A Review of Approaches for Estimation Chlorophyll and Nitrogen Contents Of Leaves Using Image Processing Technique

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Abstract **-** Chlorophyll and Nitrogen are dependent on each other. Appraising one will give content of other. Many approaches are discovered to appraise these two. Hyper spectral data , vegetation indices, remote sensing, multi spectral imaging data, light absorbance approach are some of the appraising approaches. These approaches are in two categories- Destructive and Non destructive. However, Image processing technique is proving to be proficient among all these; which come under non destructive method. In this paper, some of these approaches are reviewed. Leaf colour is usually used as a guide for appraisal of nutrient status and plant health and so to determine nitrogen and chlorophyll contents also. In this paper workregardingdeveloping an easy and proficient automatic method for finding nitrogen and chlorophyll content in a plant based on leaf colour and image processing is reviewed .We also proposing a new a algorithm with assuring better efficiency for classification using SVM technique.

Keywords*-digital image processing; nitrogen; chlorophyll; support vector machine.*

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I. INTRODUCTION

The main tenure of India is agriculture, Indian soil is comprise of many minerals and organic elements, and inspection has resolved that soil is comprise of 1% of organic elements and rest 99% of mineral content. Plants, like all other living things, need food for their growth and development. Plants demand16 fundamental elements. Carbon, hydrogen, and oxygen are derived from the atmosphere and soil water. The remaining 13 fundamental elements (nitrogen, iron, phosphorus, calcium, magnesium, sulphur, zinc, manganese, potassium, copper, boron, molybdenum, and chlorine) are supplied either from soil minerals and soil organic matter or by organic or inorganic fertilizers. Nitrogen is one of the ample mineral which plays an important role in yield of crops. Nitrogen (N) is a major element for plant growth and is a radical part of chlorophyll (Ch), which is primary absorber of light energy needed for photosynthesis. Ch and N affects the green colour of plants and ultimately determines their biomass yield and quality. Plants adequately supplied with N are green and healthy, while plants inadequately supplied with N are pale green or yellow in colour and remain small andretarded. Hence, leaf colour changes have led researchers to exploit this property by using image processing analyses to detect Ch and N status in plants if there is deficiency in the content then proper measures can be taken by farmers to improve the nutrients in crops. Present way to find nitrogen content is kjeldhahl method. Nitrate test strip and nitrate meter are other existing systems. This consumes time, man power and costlier. To overcome these we are proposing a system that will find out the nitrogen content in the leaves using image processing technique. Digital image processing is superior to manual process hence we will be able to save time and human error. Computer algorithms are used for texture analysis. “Estimation of nitrogen contents and chlorophyll of leaves" the aim of the contracted system is to overcome the problems of conservative methods and to help agriculture system to reconstruct the total system towards a low-input, higher-efficiency, higher profit in Appraising the content of nitrogen and chlorophyll in leaves using image processing technique and SVM classifier.

All plants require adequatesupplies of macronutrients for healthy growth, and nitrogen is a nutrient that is heavily available in Indian agricultural soil and which should not be in restricted supply. It is manual and time devastating. Contracted system overcomes these problems and gives aproficient way to estimate the nitrogen content. Thus it will be helpful in guiding the need of type and the amount of the pesticide which will be very helpful in agriculture industry. The quality and quantity of crop yields are related to its nutritional availability. One of vital macronutrient for plants is nitrogen (N). N application management is needed to decrease some problems caused by unsuitable N fertilizer application rate. Over-fertilization cause environmental issues while under-fertilization cause yield reduction and poor yield quality. Cultural practices and control of diseases and insects also play important 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 approaches were widely used in order to identify and detect various contents in plant leaves. The aim of this paper is to help farmers in predicting

the exact value of nitrogen and chlorophyll content of leaves using support vector machine classifier so as to increase the efficiency and prediction accuracy in comparison with the other approaches.

II. LITERATURE REVIEW

The purpose of this study [1] is to estimate N of paddy (Oryzasativa, sp.) build on leaf reflectance using Artificial NeuralNetwork (ANN). In this study, 45 leaf samples were randomlyselected under various environmental conditions. Leafreflectance was measured by handheld spectroradiometerwhile actual leaf N content was determined by Kjeldahlmethod. Spectral reflectance data in visible band (400□700 nmwavelength region) and actual N content were used as inputand target data in ANN model building. K-fold cross validation(k=3) method was applied to select the best modeland measure the overall accomplishment of model. Resultsindicated that ANN model with 17 neurons of hidden layer inrelatively could estimate N properly. It was shown by thelowest root mean square error (RMSE) of 0.23 and the highestexactitude of 93%. This study promises to helpfarmers predicting N content of paddy for optimal N fertilizerapplication.

John William ORILLO's this paper[2] presents a program which identifies the 4-panel LCC equivalent of rice plants using image processing techniques and pattern recognition of the Back propagation neural network. Images of the healthy leaves were captured by digital camera and processed through RGB acquisition, colour transformation, image enhancement, image segmentation and feature extraction procedures. The extricated features were computed using basic statistical methods, then served as the input to the neural network for LCC panel identification. Thirty (30) samples of IRR 82372H – Mestiso 26 variety were tested; divided into three sets with 10 leaf samples per field. The system was observed to provide an accuracy of 93.33%

Mr. Delgado Virden Surfactant [3] in this Contracted work, they had estimated the nitrogen content and calculating the nitrogen deficiency in pomegranate leaves. They collect different Nitrogen deficient leaves. They 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. To avoid this, various fertilizers are available in market which proportionates the quantity of these components. 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.

