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Soil pH Formulation by its Moisture using Digital Image Processing

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Abstract:
The project aims at developing a hardware module for monitoring the soil macronutrient content to achieve high yield in agricultural field. This can be done by analysing the spectral characteristics of soil image. The acquired image is processed to obtain the dielectric properties of soil. It is involved to find the basic properties of soil. It also revolves around to measure the pH value of the soil by retrieving the moisture content of it. To formulate the dyadic wavelet transform is being used. This is tested with different landscapes to estimate the pH of soil. The different landscapes which is being considered by adding small, medium and large amount of fertilizers in it. Then calculate the pH level of those landscapes soil which is being treated by fertilizers like potassium and urea. By estimating the pH value of the soil it is possible to avoid the circumstances of the barren agricultural field.

Keyword: Soil Macronutrients, soil pH, spectral characteristics.

1. INTRODUCTION

Soil plays an important role in the agricultural field for cultivating the crops. In recent survey it has been proved that 2/3 of the agricultural field has been devastated due to over consumption the fertilizers like potassium, Urea etc. Due to these reasons many productivity of lands being turned into barren land. To overcome this situation, the proposed method proceeds with formulating the pH of the soil there by which we can predict that whether the land has consumed little or large quantity of fertilizers. Soil is recognized as one of the most valuable natural resource whose soil pH property used to describe the degree of acidity or basicity which affect nutrient availability and ultimately plant growth. Fifty soil samples were collected and their pH was determined by using digital image processing technique. Soil colour is visual perceptual property corresponding in humans to the categories i.e red, green, blue and others. Soil colours are the parts of visual perceptual property where digital values of red, green and blue (RGB) provide a clue for spectral signature capture of different pH in soil. For the capturing images, digital camera was used. Colour consistency means that an image of an object should have the same colour regardless of the ambient lighting conditions. Factors affecting the colour of an object are; inhomogeneous illumination, colour temperature, and image noise. Any image can be transferred to common norms by correcting colour temperature and inhomogeneous illumination. Image noise, however it is random and cannot be corrected .In order to reduce the image noise level we prefer for an high end cameras and a powerful light source which suppress the image noise sufficiently and we also go with usage of low pass filter which also have the ability of reducing the image noise level. The process to estimate the pH of soil carried out by different modules which includes

i. Data acquisition
ii. Filtering process
iii. Wavelet transform
Iv. Texture Analysis

A high end camera has been used to capture the image of the soil here Logitech quick cam has been preferred to segment the RGB color band. Second module followed with Data acquisition, the physical parameters of the soil such as pressure, temperature, and moisture is being converted to binary form i.e digital form which is acceptable by computer. In filtering process the image noise have been removed here we are preferring for low pass filter. Third module is working of dyadic wavelet transform and reconstruction of dyadic wavelet transform which it brings out the projected image of the soil. Fourth module followed with the Texture analysis and which it produces the Local Binary Pattern image in RGB color band and histogram diagram is being obtained and by which calculating the average value of those histogram diagram we can able to calculate the pH value of the soil. The histogram diagram will be changing for different fertilizers and calculating those differences we can able to estimate pH value of the soil which is being treated with respective fertilizers.

2. SYSTEM DESCRIPTION

BLOCK DIAGRAM OF PROPOSED METHOD

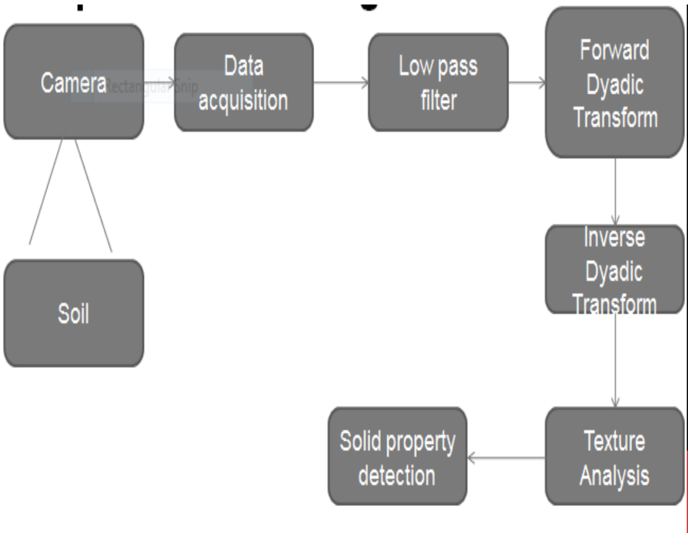

Figure.1. Block Diagram of Proposed Method

II.DATA ACQUISTION

Acquiring Image Data

The core of any image acquisition application is the data acquired from the input device. A *trigger* is the event that initiates the acquisition of image frames, a process called *logging*. A trigger event occurs when a certain condition is met. For some types of triggers, the condition can be the execution of a toolbox function. For other types of triggers, the condition can be a signal from an external source that is monitored by the image acquisition hardware. The following topics describe how to configure and use the various triggering options supported by the Image Acquisition Toolbox software and control other acquisition parameters.

