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DETECTING NITROGEN STATUS USING KNN ALGORITHM AND SUGGEST GROUND BASED PLATFORM TO GROW CROPSUSING SVM ALGORITHM

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Abstract: Agriculture is an art of science, which helps in growth of plants by taking the inputs from soil, climatic parameters and external factors. Plant growth and yield measurements primarily depend on soil characteristics. Soil is a main supply of nutrients needed through plants for growth. The proposed system using the KNN algorithm measures the content of NPK values and predicts the crop to sow in the farm field using SVM algorithm. The prediction shows that around 85-90% of accuracy with the laboratory test models.
Keywords: Nutrients, Soil, KNN,k-means cluster, SVM.

I. INTRODUCTION

Agriculture is the science and artwork of cultivating plant life. Agriculture has changed into one of the key tendencies inside the upward push of sedentary human civilization. The history of agriculture records the domestication of plant life and animals. Agriculture started independently in many parts of the globe. The improvement of agriculture enabled the human populace to develop large, which can be sustained with the aid of searching and hunting.

Soil is the main supply of nutrients needed through plants for growth. Generally, 16 essential nutrients are available for the growth of the plant in soil, which are majorly grouped into three groups such as primary nutrients, secondary nutrients and micro nutrients. Primary elements are consists of six elements such as hydrogen, oxygen, carbon, nitrogen, potassium and phosphorus, here the hydrogen, oxygen and carbon elements are directly obtained by plants through photosynthesis. Remaining three primary nutrients like nitrogen (N), phosphorus (P) and potassium (K) plays a major role in the development of the plants [1]. Together they make up the trio called NPK. Other crucial nutrients are calcium, magnesium, and sulfur. Plants additionally need small portions of iron, manganese, zinc, copper, boron, and molybdenum, referred to as hint elements, due to the fact simplest strains are needed by way of the plant.

Soil fitness is described via the capability to perform critical surroundings features along with nutrient cycling, water filtration, and habitat provision for plants and animals. Properties that decide soil fitness consists of texture, depth, density, water infiltration, preserving capacity, the quantity of natural remember, nutrient maintaining ability (CEC) and respiratory [2]. Growing situations range amongst plants. All plant life requires air, water, nutrients, light, temperature, and growing space however the specifics can vary considerably. Some flowers flourish within the wilderness, others require a tropical place, a few plants can tolerate negative wintry weather climate whilst others will perish if the temperature drops below a certain degree.

Nitrogen is one of the vital nutrients because it is a major component of chlorophyll; the compound via which plants use sunlight energy to produce sugars from water and carbon dioxide (i.e., photosynthesis). It is also a major component of amino acids, the building blocks of proteins. Most of the nitrogen in the soil exists in the form of organic matter of some kind. When the organic matter breaks down (mineralization) the nitrogen finally ends up as ammonium (NH4+) that may become ammonia gas below alkaline conditions (pH above 7) [3]. Ammonium is transformed into nitrate via micro-organisms (nitrification) under alkaline situations (enough air within the soil). Under anaerobic situations, nitrate can be changed to ammonia gas or nitrogen gas, both of which can escape into the ecosystem.

Excess nitrogen fuels speedy foliage growth, therefore, a lawn has a look of a jungle long past wild; however other plant growth also suffers the outcome. Energy for flower increases and is redirected to foliage proliferation, so plants might not even produce their essential reproductive organs in the course of the growing season. If a high-nitrogen fertilizer combination is used, the soil's mineral salts are improved; immoderate elemental nitrogen takes water far away from the plant even as leaving the salts behind. As a result, the leaves tackle a burnt look from dehydration. Leaf edges turn out to be yellow or brown and wilt. Flushing the place with water to take away the excess nitrogen is an excellent route of movement to restore the plant. Although the nitrogen produces desired massive foliage, it is observed that the rapid boom turns into decimation with leaf burn if nitrogen remains at high levels.

Dark black or brown color of soil suggests the soil has high organic matter. Minerals present within the soil also can affect the bloom of the plant. There are various shades in image processing which are primarily based on color components and color recognition. The property of soil shade is a visual perceptual property that facilitates to separate soil. Soil may be separated primarily based on coloration and texture [4]. The color and texture are particularly used to determine the soil nutrients using image processing. Hence, it may be decided that the nutrient of soil using color image processing. If the digital webcam gets the mild in terms of RGB bands. RGB are the primary colors that can be organized in RGB. It denotes the wavelength of electromagnetic radiations in a spectrum band. Using this,

RGB values decide the nutrient of soil.

