Disease and Nutrient Deficiency Detection in Cotton Plant

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***Abstract* - Cotton is one of the most important fibre crop which plays very important role in economic and social affair of people, especially in India, but if disease like Alternaria Leaf Spot and deficiency of some major nutrients goes undetected in then it can reduce as much as 25% of total production. This will be marginally beneficial for farmers to increase the production of crop and have a better profit out of it. Among different diseases, focus has been made on 'Alternaria Leaf Spot' as it is the most dangerous and frequently found disease on cotton plants in India. Deficiencies of major nutrients like Nitrogen, Potassium, Phosphorous, Manganese, Molybdenum, Chlorine and calcium has also been detected in this research. Image processing method has been selected after complete analysis of previously used methods and techniques, and so it has been proposed in this paper. Complete working flow of the system has been proposed. Algorithms that give best results have been selected and modified when needed. Template matching and color histogram algorithms have been used for detection. Complete analysis and comparison has been made with previously used techniques. After implementing the code on large number of cotton images taken from different locations, result and conclusion has been made. Results show how this research is more useful and practically more feasible than previous researches.**

***Keywords* - Cotton, Leaf, Image Processing, Disease, Detection, Nutrient Deficiency, Color**

I. INTRODUCTION

A. Image Processing Overview

"Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image."

B. Cotton

Cotton has been cultivated in the Indus valley since 1500 B.C. and archaeological evidence proved that cotton plant originated in India. Cotton is most important fiber crop in India. So it is very important for Indians to produce very large amount of cotton every year. Indian cotton suffers from various diseases which decreases production to large extent. Some of these diseases are Alternaria Leaf Spot, Anthracnose, Bacterial blight, Boll rot, Fusarium wilt, Insect Pests, etc. As described earlier, focus has been made on Alternaria Leaf Spot only as that is the one which affects the production largely.

C. Nutrients

Major nutrients which affect cotton plants are Nitrogen, Phosphorous, Potassium, Chlorine, Calcium, Manganese, Molybdenum, Zinc, Sulphur, Boron, Iron etc. This thesis describes various technologies used from years to detect deficiency of these nutrients. Not only description, but comparative analysis of different techniques has been made in this thesis. Some of them are described here.

Macro Nutrients: Carbon (C), Oxygen(O), Hydrogen (H), Nitrogen (N), Potassium (K), Phosphorus (P), Calcium (Ca), Zinc (Zn), Magnesium (Mg), Sulphur (S), and Chlorine (Cl)

Micro Nutrients: Boron (B), Cobalt (Co), Copper (Cu), Iron (Fe), Manganese (Mn), and Molybdenum (Mo) Image processing methods has been used after analysing different techniques like visual analysis, image Processing, optical sensor method and other methods. Tabulated comparision of these techniques is shown here [1] [2] [3] [4] [5] [6] [7] [8] [9] [10] [11]:

Table 1: Comparison of Techniques

		Methods		
		Visual Analysis	Image Processing	Optical Sensor
Properties	Complexity	Very Low	Average	Very High
	Cost	Very Low	High	Very High
	Accuracy	Average	Very High	High
	Scope of Research	Very Low	Very High	High
	Timing Constraints	Very High	Low	Average
	Components Required	Not Required	Camera, Network Equipments	Nutrient Analyser, Sensors
	Software Required	Not Required	Visual Analytics	Related Software

Template matching and color histogram techniques have been implemented on samples. SRM (Statistical Region Merging) method has been used to for image segmentation when needed.

II. PROPOSED FLOW

Figure shown below shows the flow chart proposed in this research.

For Disease detection, template matching algorithm has been used for this. Training set has been made and using that leafs and so as diseased plant will be detected. For Deficiency detection of nutrients like nitrogen, phosphorous, potassium, calcium, sulphur, molybdenum and manganese the chemical properties of the nutrients have been used. For example, Nitrogen deficiency causes pale, yellowish-green plants with spindly stalks. So in this research, we have used the color histogram for detecting nitrogen deficiency.

Phosphorus deficiency is usually visible by dark green with reddish purplish leaf tips and margins on older leaves. Phosphorus deficient plants are smaller and grow more slowly than do plants with adequate phosphorus. So, here too the color histogram will be used to detect phosphorous deficiency in cotton plant. Like this, color based segmentation has been implemented on the images and doing so deficiencies of nutrients have been detected.

A. Recommendations:

Consulting agriculture experts, appropriate treatment module will be recommended to farmers after detecting disease and deficiency of nutrient proper.

Following recommendations has been given after detection:

Alternaria Leaf Spot

The plant residues should be removed from the field. And then Carbendazim, Mancozeb 2.5gm, Copper Oxychloride 3gm in one litre of water should be sprayed for 3-4 times in every 15 days gap.

Nutrients

Respective fertilizers should be used in proper quantity. If nitrogen is deficient than nitrate fertilizer should be used, If phosphorous is deficient than phosphate fertilizer should be used and so on.

