Chapter 2

**PRELIMINARIES**

**2.1 Notation and Equations**

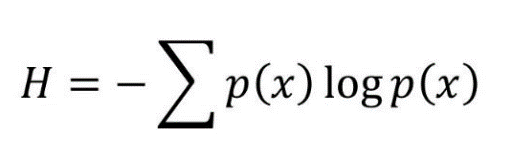
**Color NET (Online Mode)** - Our CNN architecture consists 2 base networks and 8 layers for each base network with total 16 layers. The first two layers of our CNN architecture is a convlutional layer and it does convolution process following by normalization and pooling. Convolutional layer is a layer that do convolution process that same as convolution process in image processing algorithm. For Ii is an input image and h is a some convolution kernel, output image for convolution process Io can be written as [3]



with [m, n] is pixel value at coordinate (m, n). Training process of CNN will learn h, may called as kernel, as parameters of convolutional layer. The choice of activation function in convolutional layer have huge impact for the networks. There a several choice of activation function including tanh and ReLU (Rectified Linear Unit). In our CNN networks we use ReLU activation function for all layers including the fully-connected layers. The normalization process done by following equation 2 with α = 10−4 , β = 0.75, and n = 5. [3]



**Decision tree classifier (Offline Mode)** - Entropy is degree of randomness of elements or in other words it is measure of impurity. Mathematically, it can be calculated with the help of probability of the items as [4]:



p(x) is probability of item x.

It is negative summation of probability times the log of probability of item x. [4]

**2.2 Solution of Current Problems**

* Automatic segmentation
* Automatic label detection
* Works on offline and online mode
* Paddy field monitoring
* Notifying farmer about fertilization
* No need of white paper
* Easy to use
* No need to carry LCC
* If farmer has eye problem smart phone will auto detect label

**2.3 Literature Review**

This chapter were providing the theoretical background which is related to the project development and make reference to existence of other systems

**2.3.1 Assessment of Color Levels in Leaf Color Chart Using Smartphone Camera with Relative Calibration**

Yuita Arum Sari, R V Hari Ginardi, Riyanarto Sarno, Leaf Color Chart (LCC) is used in agriculture modeling for monitoring the plant performance by comparing the leaf color and its corresponding color in LCC. To digitize the acquisition and interpretation of leaf color, smartphone camera is used. A color calibration is necessary for a smartphone before it can be used to capture and interpret leaf color. The calibration process evaluates the camera performance with the operational lighting conditions and determine whether the smartphone camera can be used for leaf color interpretation or not. The result from camera color calibration is used as a relative color chart for interpreting leaf color. In this paper, we propose a method of relative color calibration, which makes the system, learns colors chart automatically without depending on specific standard colors. KNearest-Neighbor (KNN) classification is used for color learning process in RGB color space. Our method is successfully tested with two smartphone devices in different lighting condition. The test shows an average accuracy above the threshold value of 83%. [5]

* Doesn’t uses segmentation
* Doesn’t uses real leaf
* Low accuracy

**2.3.2 Android Based Mobile Application to Estimate Nitrogen Content in Rice Crop**

Navdeep Kaur, Derminder Singh, The color of leaf corresponds to nitrogen deficiency status of that particular crop, farmers compares color of leaf with Leaf Color Chart (LCC) in order to estimate the need of nitrogen fertilizer of their crop. However the ability to compare leaf color with the LCC varies from person to person that affects the accuracy of final result. This paper proposes a mobile-device based application called "mlcc". Main idea is to simultaneously capture and process a 2-D color image of rice leaf, thus eliminating the expensive external components, reducing the human color perception and results in achieving high color accuracy. This android-based application can be correctly identified all the important 6 green color levels of rice leaf. [6]

* Segmentation needs a paper not automatic
* Doesn’t has any solve for different day light condition

**2.3.3 Automatic Leaf Color Level Determination for Need Based Fertilizer using Fuzzy Logic on Mobile Application**

Kestrilia R. Prilianti,Samuel P. Yuwono,Marcelinus A.S. Adhiwibawa,Monika N.P. Prihastyanti,Leenawaty Limantara,Tatas H.P. Brotosudarmo, Detecting plant nutrient deficiencies and evaluating fertilizer program are done by leaf tissue analysis. Unfortunately, this quantitative method is quite expensive and time consuming for traditional farmers due to its laboratory procedure. In this research, an automatic and nondestructive method based on digital image for soybean leaf color level determination was developed. Color level status is used to determine the fertilizer dose based on crops current need. The color level was adopted from 4-panel Leaf Color Chart (LCC) and a fuzzy logic model was applied to capture the leaf color gradation. Therefore, the leaf color status is not restricted only in 4 categories, but gradually change from light yellow up to dark green. Using this mechanism the N fertilizer dose will also gradually adjust. Hence, the N fertilizer could be used efficiently and in the same time prevent the environment from negative effects of fertilizer overuse. The method was embedded in a mobile application to facilitate real time field application. Hence, detection of soybean nutrient deficiencies and fertilizer program evaluation will need less time and low cost. From the field test, it was known that the mobile application could determine the soybean color level correctly. 100% accuracy in test condition. [7]

* Segmentation needs paper
* Day light change problem

**2.3.4 Nitrogen (N) Fertilizer Measuring Instrument On Maize-Based Plant Microcontroller**

Abstract—One of the growth factors of corn plant is fertilizer according to nitrogen fertilizer requirement. The identification of nitrogen fertilizer requirement in corn plant can be done by measuring the green leaf level using Color Leaf Manual, using TCS3200 color sensor combined with Arduino Uno Board microcontroller, and information. In this study a tool was created that could automatically measure the amount of fertilizer needed for corn per hectare. The results of the measurements displayed on the LCD 2x16 bits Micro made a measurement of fertilizer based on leaf color for corn plants. By taking the RGB value from the leaf that comes through the color sensor and then compared with the RGB value in the leaf color chart that has been saved in microcontroller will get the information of the fertilizer dosage needed. The level of truth of the measuring instrument of fertilizer can be categorized good enough with the level of accuracy reached 82%. [8]

* Needs external device
* Complex for farmer
* Daylight change problem

**2.3.5 Automated Color Prediction of Paddy Crop Leaf using Image Processing**

Amandeep Singh,Maninder Lal Singh, In India a majority of the population in rural areas is working in the agriculture field for their livelihood. They not only have to struggle for the better yield against the natural disasters but also have to tackle the losses of the net output because of land fertilization specifications and unskilled labor too. In the event of inadequate utilities and resources, in the face of unpredictable crises, their gain opportunities and livelihood are proportionally and adversely affected. However in this era of technology, the scenario may get changed as the Information and Communication and related fields of technology are providing a great for such type of crisis handling. Here in this paper, the method which may be used to compare the crop leaf color with the leaf color chart (LCC), has been proposed for getting a detail about the requirement of plant, before enough to get the yield affected. By making use of image processing technology a simple and robust method for the color prediction of paddy crop plant has been discussed along with the mathematical modeling which may provide a great platform to the advisory bodies in the agriculture field for the atomization of the crop health problems and solutions. [9]

* Needs white paper for segmentation
* Hard to implement on the smart phone
* Day light change problems