II. LITERATURE SURVEY

Yao Zhang et al., [5] worked on estimating total nitrogen using real time NIR spectroscopy. The interference of soil moisture was mostly removed from soil real-time spectrum in the process of soil total nitrogen prediction, and the TN (total nitrogen) content regression models installed by using the six sensitive wavebands had great performances in predicting soil TN content in actual time. Nitrogen concentrations were measured with a Kjeltecazotometer. The air-dried soil powder has been mixed with other catalyst, then H2SO4 was put into the mixture and digestion was preceded at a high temperature. The original spectral data of top-layer soil, sub-layer soil and bottom-layer soil respectively of the sampling point is randomly selected and its moisture and total nitrogen content has been listed. Each of the soil spectrum is carefully tested for further spectral characteristic analysis. This process is compared and has been analyzed for the characteristics of the soil samples with same moisture but different nitrogen contents. For soil absorption spectral characteristics analysis, it is showed that with the change of moisture and nitrogen content, the whole spectrum curve shifted in the vertical direction, which illustrated that the change of soil moisture and nitrogen content could lead to a great variation among the soil absorbance in NIR area.

Muñoz-Huerta, R.F et al., [6] studied on current method and technique in estimating the nitrogen status. Nitrogen is the principle plant mineral nutrient needed for chlorophyll production and other plant cell components (proteins, nucleic acids, amino acids). Crop yield is laid low by plant N2 status. Thus, the optimization of nitrogen fertilization has come to be the object of extreme research due to its environmental and financial impact. Nitrogen can be determined by using Kjeldahl digestion and Dumas combustion has been used as reference methods for N2 determination in plants, but they are damaging and time-consuming. By the use of spectroradiometers, reflectometers, imagery from satellite sensors and digital cameras, optical properties have been measured to estimate N2 in plants, such as crop canopy reflectance, leaf transmittance, chlorophyll, and polyphenol fluorescence. An excessive correlation was found between optical parameters and plant N2 status, and these techniques are not negative. However, some drawbacks encompass chlorophyll saturation, atmospheric and soil interference, and the high cost of the devices. Electrical properties of plant tissue were used to evaluate the quality in fruits, water content in plants, as well as nutrient deficiency, which suggests that they have the potential for use in plant N2 determination.

L G Bundy and T W Andraski [7] evaluates the PPNT (pre-plantnitrate tests) and PSNT (preside dress soil nitrate tests) in different locations with a range of organic N inputs and soil yield potentials. The use of the PPNT or PSNT improved N recommendations for corn on high yield potential soils and reduced excessive N applications without yield loss by up to 67% (PPNT) and 56% (PSNT) compared with standard N recommendation methods. Separating soils according to yield potential often improve the predictive value of the PSNT and PPNT in the N responsive range. A response to added N at high soil nitrate test values could occur if part of the soil nitrate detected in the test procedure was lost before crop use. The results indicate that soil nitrate tests are more reliable on HYPS (high yield potential soil) than on, MYPS (medium yield potential soil), probably because of the lower potential for nitrate retention in the root zone on MYPS. This approach may also be useful elsewhere for improving the utility of soil nitrate tests where data from soils with varying yield potentials are included in the test calibration database.

Amrutha A et al., [8] worked on measuring the soil fertility, that the research aims at restoring the levels of Nitrogen, phosphorous, potassium in the soil by measuring the amount of nutrients present. The presence of nutrients is decided via chemical processes and quantified using sensors. An automated system has been developed for the controlled addition of fertilizers to avoid excess/ deficient fertilizers in the soil. The principle used for the identification of the NPK nutrients in the soil is 'colorimetry'. By this percept, as the concentration of the element or compound in a solution increases, its color intensity increases linearly. To estimate the amount of nutrients present from the colored solution a color sensor is used. Here, the estimation of nitrogen is based on the Griess Ilosvay reaction, in which Nitrate present in the soil is first reduced to Nitrite, using a suitable reducing agent such as zinc dust. Thus, the estimation of Nitrogen is based on the estimation of the intensity of the azo complex formed at the end of diazotization reaction.

S Vaishali et al., [9] worked on measuring the real time climatic parameters and soil parameters.The real time data has been accessed by the proprietor of the land which helps him monitor the present soil parameters and can thus prevent the harm whenever there is a severe variation in these parameters. The problem considered here is to analyze the soil parameters such as soil pH, temperature and moisture values using Raspberry Pi and to send an alert message. Raspberry Pi is intended to determine the parameters of soil using sensors and alert the owner of the land. Here, it is observed that the system is designed for a fully automated monitoring system. The system provides a real time system which monitors soil pH, temperature and soil moisture efficiently. Using this system, it may be seen the steps are taken in using water to improve production and ultimately increase profit.