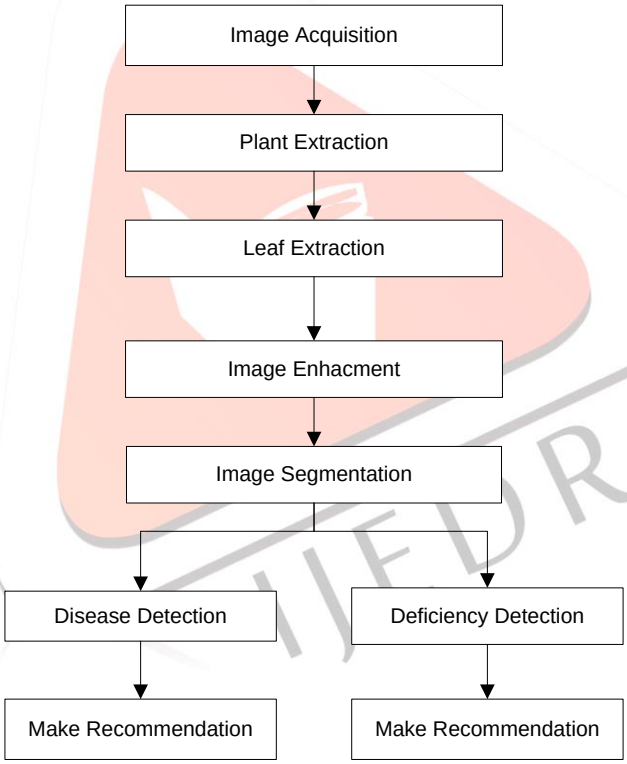

Figure 1: Proposed Work Flow

III. IMPLEMENTATION

Image Segmentation

Different algorithms for image segmentation has been implemented on image database and according to results got, Statistical Region Merging algorithm has been chosen for image segmentation. Given diagram shows snapshots of the same.

Template matching

Algorithm for template matching has been implemented for detecting alternaria leaf spot in cotton plant. For doing this, training matrix has been made using database of images. The images taken from the farm has been compared with the database to detect alternaria leaf spot. As the images taken are largely varying in size and shape, the training matrix has been made with number of possibilities, so that no diseased plant goes undetected. Given figure shows detection of alternaria leaf spot.

Color histogram

Different algorithms have been implanted for color detection. These algorithms use different color models. Color histogram algorithm has been used to detect nutrient deficiency in cotton plant. Figure 5 and 6 shows Potassium and sulphur deficient plants respectively.

