOLUME 2, ISSN 2348-4853.

[7] Nutankumar S. Jane, AnupamaP.Deshmukh," Study and Identification of Powdery Mildew Disease for Betelvine Plant Using Digital Image Processing With High Resolution Digital Camera", (2015), International
Research Journal of Engineering and Technology (IRJET),VOLUME e:02 Issue :03, e-ISSN:2395-0056,p-ISSN:2395-0072.

[8] GodliverOwomugisha, John A. Quinn, Ernest Mwebaze, James Lwasa," Automated Vision-Based Diagnosis of
Banana Bacterial Wilt Disease and Black Sigatoka Disease", (2014), 1st international conference on the use of mobile ICT in africa 2014,ISBN-978-0-7972-1533-7.

[9] J.Vijayakumar and S.Arumugam." Powdery Mildew Disease Identification in Karpoori Variety of Betel Vine Plants using Histogram Based Techniques",(2014), Society of science and Education, United Kindom,
VOLUME 2, ISSN-2054-7412.

[10] P. Revathi, M. Hemalatha," Cotton Leaf Spot Diseases Detection Utilizing Feature Selection with Skew
Divergence Method",(2014), International Journal of Scientific Engineering and Technology , Volume No.3,
Issue No.1 pp : 22-30 , ISSN : 2277-1581.

[11] Savita N. Ghaiwat, Parul Arora," Detection and Classification of Plant Leaf Diseases Using Image processing
Techniques: A Review",(2014), International Journal of Recent Advances in Engineering & Technology
(IJRAET), ISSN (Online): 2347 - 2812, Volume-2, Issue - 3, 2014.

[12] Hrishikesh P. Kanjalkar, S.S.Lokhande," Feature Extraction of Leaf Diseases" ,(2014), International Journal of
Advanced Research in Computer Engineering & Technology (IJARCET),Volume 3, Issue 1, ISSN: 2278 – 1323.

[13] P.R. RotheȦ and R. V. KshirsagarȦ," A Study and Implementation of Active Contour Model For Feature Extraction: With Diseased Cotton Leaf as Example",(2014), International Journal of Current Engineering and
Technology , Vol.4, No.2 , E-ISSN 2277 – 4106 , P-ISSN 2347 – 5161.

[14] S.Lakshmi , V.Sankaranarayanan," Diseases detection of God‟s plant - Aloe vera using image processing",(2014), IJIPDV INTERNATIONAL JOURNAL OF IMAGE PROCESSING AND DATA
VISUALIZATION , VOL.1, NO.2.

[15] Sachin B. Jagtap, Shailesh M. Hambarde," Agricultural Plant Leaf Disease Detection and Diagnosis Using Image Processing Based on Morphological Feature Extraction",(2014), IOSR Journal of VLSI and Signal
Processing , Volume 4, Issue 5, e-ISSN: 2319 – 4200, p-ISSN No. : 2319 – 4197.