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SOIL CLASSIFICATION THROUGH AI TECHNIQUES

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Abstract:

A vital element in agriculture is soil. There are numerous varieties of soil. Many types of soil support a wide range of crops, and each type of soil has unique qualities. Understanding the qualities and characteristics of various soil types is necessary to determine which crops thrive in particular soil types. Machine learning techniques might prove helpful in this situation. In recent years, it has undergone substantial development. Machine learning is still a very young and challenging research area in agricultural data processing. The conventional procedures for classifying soil in a laboratory take a lot of time, work, and money. In this, we created a model that predicts the red soil type from other soils using convolutional neural networks. Our strategy entails creating a model to determine whether or not red dirt is present in an image when the user delivers the input image. Image pre-processing, feature extraction, and classification are a few of the processes that make up the process of detecting and classifying red dirt.

Keywords: - Agricultural, land type, SVM technique, image processing, and classification techniques.

1.INTRODUCTION

A digital system is one that processes digital images. a digital apparatus operates on a digital image or works on one. X and Y are two coordinates that describe an image in a two-dimensional signal mathematically. This is depicted by the f(x,y)function. The function's amplitude is defined as the image's entry point or grey level at point x and y. Digital images of x, y, interchange of function f, and finite deferments quantities are referred to as images. The primary objective is to build and develop a computer system that works with images, with digital images serving as the developed system's input and users and algorithms processing those images as its output.

A. Fundamentals of Image Processing: As depicted in figure 1.1, there are three levels of digital image processing.

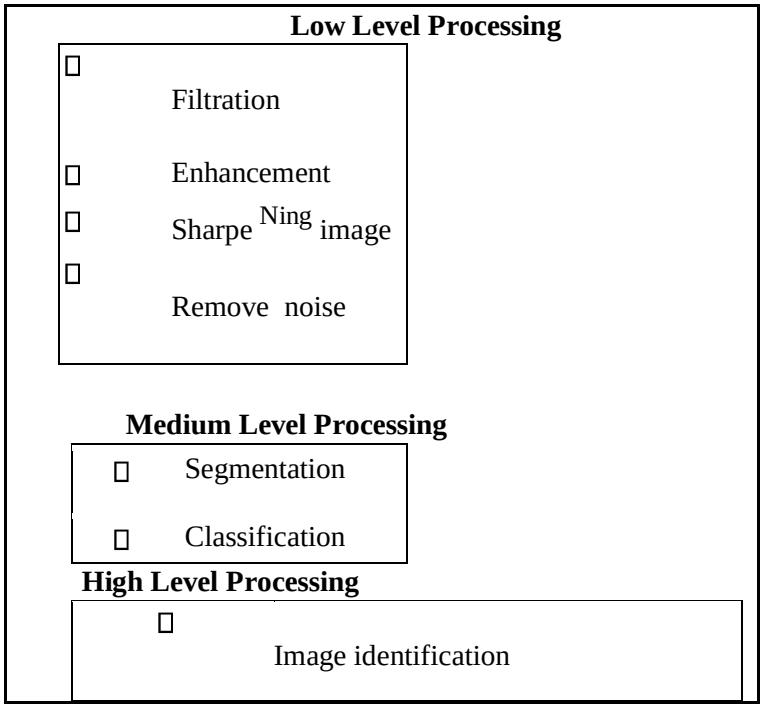


Figure 1.1: The classification process during image processing

- Low level processing (LLP) entails structuring the image, noise removal with a filter, and image enhancement.
- High level processing (HLP): This covers picture identification.
- Middle level processing (MLP): This includes image segmentation and classification.

The main elements of a digital image processing system include an image sensor, a compiler, software, a large number of images, color TVs or monitors, hard copy devices like laser printers, film cameras, CD-ROM devices, etc., and specialized image processing hardware, which combines a digitizer with hardware to perform logical and arithmetic operations.

Frequency domain processing (FDP) and special domain processing are the two methods of image improvement (SDP).