Leaf colour is usually used as a guide for computation of nutrient status and plant health. This paper propose a new inexpensive [4], hand-held and easy-to-use technique for the detection of chlorophyll content and foliar nitrogen content in plants build on leaf colour. This method provides a rapid analysis and data storage at minimal cost and does not require any technical or laboratory skills. Most of the existing methods that examined relationships between chlorophyll status and leaf colour were developed for particular species. These methods acquire leaf images using digital cameras, which can be sensitive to lighting conditions (colour, angle, flux density) and hence, require proper calibration. Our method analyses leaf colour images obtained from a digital scanner that requires minimal calibration compared as it has its one light source and the angle and distance between light and leaf are constant. Our new algorithm produced superior correlations with the true value of foliar chlorophyll content measured in the laboratory compared with existing non-destructive methods when applied to three different species (lettuce, broccoli and tomato).

III. METHODOLOGY

The processing scheme consists of image acquisition through digital camera or scanner or mobile phone. Image processing includes image enhancement, filtering of image to remove noise etc .image segmentation, feature extraction and comparison through SVM classifier.

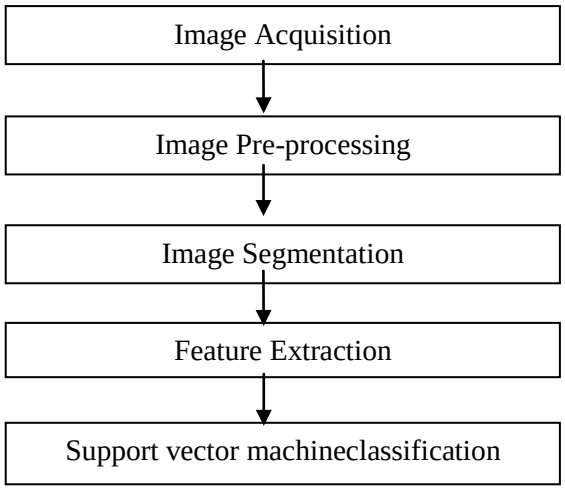

Image Acquisition:-

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Image Preprocessing:-

Second step is to improve the database of images that suppress undesired distortion. Enhance image feature is important for further processing and analysis task .It includes colour space conversion, image enhancement for

contrast improvement, image resizing, filtering to remove noise etc.

Image Segmentation:-

Segmentation means partitioning of images into various part or region and extracting meaningful region known as region of interest (ROI).The level to which subdivision is carried depends on the problem being solved .Segmentation can be stopped when the region of interest in an application have beenseparated. Segmentation exactitude determines success or failure of computerized analysisoperation. So algorithm picked for segmentation should perform best for given requirement.

Feature Extraction:-

Feature extraction plays important role for identification of object .After segmentation the area of interest Image feature includes colour texture. Texture means how the colour is distributed in the image ,roughness, hardness of the image .There are various methods for feature extraction such as colour co-occurrence method, leaf colour extraction using H and B components ,gray level co-occurrence matrix ,Gabor filter ,wavelet transform etc.

SVM Classification.

The support vector machine (SVM) is a type of classifier that is originally a binary classification method developed by Vapnik and colleagues at Bell laboratories. The main advantages of the SVM are that it can obtain current optimal solution under finite samples; it can obtain the global optimal solution without falling into local optimums that normal algorithms have; it transforms nonlinear problems into linear problems in a higher dimension space, and the algorithm complexity is irrigated with space dimension.

SVM is one of the most useful learning algorithms that are considered as the alternative to the neural network approach. This algorithmic approach is built on distinctive characteristics analysis by analyzing the expected error minimization. This approach considered the empirical risk to improve the training procedure. The risk estimation is here build on the structural analysis so that the generalization error will be reduced. The error margin is analyzed under class deviation and build on its nearest training patterns are obtained. SVM is proficient to analyzing the separating planes and to identify the largest margin so that the support to the data points will be identified. This model is also build on the polynomial kernel representation so that the clever learning to the elements will be done and more exactitude will be obtained.

IV. CONCLUSION

Chlorophyll and Nitrogen are important components, which are present in plant leaf. Deficiency of these two may cause lower or unhealthy productions. To avoid this, various fertilizers are available in market which proportionates the quantity of these components. These fertilizers are applied to plants. However, sometimes application of fertilizer would not be proper. Means, there may be higher or lower quantity of fertilizer applied by farmers. Most of farmers, apply fertilizer on the basis of predetermined date of seeding. Measuring the quantity of actual content of Chlorophyll and Nitrogen would be useful in this case. If we measure the content and apply fertilizer according to actual need of the plant; then it will be beneficial to crop as well as to farmer. Since the correct and timely estimation of Nitrogen and Chlorophyll is very important, for this we need to search for fast, automatic, less expensive and accurate method to estimate these nutrients.The development of smart phones, specifically their cameras, and imaging technologies has enabled their use as sensors/measurement tools. Here we aimed to evaluate the applicability of a fast and noninvasive method for the estimation of total chlorophyll and nitrogen contentof plants using a smart phone camera.The review of literature says about how to estimate nitrogen content in plant leaf. The estimation of nitrogen content in leaf is done based on colour and texture features .The review outlines several methods for estimation of nitrogen content in the leaf. The estimation methods are costlier and time consuming. The image processing methods reviewed is this paper gives a cost effective and speedier approach for estimating nitrogen content in leaves.

Further work can be carried out as the extension of the outlined work in the paper. Leaf image can be capture under Different lighting condition and their effect can be analyzed. Also, other features of the leaf images can be explored and evaluated for their improved representation of nitrogen content in leaves.

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