International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 03 Issue: 10 | Oct -2019 ISSN: 2590-1892

Nutrient Content Estimation In Agriculture Automation : A Review

Chetana Dadasaheb Balip, .Ankita Aglave , Ankita Shitole , komal madilwar

Guide – Keshav Bhagwat (Professor)

Abstract:

Agriculture is the source of development and as the increasing population needs morestorage of food stuffs, there is need of precision farming and this needs non- destructivemethods for more evaluations in agricultural farming automation.Our existing system estimates the nutrient content in crop leaf using a color constancy method using neural networks fusion to normalize images captured under sunlight with a variation of light intensities. A 24-patch Macbeth color checker is utilized as the reference to normalize the images.An Otsu algorithm is used to calculate the threshold value. To reduce the different appearance of image acquired from the same field and same treatment the images are normalized prior to subsequent image processing steps. These steps involve the following methodologies as image acquisition, image processing, contrast enhancement, image segmentation and feature extraction. All the non-destructive methods are used to estimate the nitrogen to get the nutrients via processing image.

Keywords:MLP (Multilayer Perceptron), BP (back propagation), SPAD.

Introduction

Nutrient content Estimation in automated agriculture is a proposition of low-cost and accuratenondestructive image-based technique used to estimate nitrogen amount in crops on field with varioussunlight intensities using a conventional digital camera. The methodology used for estimation of the nitrogen is image processing. Image processing is method to perform operation on an image, in order to get an enhanced image or to extract some useful information from it.Imageprocessing involves Image Normalization, ImageSegmentation, Otsu Algorithm and Feature Extraction. Image Normalization is a process that changes the range of pixel intensity values it normalizes the image containing the intensity of light on it under various sunlight intensities like the low sunlight intensities, medium sunlight intensities or high sunlight intensities .Also the shadow of the leaves on another leaf or of a person or a thing may changes the original image so to obtain the original image normalization is used. Image segmentation is a technique used in digital image processing and analysis to partition an image into multiple parts or a region. Otsu is used to perform automatic image thresholding.In the simplest form the algorithm returns a single intensity threshold that separates pixels into twoclasses, foreground and background. Firstly it requires the image in gray form and changes the values accordingly and assigns the maximum value to the pixel.Feature Extraction it extracts the wanted part of the images and hides all unwanted part of the image and also removes the noise and glitter.Through all this process the image is processed for the calculation of the

nitrogen content to get the nutrient content in the leaves. This is a non-destructive method and is very much necessary for precision farming.

I. Literature survey

• Di Wu, Wai Lok Woo [1] proposed the development of DSELM fusion and GA to normalize plant images and to reduce color variability due to a variation of sunlight intensities. Also appliesDSELM in image segmentation and Macbeth color checker to differentiate wheat leaves fromcomplex background. 4 moments of color distribution are utilized as predictors in the nutrientestimation. The results have shown superiority of the proposed method in the term of quality andprocessing speed in all steps [1].

•P. Auearunyawat, T. Kasetkaem, A. Wongmaneeroj,[2] A. Nishihara, and R. Keinprasit, "An automatic nitrogen estimation method in sugarcane leaves using image processing techniques," in Proc. Int. Conf. Agriculture. Environ. Biol. Sci. (ICAEBS), 2012, pp.

•M. Pagola et al.[3], "New method to assess barley nitrogen nutrition status based on image color analysis: Comparison with SPAD-502,SPAD meter device is one of the most costly devices used for detection of nutrients so the image processing methods are used and cost less as compare to the SPAD device.

•H. Min, C. H. Jin, and Y. Sang-Hee, "A neural network approach to color constancy [4] .This method is used to represent the image in different forms so to obtain the desired +results through color consistency in image.

• Zhan Yane[5] Study on vision-based crop growth diagnostic mechanism and method in greenhouse.This is a non-destructive method and is very much necessary for precision farming.

• Gao Huang, Shiji Song, Jatinder N. D. Gupta, and Cheng Wu[6] proposed the terms Clustering, embedding, extreme learning machine (ELM), and manifold regularization, semi-supervised learning, unsupervised learning.

• W. L. Woo[7] proposed Independent component analysis (ICA), neural networks, nonlinear distortion, nonlinear systems, signal reconstruction, Computational Intelligent Color Normalization for Wheat Plant Images to Support Precision Farming .The results of this shows the accuracy while performing the processing.