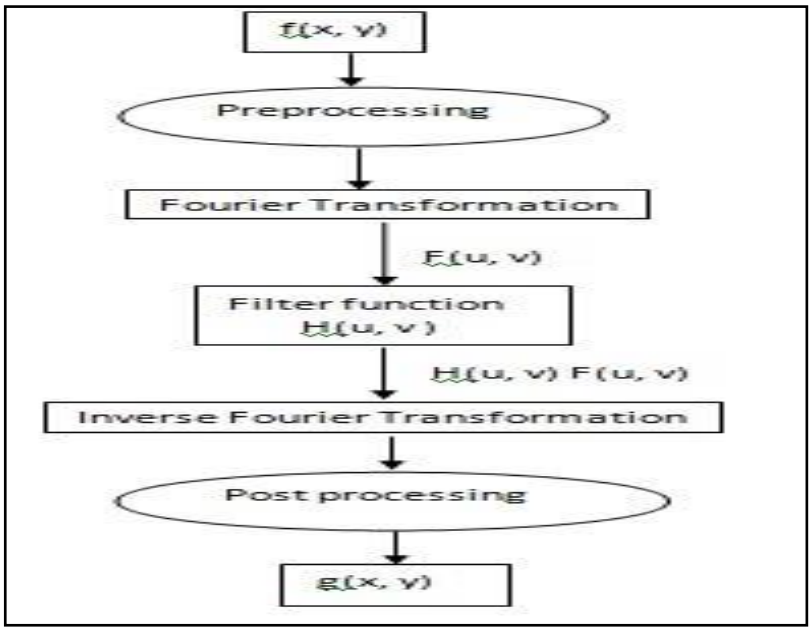


Figure 1.2 Image enhancement steps

FDP: It is primarily performed by filter operation based on Fourier transformation as described in equation number I. G(u, v)=H(u, v)F(U,V)…… (I)

A Fourier transformation is used where: F(u, v)

The filter function is H(u, v).

Yields: G(u, v)

SDP: Equation no. II, g(x, y)=T[f(x, y)], allows for the basic manipulation of pixels in an image. ……(II)

in which: f(x, y) - Image input g(x, y) - a finished image

operator T: on f, split over f's nearest neighbour (x,y)

Gray level transformation, histogram processing, arithmetic logic operation, and specific filtering can all be used for enhancement.

The process of segmentation involves grouping regions with similar characteristics and traits. There are basically six categories for picture segmentation.

Edge detection, regions-growing, models-based, histogram-based, clustering-based, and semi-automated segmentation are some examples.

The value of an image's characteristics and the category of organised data are used to classify it. The classification process essentially comprises two steps.

• Training period

• Phase of testing

There are three different categories. Both supervised and unsupervised categorization are available.

• Static processing

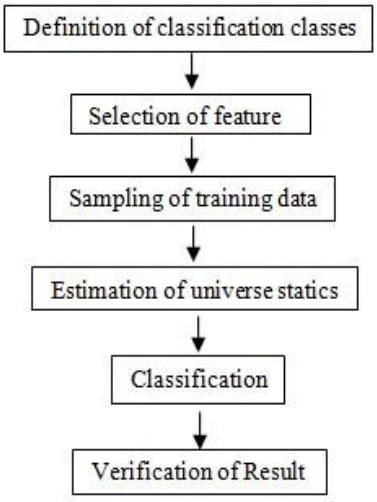


Figure 1.3: Steps of classification

Training can be sampled using either supervised or unsupervised learning. Universe statics estimation entails a decision rule (that may be based on means variance etc.)

Multilevel slice classification, minimum distance classification, maximum distance classification, and other classification methods such expert systems, fuzzy systems, etc. are the most fundamental classification approaches. The closest neighbor method, further neighbor method, centroid method, group average method, and wand method can all be used to calculate distance.

B: Soil: The top layer of the earth is called the soil. The structure was created as a result of the decomposition of animals and plants and the breakdown of rocks.

The two main types of soil are local soil and transportation soil.

While the following list covers six varieties of Indian soil Black soil, alluvial soil, Mountain soil, red soil, laterite soil, sandy soil.