Rushika Ghadge et al., [10] worked on checking the soil quality. It has been discussed that work proposes to assist farmers to check the soil quality depending on the analysis done based on the data mining approach. The system makes a specialty of checking the soil quality to predict the crop suitable for cultivation according to their soil type and maximize the crop yield with recommending appropriate fertilizer. The proposed system here is achieved using unsupervised and supervised learning algorithms, like Kohenon Self Organizing Map (Kohenon SOM) and BPN (Back Propagation Network). Datasets will then be trained

by learning networks. It compares the accuracy acquired by different network learning techniques and the most accurate result will be delivered to the end-user. The proposed system will check soil quality and predict the crop yield accordingly along with it provides fertilizer recommendation, if needed depending upon the quality of the soil. Location is used as an input to controller 1, along with the use of third-party applications like APIs for weather and temperature, type of soil, nutrient value of the soil in that region, amount of rainfall in the region, soil composition can be determined.

III. PROPOSED WORKS

The proposed system aims at measuring the nitrogen content level in the soil through digital image processing using KNN algorithm precisely and accurately. Then the SVM based algorithm is designed to predict the best crops for that farm field to get better yield production. The block diagram in figure 1 shows the proposed model for the system.

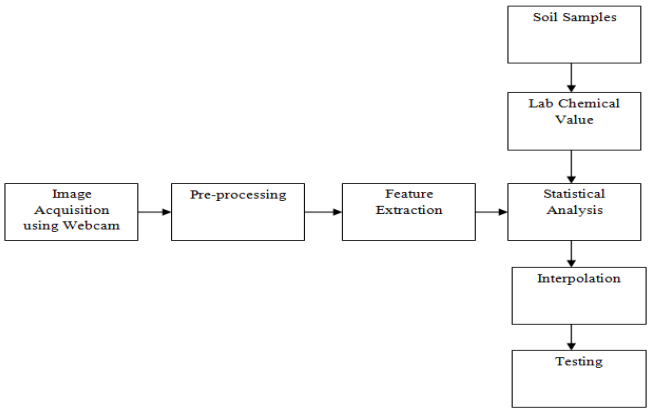

Figure 1: Block diagram for the proposed model

The samples of soil are collected and after processing the images, the nitrogen in soil is determined by using image processing techniques. Soil samples are analyzed for the present study and digital web camera having the high resolution is used for capturing images (JPEG format). This JPEG format of images is converted into the image file. With the obtained color image, we determine R, G, B value of soil sample, it is further changed into a grayscale image and is converted to binary values. By using the resultant image, the identification of the soil type is conducted. The amount of nitrogen present in the soil is tested with the steps as shown in figure1.From the above process, measured soil nitrogen value is correlated. Keeping the resultant values as a reference, the suitable crop for the soil is described. Further, the prediction of the crop yield is generated.

Process:

Image Acquisition: The image of soil samples is captured with the help of a web camera having high resolution and it is connected to Raspberry pi module.

Preprocessing: The preprocessing is nothing but the process of filtration. In the filtration process the blurred images and noise reduction is done. And various techniques like binarization and gray scaling is applied to the input image.

Feature Extraction:Feature extraction handles the most important role in the field of image processing. It is a method of capturing visual content of images for indexing & retrieval. Primitive or low-level image features can be; extraction of color, texture and shape.

Computing using Machine learning: The power of complex Image Processing techniques is to extract meaningful features from given image samples, while Machine Learning deals with pattern recognition and computational learning in AI system.The neural network takes one pixel of the image and applies a simple computation to generate a result. That result is fed to a network which generates a prediction of each pixel.

Experiments:

To obtain the nitrogen nutrient value of a respective soil, several images of the soil that needs to be tested are taken with a high-resolution camera. These images are considered to be the testing images that are used to obtain the data of the particular soil within a short amount of time.

1) A GUI page of the name “Detection of Nitrogen in Soil Using Image Processing” is created where the image required to extract soil data is uploaded from a respective folder. Further, when the choose image option is selected;the image is loaded to the environment. Once the soil image has been successfully uploaded**,**the original image is the processed into a grayscale, binary, contrastedimage; edge detection and HSV of the image are obtained for extraction of data from the image.
2) Since the information can obtain easily through a grayscale and a binary image, the original image is processed into grayscale image. The path of the image from its respective folder is stored in a bitmap format. Each pixel is read by the compiler to obtain specific details of the image by looping statements to get hexadecimal value and is converted into a complete grayscale, binarized image, contrasted image to highlight the image if the lightning condition is dull, edge Detection is made to classify top layer and bottom layer and later HSV image is obtained for water sheading. An array is created for each particular soil. which consists of a set of data regarding the trained images. The uploaded image is treated as test data and is compared concerningthe set of images that are considered as trained images.
3) KNN (K-nearest neighbors) algorithm is used to predict the values of new datapoints which further mean that the new data point will be assigned a value based on how closely it matches the points in the training set. KNN algorithm consists of two steps:

1. Test data set – Upload image of the soil.
2. Train data set – Trained Soil images.

A pixel value of the test image which is nearest to the data points of the trained image is to be chosen. This data point of the value K is considered to be centroid point. K value is compared with the trained data set using KNN methodology like Euclidean, Manhattan, where valuesare clustered based on the nearest distance. Here the nearest matches of soil to test data are obtained from trained data set in turn to predict the NPK value.

