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Measurement Of Soil PH Value Using HSV Color Space Value Of Image

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Abstract: ***Image processing has received many research areas such as pattern recognition, medical applications and surveillance system. Image processing has gained popularity in the field of agriculture also. The major parameter that helps to determine the quality of soil is soil PH; hence measurement of this in agriculture applications is the major issue. The two types of extremes that describe chemicals are Acidic and Alkaline. Determining PH can tell us whether the soil is acidic or Alkaline in nature. If the soil is neither basic nor acidic then we can consider it as neutral. PH scale ranges from 0 to 14. The soil is considered as neutral if the PH is 7. If the range is less than 7 then it is considered as acidic and Soil is basic in nature if its PH is above 7. Thus soil PH range varies from 7.30-7.50, 6.80-7.04 and 5.58-6.58 in deep brown colour, light yellowish colour and greenish colour respectively. Similarly its respective PH index value will vary from 0.0070-0.0261, 0.0071-0.0451 and 0.0084-0.0239 are considered in this paper. In the proposed work we made use of K-means clustering to classify different clusters in an input image to select the clusters with only soil area.***

Keywords: PH, Acidic, Alkaline, neutral, K-means clustering.

I. INTRODUCTION

Soil is well-known as one of the most useful natural resource. Soils are regarded as the necessary part of the landscape and their characteristics are largely governed by the landforms on which they have developed. The pH in soils is a principal regarding part of the soil wellbeing. To measure the amount of acidity and basicity present in the soil knowing the PH level of the soil is very necessary. . If the soil is more acidic or alkaline in nature the plant growth is effected, similarly if the soil is too sweet or too sour plants cannot absorb nutrients like phosphorus, potassium and nitrogen. Hence if PH of the soil ranges from 6.0 to 7.5, all the nutrients needed by the plants are obtained. Soil color also differs based on the organic matter, iron oxidation state and amount of water present in it.

M.A. Abu et.al [04] proposed an efficient approach for designing and controlling control system for providing and maintaining agriculture soil PH value based on the particular type of plant. They made use of Fuzzy based expert system with GUI in matlab domain. This system could recognise changes in humidity, temperature and lightning in the plant area to determine parameters like light intensity. GUI is designed in such a way that it gives real values for all these parameters and changed soil PH with respect to this.

Vinay Kumar et.al [05] proposed an efficient method for soil PH calculation. Fifty soil samples were taken and using digital image processing technique soil PH is calculated. For capturing the different PH value in soil Digital valued of R, G and B planes of RGB color space is used. TNT is used for transforming multispectral images. Initially PH index calculation is done then these values are correlated with the PH value ranges to get the exact PH value of the soil. B.Y. Loh et.al [10] proposed a robust classification algorithm for soil PH calculation. This technique Performs automatic identification of the PH values on a test strip.

The implementation of this algorithm is done on the camera phone that captures different color image of PH test trip for medical or health care purpose. The previously installed

and program which are platform independent in the camera cell phone takes the images captured and informs the visually challenged users of the PH level of the strip. The proposed methodology gives an efficient method for soil PH calculation. We made use of K- means clustering [06] for ignoring the clusters other than soil related clusters during PH calculation. The indexing is calculated by converting the selected cluster into HSV plain and finds the PH of the particular soil with respect to the calculated index value. The proposed system reduces the burden of collecting soil samples and saves more physical resources. The detailed explanation for the proposed work is given in the paper below.

II. METHODOLOGY

Proposed methodology is as shown in the Figure 1. Digital remote sensing images are taken as the input for the proposed system. The input RGB image is passed to pre-processing block. In the pre-processing block different steps like image resizing and noise removal is done. For Image de-noising we made use of decision based median filter. The noise free image is passed to K-means clustering block [07], [09]. Here the image is divided into different clusters. Input image may consist of soil and non-soil regions. Non-soil region many include stones, leave, etc. Therefore, clustering (Segmentation) technique is applied to extract soil region. The obtained segment with soil information is then passed to HSV Color space conversion block to convert from RGB to HSV. The H, S and V planes are then used for calculating PH index value. Respective PH value is then calculated based on the index value obtained.