- “Data Logging”
- “Setting the Values of Trigger Properties”
- “Specifying the Trigger Type”
- “Controlling Logging Parameters”
- “Waiting for an Acquisition to Finish”
- “Managing Memory Usage”
- “Logging Image Data to Disk”

TEXTURE ANALYSIS (Colour Representation)

The appearance of an object is basically resulted from the nature of the light reflected from the object, its optical characteristics, and the human perception. The colors are actually electromagnetic waves described by their wavelength. The visible spectrum, i.e., the portion of the electromagnetic spectrum that can be detected by the human eye, ranges from 390 nm (violet) to 750 nm (red). There are four main attributes that characterize the light: *intensity*, *radiance*, *luminance*, and *brightness*. In the case of achromatic light, the intensity is the only attribute involved. This is the case where the called *gray-scale* is used: intensity varies from black to white (gray levels in between). On the other hand, in the case of chromatic light, the other three attributes are used to measure the quality of the light source. The radiance refers to the amount of emitted energy by the light source, and it is measured in watts (W). The luminance measures the amount of radiation perceived by an observer, and it is measured in lumens (lm). The brightness is associated to the light intensity. Although the brightness has an accurate interpretation in monochromatic images, it is a very subjective property in the case of chromatic images. Because of the absorption characteristics of the human eye, the colors are con- side to be formed from different combinations of the *primary colors* red, green, and blue. These three colors can be added to create the *secondary colors* magenta (red + blue), cyan (green + blue), and yellow (green + red). The white color can be formed if the three primary colors are mixed or if a secondary color is mixed with its opposite primary color (all in the right intensities). In color image analysis three attributes are used to differentiate one color from another: *brightness*, *hue* and *saturation*. The hue attribute brings the information concerning the main wavelength in the color, i.e., it is responsible for verifying the color, in the complete spectrum, from red to violet, and magenta. The saturation describes the level of mixture between the hue and the white light, i.e., it defines the “purity” of the color. High values of saturation result in more gray-scale pixels and small values result in pixels with high “purity”. For instance, the red color is highly saturated and the pink color is unsaturated. A fully saturated color does not contain white light. Finally, the *chromaticity* is a description that combines hue and saturation. Hence, it is possible to describe an image according to brightness and chromaticity. The *color depth* measures the amount of color information available to display or print each pixel of a digital image. A high color depth leads to more available colors, and consequently to a more accurate color representation. For example, a pixel with one bit depth has only two possible colors: black and white. A pixel with 8 bits depth has 256 possible values and a pixel with 24 bits depth has more than 16 million of possible values. Usually, the color depths vary between 1 and 64 bits per pixel in digital images. The *color models* are used to specify colors as points in a coordinate system, creating a specific standard. In the following, the most common color spaces are briefly presented.

III. RGB COLOR MODEL:

The RGB (Red, Green, and Blue) color space is one of the most used color spaces, specially for 8 bit digital images. This model is usually used for representing colors in electronic devices as TV and computer monitors, scanners, and digital cameras. The theory of the trichromatic color vision of Young–Helmholtz and the Maxwell’s triangle is the basis of the RGB model. The RGB is an additive model where the red, green, and blue colors are combined on different quantities or portions to reproduce other colors. The pixels of an image represented in the RGB model have usually 8 bits depth, resulting in 256 possible intensities, i.e., the range of [0, 255] for each color. A color in the RGB model can be described indicating the amount of red, green, and blue. Each color can vary between the minimum value (totally dark) and the maximum value (totally intense). When all the colors have the minimum value, the resulting color is black. On the contrary, when all the colors have the maximum value, the resulting color is white. This model is known as the RGB color cube, because the model is based on the Cartesian coordinate system and its color subspace of interest is a cube. The primary and secondary colors are at the corners of the cube. The black color is at the origin and the white color is at its opposite corner. The diagonal between the black and the white colors is the gray scale