•Cao Shengxian, Du Bangkui, Sun Jiawei, Liu Fan, Yang Shanrang, Xu Zhiming Automation Engineering College Northeast Dianli University Jilin City Jilin Province, Nostate 132012, China proposed A Color Constancy Algorithm Based on Neural Network and Application. The paper contains the neural network and image processing techniques.

•Er. Nirpjeet Kaur, proposed various methods for finding thresholding by the Otsu Image Segmentation Algorithm. Histogramretains bimodal distribution and is inferred to utilize a deep and sharp valley linking two peaks.

•L. Dongju and Y. Jian,"Otsu method and k-means" proposed Otsu method forImage Segmentation Algorithm .The methods involve histogram representation of the image and elimination of unwanted noise in the image.

•Y. T. Kim, [12]"Contrast Enhancement Using Brightness Preserving Bi-Histogram Equalization and waveform enhancement.

•S. B. Sulistyoproposed computational intelligent image processing, neural networks, committee machines, adaptive learning, color normalization, agriculture engineering.

II.System Architecture

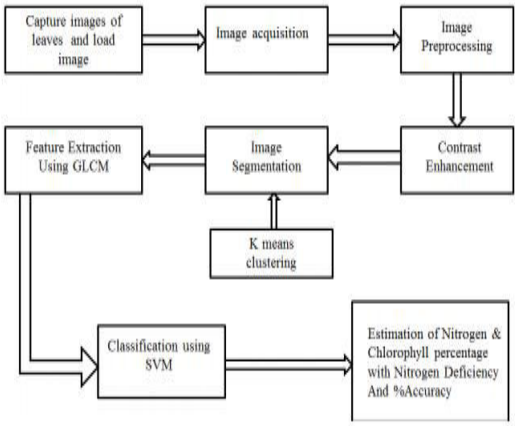

Fig. System Architecture [ ]

There are many technologies available in market which can be used to help farmer for improving crop quality and quantity. But the main constraint on current system is those available technologies not in reach of farmer. Forexample, it is not possible for every farmer to buy the nutrient detection machines as they are very costly so,To make all the technologies available for farmer, one has come up with “Nutrient content estimation in agriculture automation”[1].

The very first thing that we need to do is capture the images of crop leaves on field as this captured image needs to be processed .The image captured can be a digital image a video or a normal image captured on the phone camera, But the preferred input is the captured image which can be digital or normal camera image.

(A).Image Acquisition:

a.The video processing acquisition [9]is one of the technique used by the digital camera with focus of 14mm then converting this video series of images in order to obtain the principle of image processing.

b.This process is easy to use and now a days in the world of technology the phone cameras have adapted the features of digital cameras. In image processing, it is defined as an action of retrieving an image from source, usually a hardware based processing .The image acquisition is the first most step of the workflow sequence because, without an image, noprocessing ispossible. The image acquired is completely unprocessed [1].

(B) Image Preprocessing:-

a.Image preprocessing:[2] 20*20 pixels images are obtained from five images sampling, all of the images are processed by noise-excluded and filtering, and then the pixel values (RGB) are abstracted.

Design of BP neural network: based on Kolmogorov theorem, a three-layer BP neural network (NN) could achieve any mapping from Dim n to Dim m, so the single hidden-layer neural network could meet the requirements of accuracy as long as the number of hidden neurons is reasonable. If the number of the hidden layer be changed from 1 to 2, it has a little influence on the accuracy, that not only the structure of the neural network become more complicated but also the training time is lengthened obviously. A three-layer BP neural network including simple hidden layer is adopted in this paper,in consideration of a large scale of

data processing and real-time on-line calculation. The “tansig”[1] sigmoid transfer function is used in the hidden layer and the output layer.

r = R/(R+B+G)

g =G/(R+B+G)

b =1-r-g

b.The method used for image preprocessing [2]as the method has more accuracy .This is the second step to improve the database of images that suppress undesired distortion. Enhance image feature isimportant for further processing and analysis task .It includes color space conversion, image enhancement for contrastimprovement, image resizing, filtering to remove noise etc.

Steps Used here are:

• Color space transformation: That is RGB image is transferred in to gray scale image using formulae

• Where R, G, B correspond to the color of the pixel, respectively.