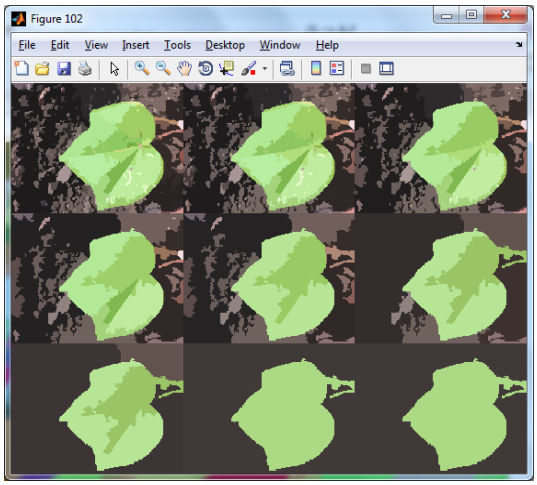

Figure 2: Segment Map with Average Color in Each Segment

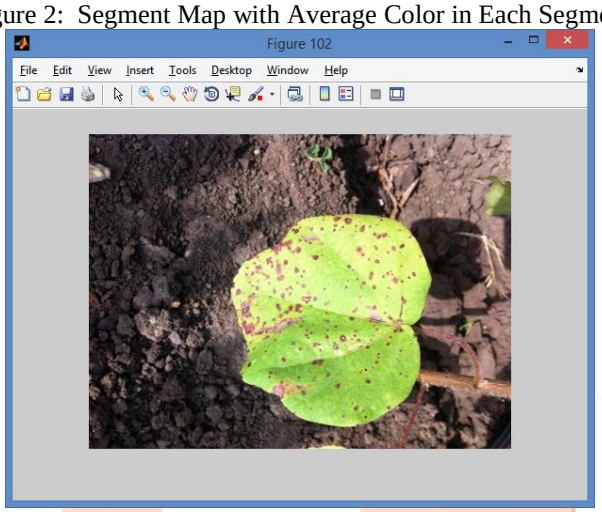

Figure 3: Plant Diseased with Alternaria Leaf Spot

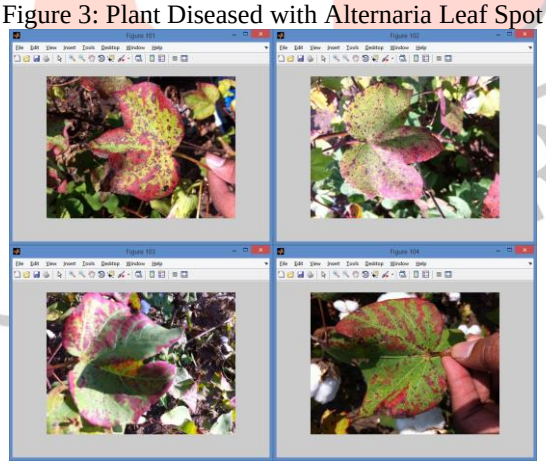

Figure 4: Potassium Deficient Plants

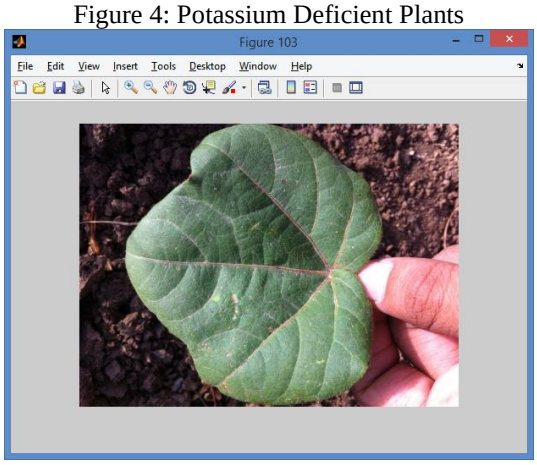

Figure 5: Sulphur Deficient Plant

IV. CONCLUSION

After analysing the results got after implementing the proposed system, it can be concluded that with high accuracy the system is detecting alternaria leaf spot disease in cotton plant. And after detecting, proper recommendations have been given to overcome it. The system is also detecting deficiency of Nitrogen, Phosphorous, Potassium, Calcium, Manganese, Molybdenum, Sulphur, Boron and Calcium. After comparing the results of the proposed system with existing systems, it can be concluded that the proposed system is more accurate and precise than the existing ones. Proposed system is more practically feasible than existing ones as in this research, real images of cotton plants taken from the farm has been used in implementation. It is also less time consuming.

REFERENCE

[1] John Sawyer, Department of Agronomy. "Nutrient Deficiencies and Application Injuries in Field Crops" in IOWA State university (University Extension) IPM 42 Revised July 2004.

[2] Ann McCauley, Clain Jones, Jeff Jacobsen. "Plant Nutrient Functions and Deficiency and Toxicity Symptoms" in MONTANA State University Extension 4449-9 May 2009.

[3] Mr. Viraj A. Gulhane, Dr. Ajay A. Gurjar. " Detection of Diseases on Cotton Leaves and Its Possible Diagnosis" in International Journal of Image Processing (IJIP) Volume (5) : Issue (5) : 2011

[4] Alexandre A. Bernardes, Jonathan G. Rogeri, Roberta B. Oliveira, Norian Marranghello and Aledir S. Pereira. "Identification of Foliar Diseases in Cotton Crop" in Instituto de Biociências, Letras e Ciências Exata (IBILCE), São José do Rio Preto, São Paulo, Brasil.

[5] Manoj Mukherjee, Titan Pal and Debabrata Samanta. "Damaged Paddy Leaf Detection Using Image Processing" in Journal of Global Research in Computer Science Volume 3, No. 10, October 2012, ISSN: 2229-371X.

[6] Anamari V. A. Motomiya, Joseph P. Molin; J. Ederaldo Chiavegato. "Use of an active optical sensor to detect nitrogen deficiency in cotton leaf" in Brazilian Journal of Agricultural and Environmental Engineering. ISSN : 1807-1929 Rev. bras. eng. agric. ambient. vol.13 no.2 Campina Grande Mar. / Apr. 2009.

[7] Asundi Anand, OiWah Liew, Bingqing Li, and Jenny Chong. "Optical sensors enhance plant nutrient monitoring" in The International Society of Optical Engineering. ISSN : 10.1117/2.1200601.0096

[8] Ajay A. Gurjar, Viraj A. Gulhane. "Disease Detection On Cotton Leaves by Eigenfeature Regularization and Extraction Technique" in International Journal of Electronics, Communication & Soft Computing Science and Engineering (IJECSCSE) Volume 1, Issue 1.

[9] Jaime Lloret , Ignacio Bosch , Sandra Sendra 1 and Arturo Serrano. "A Wireless Sensor Network for Vineyard Monitoring That Uses Image Processing" in Sensors 2011, 11, 6165-6196; doi:10.3390/s110606165.

[10] Debabrata Samanta1, Prajna Paramita Chaudhury2, Arya Ghosh3. "Scab Diseases Detection of Potato using Image Processing" in International Journal of Computer Trends and Technology- volume3Issue1- 2012

[11] Hrushikesh Dattatray Marathe, Prerna Namdeorao Kothe. "Leaf Disease Detection Using Image Processing Techniques" in International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 3, March – 2013 ISSN: 2278-0181.