IV. SOIL PROPERTY DETECTION

Local Binary Patterns for Still Images

The local binary pattern operator is an image operator which transforms an image into an array or image of integer labels describing small-scale appearance of the image. These labels or their statistics, most commonly the histogram, are then used for further image analysis. The most widely used versions of the operator are designed for monochrome still images but it has been extended also for color (multi-channel) images as well as videos and volumetric data

Mappings of the LBP Labels: Uniform Patterns

In many texture analysis applications it is desirable to have features that are invariant or robust to rotations of the input image. As the $\mathrm{LBP}_{P,R}$ patterns are obtained by circularly sampling around the center pixel, rotation of the input image has two effects: each local neighborhood is rotated into other pixel location, and within each neighborhood, the sampling points on the circle surrounding the center point are rotated into a different orientation Another extension to the original operator uses so called *uniform patterns*. For this, a uniformity measure of a pattern is used: *U* (“pattern”) is the number of bitwise transitions from 0 to 1 or vice versa when the bit pattern is considered circular. A local binary pattern is called uniform if its uniformity measure is at most 2. For example, the patterns 00000000 (0 transitions), 01110000 (2 transitions) and11001111 (2 transitions) are uniform whereas the patterns

11001001 (4 transitions) and 01010011 (6 transitions) are not. In uniform LBP mapping there is a separate output label for each uniform pattern and all the non-uniform patterns are assigned to a single label. Thus, the number of different output labels for mapping for patterns of P bits is $P(P-1)+3$. For instance, the uniform mapping produces 59 output labels for neighborhoods of 8 sampling points, and 243 labels for neighborhoods of 16 sampling points.

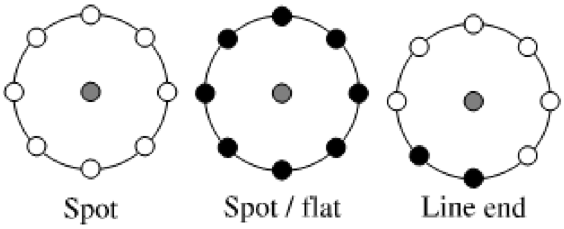

Figure.1. Rotational Invariance

3. EXPERIMENTAL RESULTS

This chapter revolves around the simulation process and finishing the process the results of the process is being attached here for further clarification.

ORIGINAL IMAGE

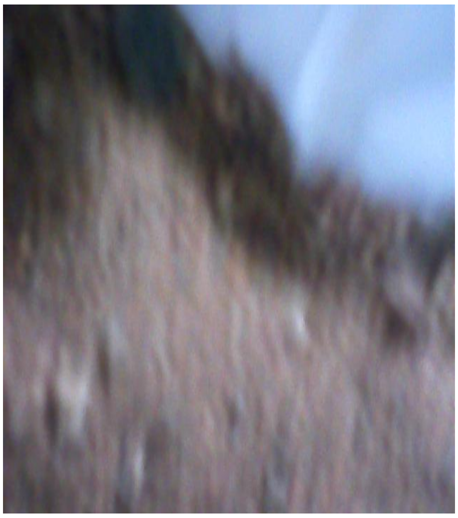

Figure.2.Original Image

NOISE REMOVAL IMAGE

Figure.3.Noise Removal Image

The above image which is acquired after the removal of noise from the soil.

PHASE IMAGE

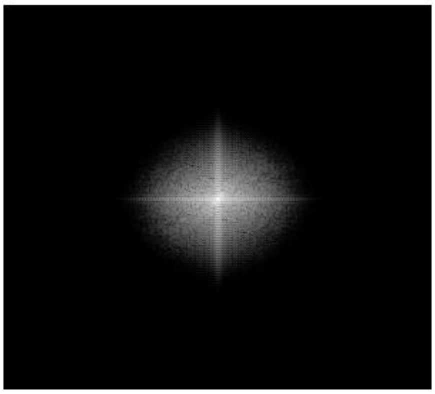

Figure.4.Phase Image

The above image is the phase image of the soil which we acquired during removal of noise from the soil