Rajasthan soil can be categorized as follows:

The following soil types are: Kachahri soil, red-yellow soil, laterite soil, mixture of red and black soil, and desert soil.

C: The importance of soil to economic growth: As is well known, soil is the foundation of the agriculture sectors such as farming and plantations. The demand for crops has expanded during the previous few decades. Using scientific approach and fertilizer also enhances productivity. Since 65 to 75 percent of Indians are either directly or indirectly involved in farming, higher economic growth depends on better soil utilization based on its characteristics.

II.CONNECTED WORK

In 2017, Umesh Kambale and coworkers used image processing to categorize soil depending on its PH value. Hence, they categories the soil according to its acidity, alkalinity, or neutrality. Since farmers find it difficult to understand, this classification is not helpful to them [1].

In 2017, Bhawna J. Chilke and coworkers used image processing to determine the soil's pH value. Nonetheless, there were differences in the outcomes of automated tests using digital image processing and experimental tests [2].

In 2017, Sudhir.R. and et al. used image processing to assess the PH value of the soil. They made use of the GIS system's images [3].

In 2016, V. Rajeshwari and K. Arunesh used data mining to analyse the soil and classify it. JRip, J48, and the Naive Bayes method were also used in their accuracy comparison [4].

In 2016, Sneha Pethkar and colleagues reviewed the digital image processing-based soil categorization approach. They compared based on accuracy and affordability using ANN and SVM algorithms [5].

In 2016, K. Srunitha and colleagues attempted to evaluate the effectiveness of an SVM classifier on soil data using a low pass filter, a Gabor filter, and a colour quantization approach. As the statistical parameters, mean amplitude, HSV histogram, and standard deviation are used [6].

In 2016, Pravat Kumar and colleagues used a computer-aided image analysis tool to extract geometric characteristics of fractures from scanned photos of the desiccation process, including width, length, and surface area values [7].

Comparison examination of a classification algorithm using soil data to forecast fertility rate for the district of Aurganbad by Bhuyar V. and et al. in 2014 [8]

In 2011, R. Shenbagavalli and Dr. K. Ramar calculated statistical parameters on sequential window (SW) and random window (RW) derived from Law's 3x3 mask parameters (RW). they discovered The proportion of categorization for the RW on preprocessed approaches is the same as for the conventional SW method [9].

In 2005, Anastasia Sofou introduced computer techniques for analyzing soil structure utilizing segmentation and texture analysis of soil images. They show how it can be used for remote sensing as well [10].

III. PROBLEM STATEMENT AND OBJECTIVE

A. Problem Statement

The only layer of the earth's surface that is required for farming, planting, and forestry is the soil. The farming land is decreasing day by day due to industrialization and population growth of any country. To ensure that supply and demand are balanced, it is essential to practise scientific agricultural methods while utilising cutting-edge technologies such as data mining, artificial intelligence, and digital image processing. In order to categorise soil and recommend crops, numerous academics have proposed a number of ways. Nonetheless, they divided the soil into three categories: acidic, neutral, and alkaline. Because farmers find it difficult to understand, these classifications are not helpful to them.

B. Purpose

The following are the key goals:

In order to classify the soil in Udaipur, Rajasthan, using SVM classification, and to analyse the soil based on the following parameters:

Wavelet motion and automatic correlation

HSV Histogram

• To advise a farmer of the following characteristics of the soil:

Soil type, Soil nutrients, A list of appropriate crops for the specific type of soil, Fertilizer type