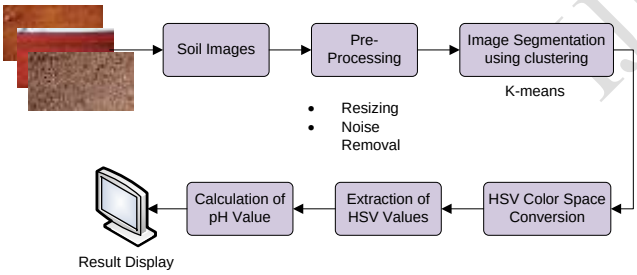


Figure 1: Proposed System Architecture

A. PRE-PROCESSING

Remodelling the input image into a new image for further computation is the necessary step in the image processing domain. The output obtained after this stage will be the improved one when compared to the input image. In the proposed work different pre-processing steps like image resizing and filtering is done. Resizing involves resizing the image into a fixed size. Filtering involves applying a noise removing filter to get a noise free image. Decision based median Filter is used as the noise removing filter [02], [03], [08]. Where it every time checks whether the pixel is corrupted or not. The filtering operation is done only if the pixel is corrupted, if not the pixel is kept unaltered. Output of this is then passed to K means clustering block.

B. K-MEANS CLUSTERING

One of the simplest unsupervised classification methods is K-means clustering. This clustering approach makes use of iterative process to divide the input into different clusters, Such that the sum of its distances between the corresponding cluster centroid and the data is minimised. This obtained distance can be considered for similarity measurement. Depending on the information number of distance measures can be used. Few examples for distance measures are Mahalanobis distance and Euclidian distance. In the proposed work we made use of Euclidean distance. The mathematical representation for given set of data is given by $\{X_1, X_2 \ldots\ldots X_n\}$ where n denotes the no of points. During the process the K-means clustering algorithm performs data grouping into k-means clustering. Euclidian distance is formulated as given below,

$$d = \left(\sum_{j=1}^{k} \sum_{i=C_i} (x_i - Z_j)^2\right)^{\frac{1}{2}} \quad (1)$$

where C_j denotes the jth cluster and Z_j denotes the centroid of the cluster C_j and x_i represents the input pattern. Interactive property of this makes suitable partition during clustering. The methods involves randomly selecting k data points from the given input data and by distance calculation remaining data points are classified into the k clusters. The brief explanation for k-means clustering is given in the steps below,

- ✓ Initially K initial cluster centres $\{z_1, z_2 \ldots\ldots z_n\}$ are chosen randomly from the given data points $\{X_1, X_2 \ldots\ldots X_n\}$
- ✓ Assignment of point X_i to cluster C_j is done only if the condition in eq. 2 satisfies. Where i = 1, 2.... n and j ϵ {1, 2… K}

$$\|X_i - Z_j\| < \|X_i - Z_p\| \quad p = 1,2 \ldots\ldots K \text{ for } j \neq p \quad (2)$$

- ✓ Computation of new clusters z*1, z*2…… z*k is done using equation below,

$$Z_i^* = \frac{1}{n_i} \sum_{x_j \epsilon c_i} X_j \qquad i = 1,2 \ldots\ldots\ldots, K \quad (3)$$

Where n_i denotes the number of elements belonging to clusterc_i. The process terminates if $Z_i^* = Z_i$, where i =1, 2.....K. The process is continued from second step if this condition is not satisfied [01].

C. HSV COLOR CONVERSION AND PH MATCHING

The obtained clusters from the K-means are checked for soil or non soil cluster and manual selection of cluster with soil is done. Once the Soil cluster is obtained it is converted into HSV color plane. H, S and V plane from this is separated to find the PH index using the formula given below,

$$PHindex = \frac{\left(\frac{H}{S}\right)}{V} \quad (6)$$

Once the PH index is obtained it is compared with PH look up table to get the best matched PH to the given input soil image. This comparison may also give colour and acidic and basic nature of the soil.