MAGNITUDE IMAGE

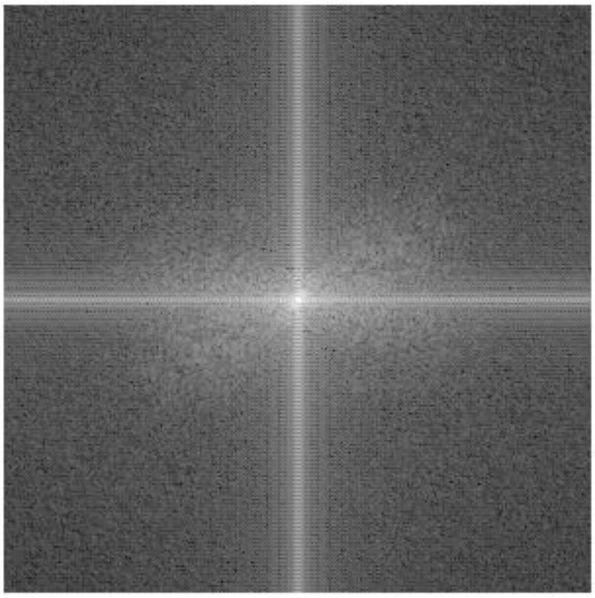

Figure.5.Magnitude Image

The above image is the magnitude image of the soil which we acquired during removal of noise from the soil

DYADIC WAVELET IMAGE

PROJECTED IMAGE

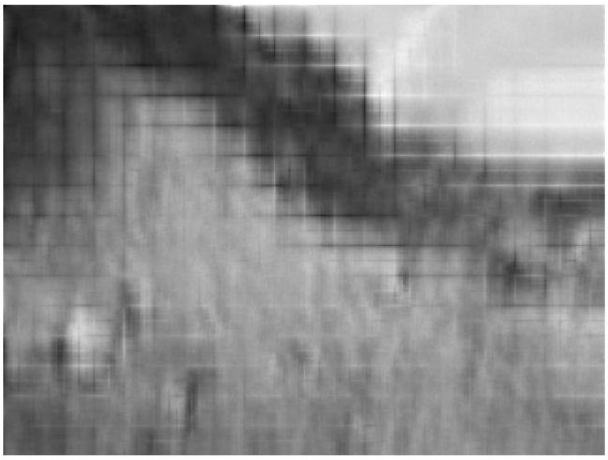

Figure.6.Projected Image

The above image is result of the dyadic wavelet transform which we acquired during wavelet processing, from this image we can able to easily segment RGB color band

TEXTURE ANALYSIS IMAGE

HISTOGRAM IMAGE

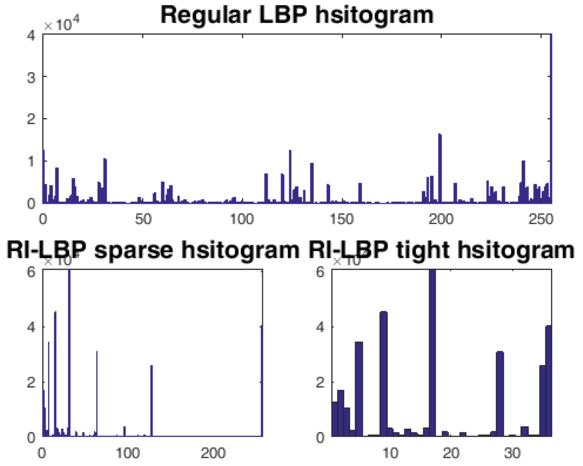

Figure.7.Histogram Image

The above image is result of the soil property detection in this process we acquired the histogram image from that image we can able to calculate pH value.

LBP IMAGE

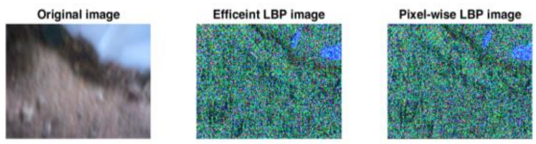

Figure.1.LBP Image

The LBP image is result of the texture analysis, which we obtained during this process, the scattering of pixels in the image makes us to know whether the soil is treated with large or small quantity of fertilizers.

4. CONCLUSION

Image analysis and especially its application to soil science is still a young science. Most research within the field has been done during the last decades. Some applications are already routinely used whereas many potential applications have received little attention yet. Especially interesting is automated image analysis for soil classification and studies where pore scale soil properties are related to macroscopic features like water retention or soil fertility. The main aim of the project which conclude about it reduce the backscatter of the reflectance when the light is made to fall on the soil and which the illumination and its reflectance plays a major role to find the pH value the noise which is produced when the backscatter is caused and the light wavelength tends to be change and which it gives us the wrong prediction in order to overcome this by analysing the spectral characteristics of the soil instead of the light wavelength and we can reduce the backscatter and reflectance.

5. FUTURE ENHANCEMENT

Another area where we expect further development is the use of automated image analysis to study dynamic processes, e.g., solute transport or root growth. Especially interesting is automated image analysis for soil classification and studies where pore scale soil properties are related to macroscopic features like water retention or soil fertility.

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