Gray = 0.2989 ∗ R + 0.5870 ∗ G + 0.1140 ∗ B (7)

Image Resizing: In this work, all images must be with the same size and equal dimension. So, the gray imageshould be resized to equal dimensions.

c. Otsu method[1]is easy to perform it gives automatic image thresholding .In the simplest form algorithm returns a single intensity threshold that separate pixels into two classes, foreground and background.

d. Otsu and K-Means Method L. Dongju and Y. Jian [11] reviewed that the key role of Otsu method is similar to that of K means method in multilevel thresholding. Both are based on the criteria of minimizing the within-class variance. Furthermore, the Otsu method deploys global thresholding while the K –Means employs local thresholding. The Otsu method requires a gray level histogram which is not true for K means. Both methods yield better segmentation results yet K -means imparts more satisfactory results rather than Otsu. Otsu method consumes more time and hence is more complex.

(C) Contrast Enhancement:-

a. The Image enhancement process involves noise reduction and contrast adjustment.[12]Thevalue color plane had its intensity adjusted so that the darker parts of the image goes Darker to aid the imagesegmentation process .The method is easy to use and has more accuracy.

b. Contrast enhancement[12]techniques are mainly classified into two groups: context-sensitive (point-wise operators) and context-free (point operators). In context-sensitive approach the contrast is defined in terms of the rate of change in intensity between $_z$by directly altering the local waveform on a pixel by pixel basis.

c.Our proposed method of neural networks fusion and genetic algorithm for image normalization is described below. First, the image of the Macbeth color checker is captured under sunlight using the digital camera and subject to variations in light intensity.

Fig: Macbeth color checker[12].

The number of hidden layer [12] nodes in each network is determined by applying the formula below:

$$\text{nh} = \left(\frac{n1+n0}{2}\right) + \sqrt{np} \qquad (1)$$

Whereni, nh and no are the number of input, hidden and output layer nodes, respectively, and np is the number of input patterns in the training set (number of training samples).

The final output RGB values from the networks fusion is obtained as follows:

$$Z = \alpha . O[1,2,3,\cdots,24][01,02,03,\cdots,024]T \qquad (2)$$

Where α the weight matrix of each network output, O is is the output matrix of each neural network and Z is the final output.

(D) 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 been separated using[1] Segmentation.

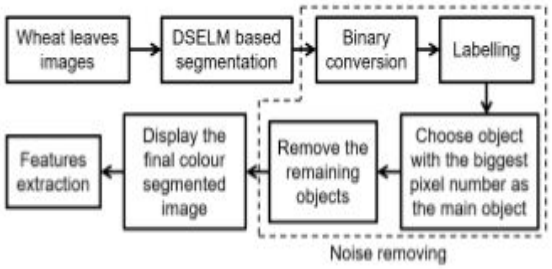

Fig: ImageSegmentation [1].

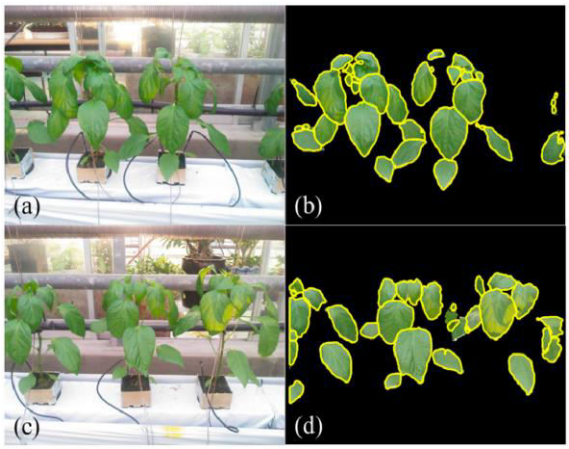

Fig: Segmented parts.

Extraction determines success or failure of computerized analysis operation. So algorithm picked for segmentationshould perform best for given requirement. The segmentation can be done using various methods like Otsu' method[11], converting RGB image into HIS model etc.

(E) Feature Extraction:-

Feature extraction[1] plays important role for identification of object .After segmentation the area of interestImage feature includes color texture. Texture means how the color is distributed in the image, roughness, hardness ofthe image.

Representation of a document image by statistical distribution of points takes care of style variations to some extent. Although this type of representation does not allow the reconstruction of the original image, it is used for reducing the dimension of the feature set providing high speed and low complexity. The major statistical features mentioned below:

The statistical features [1] can be extracted by using the formula:

Mean= $y = \frac{1}{n}\sum_{i=1}^{n} yi$(3)

Variance=$\sigma 2 = \frac{1}{n}\sum_{i=1}^{n}(yi - y)\text{^}2$(4)

Skewness=skew=$\frac{\frac{1}{n}\sum_{i=1}^{n}(yi-y)\text{^}3}{\sigma 3}$(5)

Kurtosis= Kurt =$\frac{\frac{1}{n}\sum_{i=1}^{n}(yi-y)\text{^}4}{\sigma 4}$(6)

Here y refers to each color channel RGB [2] (red, green and blue) n is the number of pixels, andσ is the standard deviation.