4) Furthermore, k-means clustering may be a method of vector quantization, originally from signal processing, that aims to partition n observations into k clusters during which each observation belongs to the cluster with the nearest mean (cluster centers or cluster centroid), serving as a prototype of the cluster. This leads to a partitioning of the info space into Voronoi cells. It is popular for cluster analysis in data processing. From the classification, the cluster colors are identified an arranged in the correct order by extracting the major colors. This create the opportunity to search for images based on certain colors. If the choosed image returns a hex value and if it's hex value count matches or is close to the hex of the hex values which is stored in an array as a predefined data sets, then we can say this belongs to the Alluvial soil, black soil or red soil and the crop suggestion is given for that particular type of the soil.
5) After the suitable data is obtained from the processed binary image, the webpage is programmed to notify the user about the type of soil image that has been processed. This alert message is passed on to user after thorough comparison of the test image along with the trained image. The final result obtained that is showed in the message box with soil Type and NPK value and the crop is suggested for that particular soil.

SVM algorithm:

"Support Vector Machine" (SVM) is a supervised machine learning algorithm that is used for both classification/regression problems. However, it is very commonly used in classification problems. In the SVM algorithm, we plot each data item to some extent in n-dimensional space (where n is the number of features present) with the value of every feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiates the classes, based on the nitrogen value from the Dataset. From this classification based on the NPK value we can suggest the crop, which is defined in predefined datasets.

Results:

The figure 2 and figure 3 is the output obtained from GUI. A message box is generated as to indicate the result i.e., thesoil class, Nitrogen level is displayed in message box and crop suggestion is displayed in output screen as shown in figure 3 which is obtained by processing the soil image. Here, by comparing the obtained results with the predefined dataset, the suitable crops that can be grown in the given soil are suggested.

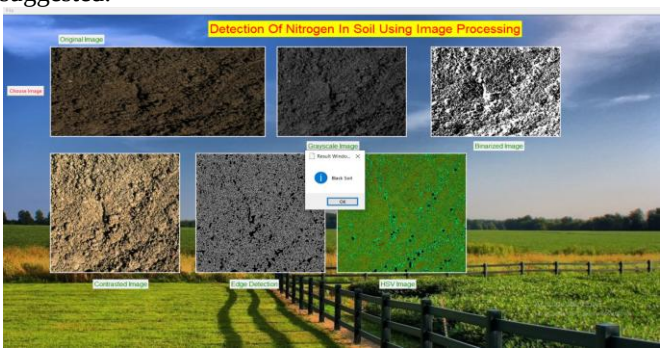

Figure 2: KNN algorithm based prediction of the soil.

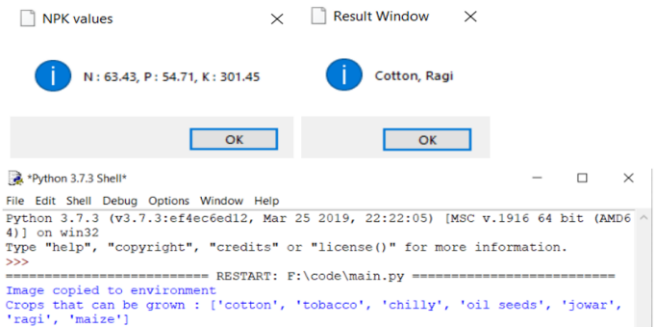

Figure 3: KNN algorithm based NPK values display and SVM algorithm based crop suggestion.

The same soil sample was tested in Government Soil Testing Laboratory to obtain the Nitrogen Level and other mineral content in the soil using chemical methods. And by comparing the results of both the methods, theimage processing based result was 85% accurate while considering chemical method based result as 100% accurate. Fig.2. shows the detailed result obtained for one type of soil sample and the Figure 3 is the result obtained for three types of soil.

IV. CONCLUSION

The research designs an image processing technique where the soil image is captured by a high resolution camera which is considered as testing images which are used to detect the soil Nitrogen. By using color image processing R, G, B values of the soil sample can be extracted. After collecting related details and values, it is converted to gray scale image and later to binary image. The tested image is compared with another set of images that are called trained images. By using KNN algorithm a new data's will be compared with the trained image, where the nearest data will be used to predict

the Nitrogen value. Final result will be displayed which will be consisting of a crop name and the crop that is predicted to grow in the tested soil and the total amount of nitrogen present in that particular soil. Based on the above applications and methods, it is proposed to characterize soil using imaging techniques.

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