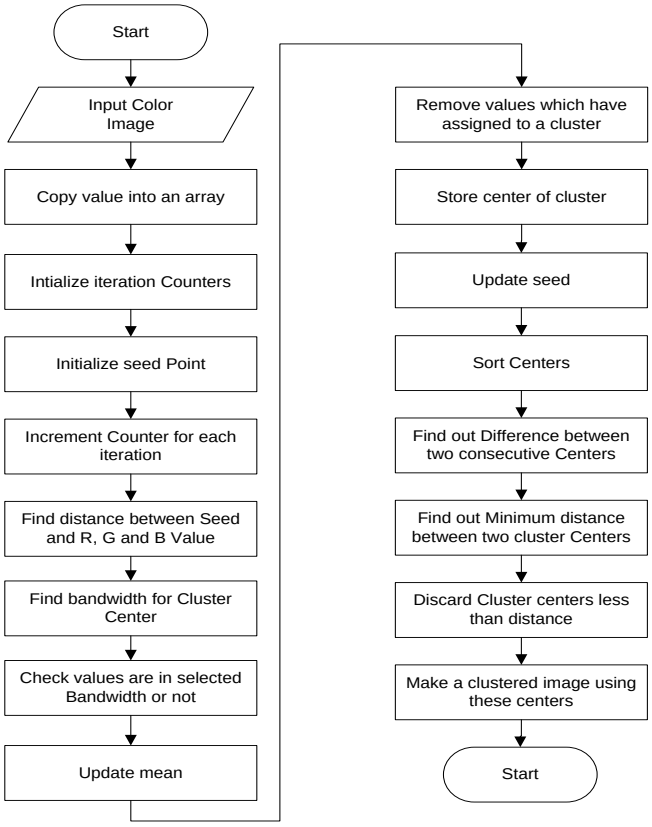
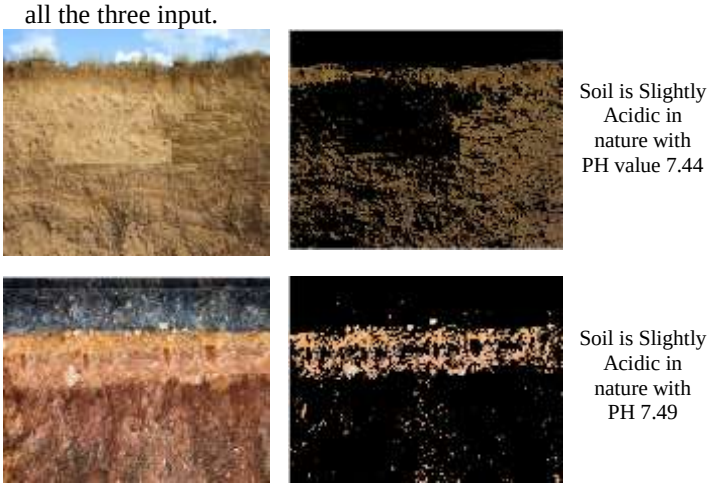
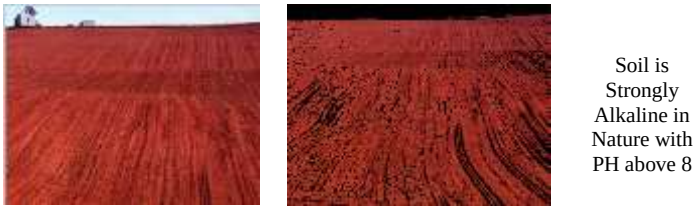


Figure 2: Flow Chart for K-means Algorithm

III. EXPECTED RESULT

The proposed system is evaluated on Remote sensing images with soil and other objects. The input image is taken and passed to pre-processing block to get the final filtered image as in Figure 3(a). This image is then passed to K-means clustering block to get the segment with soil information disregarding the information other than soil like sky, Buildings and rock parts as in (b). (c) Gives the Matched PH values for all the three input.





(a) (b) (c)

Figure 3: (a) Filtered Input Image; (b) Soil Cluster; (c) Obtained Matched Result

IV. CONCLUSION

An efficient system for soil PH calculation is proposed in this work. Here the digital images with soil and other information are taken as the input. With the help of K-means algorithm, segment with only soil information is picked. Using the HSV information of the soil image PH index is calculated and using which its respective PH and amount of acidic and basic nature is also calculated by comparing it with already given hardcore values. The proposed system could give good result when compared to the existing system.

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