(E) Estimation of Nitrogen:-

An MLP (Multilayer Perceptron) with back propagation error is used to determine the nitrogen amount in wheat leaves. The developed neural network consists of 12 nodes of input layer which corresponds to the statistical color features and one node of output layer that corresponds to the percentage related to the nitrogen amount. In this step, the number of hidden layer nodes is also determined by using Eq. (6).From the hidden outputs [12] and statistical features [1]actual nitrogen contents are extracted from leaves of the plants.

III Conclusion

Thus a low cost, simple, nondestructive method is used to get accurate nitrogen estimation of wheat leaves. The proposed method focuses on color constancy which is subjected to variation in images, besides this elimination of background and foreground by Otsu algorithm to get the threshold values in the image and neural network for image segmentation and output matrix for nitrogen content estimation. The developed neural network based image segmentation can remove unnecessary components of plant images and retain the leaves as the region of interest. Four statistical features mean ,kurtosis ,variance and skewness can be used to estimate nitrogen content in wheat leaves more accurately than by using simple averaged neural networks, as well as the SPAD meter and greenness index based methods.

IV References

[1]Di Wu received the B.S. degree from the Minzu University of China, Beijing, China, and the M.Sc. degree in communications and signal processing from Newcastle University, Newcastle upon Tyne, U.K., in 2010 and 2012, respectively, where he is currently pursuing the Ph.D. degree.

[2] P. Auearunyawat, T. Kasetkaem, A. Wongmaneeroj, A. Nishihara, and R. Keinprasit, “An automatic nitrogen estimation method in sugarcane leaves using image processing techniques,” in Proc. Int. Conf. Agriculture. Environ. Biol. Sci. (ICAEBS), 2012, pp. 39–42.

[3] M. Pagola et al., “New method to assess barley nitrogen nutrition status based on image color analysis: Comparison with SPAD-502,”

Comput. Electron. Agricult. vol. 65, no. 2, pp. 213–218, 2009.

[4]H. Min, C. H. Jin, and Y. Sang-Hee, “A neural network approach to color constancy,” in Proc. 11th Int. Conf. Control, Autom. Syst. (ICCAS), Oct. 2011, pp. 1678–1681.

[5] Zhan Yane,Y. Xu, X. Wang, H. Sun, H. Wang, “Study of monitoring maize leaf nutrition based on image processing and spectral analysis,” in Proc. IEEE World Autom. Congr. (WAC), Sep. 2010, pp. 465–468.

[6] G. Huang, S. Song, J. N. D. Gupta, and C. Wu, “Semi-supervised and unsupervised extreme learning machines,” IEEE Trans. Cybern., vol. 44, no. 12, pp. 2405–2417, Dec. 2014.

[7]Wai Lok Woo (M’09–SM’11) “Neural network approach to blind signal separation of mono-nonlinearly mixed sources,” IEEE Trans. Circuits Syst. I, Reg. Papers, vol. 52, no. 6, pp. 1236–1247, Jun. 2005.Ph.D.

[8]W. L. Woo and S. Sali, “General multilayer perceptron demixer scheme for nonlinear blind signal separation,” Proc. Inst. Elect. Eng.—Vision, Image Signal Process. vol. 149, no. 5, pp. 253–262, 2002.

[9]Cao Shengxian, Du Bangkui, Sun Jiawei, Liu Fan, Yang Shanrang, Xu Zhiming Automation Engineering College Northeast Dianli University Jilin City Jilin Province, Nostate 132012, China.

[10]Er. Nirpjeet Kaur and Er Rajpreeet Kaur, “various methods of Image Thresholding”, IJCSE-2011.

[12]L. Dongju and Y. Jian, “Otsu method and k-means”, 2009, Ninth International Conference, vol. 1, 2009, pp. 344–349.

[11]Y. T. Kim, "Contrast Enhancement Using Brightness Preserving Bi-Histogram Equalization," IEEE Transactions on Consumer Electronics, 43(1), pp.1-8, 1997.

[12]S. B. Sulistyo, W. L. Woo, and S. S. Dlay, “Regularized neural networks fusion and genetic algorithm based on-field nitrogen status estimation of wheat plants,” IEEE Trans. Ind. Informat., vol. 13, no. 1, pp. 103–114, Feb. 2016.