• Create and develop tools

IV. PROPOSED WORK

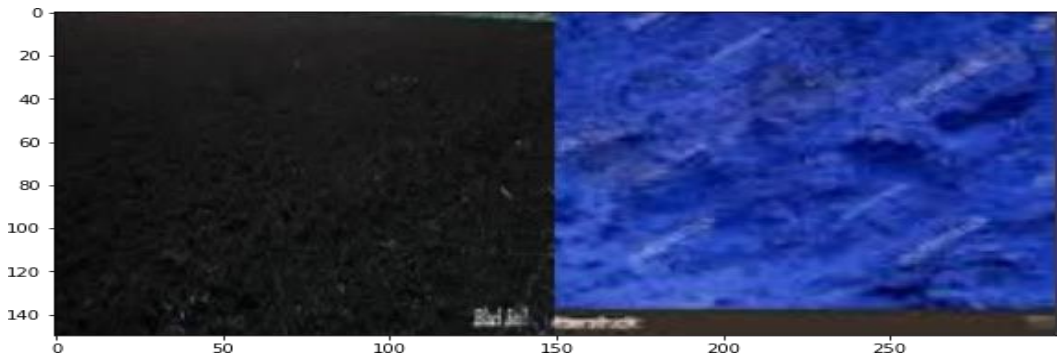
❖ Loading of the picture

Several images of soil samples that need to be identified are captured using a color camera and provided as input into the system. Each type of soil has a unique set of traits that are gathered and recorded in a separate dataset. The final step uses this dataset to categories soil.

❖ Pre-Processing

The image we obtained in the earlier stage isn't ideal. The results of the analysis are significantly influenced by the image quality because it affects both the ability to distinguish features and the accuracy of subsequent measures. To produce an error-free image, pre-processing techniques are used. Since the image is enhanced during this phase to produce a higher-quality image for subsequent procedures, it is often referred to as the "image improvement" phase. Before continuing with the processing, it is necessary to eliminate any imperfections like noise or artefacts like scratches, lapping tracks, comet tails, and so forth from the image.

The Smoothing filter is employed to remove noise and artefacts from the image. Low pass and high pass filters are the two categories. A low pass filter is a smoothing filter. This method eliminates high-frequency noise from digital images. A moving window operator is used by smoothing filters to change the value of each pixel in a picture one at a time based on the function of a small area of pixels. All of the pixels are impacted as the operator moves over the image. As a result, the smoothing filter gradually improves the image over time by removing flaws.



Black soil vs Red soil pre-processed image

V. IMPLEMENTATIONS

Be aware that your soil application was created using Matlab 2011R.

Design is carried out with the use of Matlab active control. SVM classify, an internal function, is used for classification. A matrix, a description of the plotting region, three input arguments (SVM Strut, Sample, and Show plot), one output argument (Group), and the ability to display the classifier in column vector form are required for classification. where each row corresponds to a particular sample's classes. Moreover, two tables were needed for the training phase and the testing phase.

VI. RESULT ANALYSIS

CHOOSING RANDOM IMAGE:

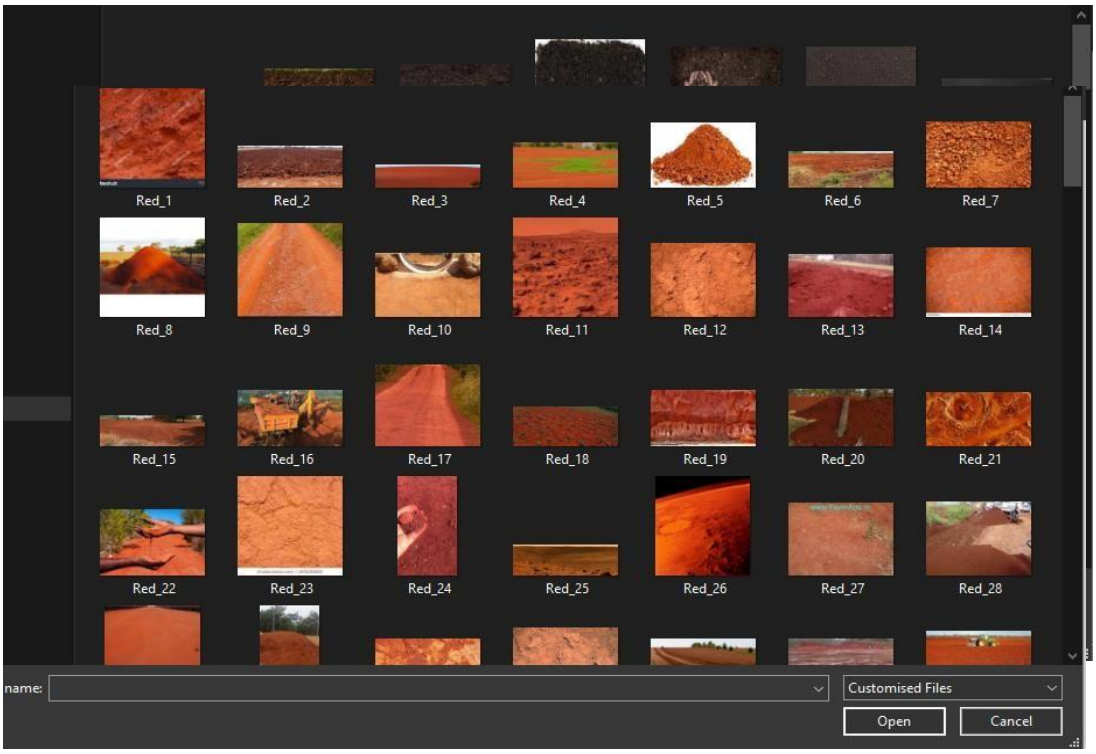


Fig 6.1 Soil Image Dataset

AFTER CHOOSING IMAGE CLICKING ON THE PREDICT BUTTONPRODUCES THE OUTPUT:

Fig 6.2 Screenshot of Image Uploading THE OUTPUT IS PRODUCED BY THE TRAINED MODEL:

Fig 6.3 Screenshot of Detection of Red soil

AFTER CHOOSING IMAGE CLICKING ON THE PREDICT BUTTONPRODUCES THE OUTPUT:

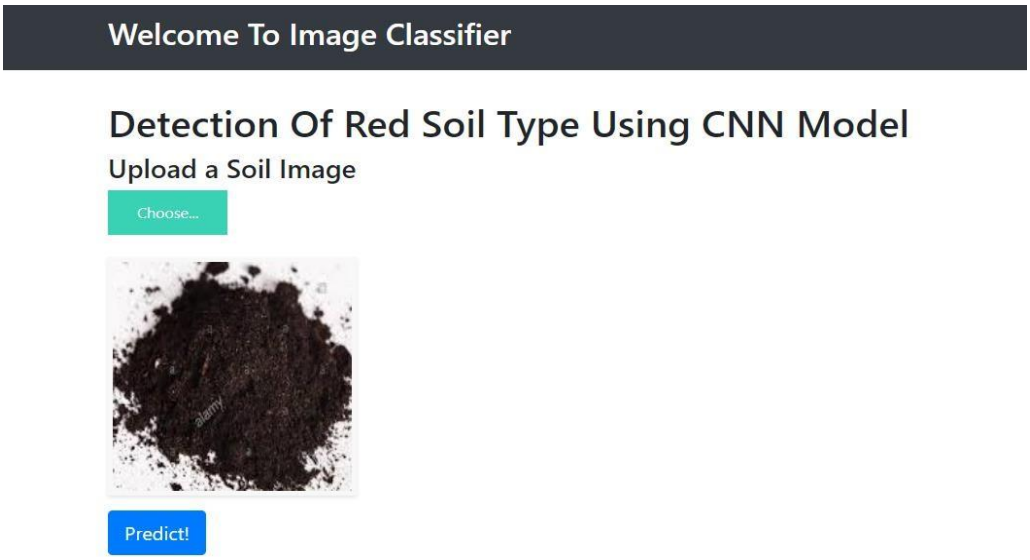


Fig 6.4 Screenshot of uploading other imagesTHE OUTPUT IS PRODUCED BY THE TRAINED MODEL:

Fig 6.5 Screenshot of detection of not Red soil

VII.CONCLUSION

The suggested application contains additional features than the current system, such as suggested urea, suggested crops, and soil nutrient lists. Because they are helpful in farming and simple to understand, these traits are essential for novice farmers.

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