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Soil Classification and Crop Prediction

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Abstract: ***Agribusiness is the core of numerous nations and soil is the primary significant component of horticulture. There are diverse soil sorts and every sort has various highlights for various yields. In this field, presently a day's various techniques and models are utilized to build the amount of the harvests. So the primary motivation behind this of this task is to make a model that assists ranchers with realizing which harvest should take in a specific kind of soil. In this task, we measure the dirt pictures to produce an advanced soil characterization framework for rustic ranchers for minimal price. Tensorflow climate is utilized from this we can download the necessary bundles. We are utilizing two datasets, that is preparing set comprises of four sorts of soil Alluvial, Red, Dark, Earth and train set. Soil surface is the principle factor to be considered prior to doing development. In this methodology, we can gather 50 examples from the various areas of our country. The examples are shot under light condition utilizing an any camera. Soil pictures are handled through the various stages like Convolution layer is to separate highlights from the info picture, Max pool layer is to decrease the spatial component of the information volume for next layers, Drop out layer is arbitrarily sets input units to 0 with a recurrence of rate at each progression during preparing time, which forestalls over fitting, and different layers.***

Keywords: Convolutinal Neural Network, Soil Classification, Deep Learning

I. INTRODUCTION

Agriculture is one of the most essential economic activity and also plays significant role in social and environmental aspects of the countries that primarily depend on Agriculture. Soil is the most essential aspect that determines the agriculture and cropping patterns. There are different types of soil which can be used for various types of cultivation and hence, predicting the texture of the soil is one of the main criteria . Soil texture is one of the most important physical soil properties which allows water retention capacity, soil density, availability of nutrient and reaction of soil. Based on the soil texture, decisions are made for crop selection for better productivity plan. The distribution of soil particles shows the feature of soil texture and it is characterized as alluvial, black, clay and red soils. The texture of soil influences the soil's capability to store water and its fertility. Soil texture and organic matter are the two important properties of soil which control the soil water retention capacity. alluvial and clay which have smaller particles have a larger surface area and allow soil to hold more water. Black soil which has larger particles with a small surface area will hold only less water. The water holding capacity of black soil is low as compared to alluvial and clay soil. It indirectly affects the plant growth, the weight of the plant and the percentage of chlorophyll. For example, chlorophyll contents of leaves are dropped in black as compared to alluvial and clay soil.

Conventionally, there are different methods to classify the soil. All these methods are time and labour consuming processes. These are not appropriate approaches for rural farmers. In the field study, it is found that rural farmers do not have any knowledge about the soil texture. They are doing their farming without any proper soil testing and are unaware about the selection of soil and seed. It indirectly affects the overall growth of the plant. To overcome this problem, researches are done to develop the computer system and it efficiently classifies the soil texture using digital image processing.

II. RELATED WORKS

The paper[1] titled **"Convolutional Neural Network Approach For The Prediction Of Soil Texture Properties**" Soil texture is one of the main factors in agricultural production, and its precise prediction is important for the normal use and management of water resources. However, Soil texture involves complex structural characteristics with soil features which is difficult to make a prediction on soil type. Hyperspectral data is used as a feature for the prediction of soil properties. Predicting soil features from hyperspectral data need more preprocessing for better understanding of the soil and for accurate prediction and it is a challenging research task. In the proposed methodology, a Convolutional neural network model is used to train the spatial information mapped to soil texture. Soil feature prediction is helpful in predicting and understanding various hydrologic processes, such as energy and moisture fluxes, drought and irrigation scheduling. By using spectral data, it is possible to predict different soil features. The main objective is to predict six soil properties organic carbon content (OC), cation exchange capacity (cmol+ kg-1), clay particle size fraction (%), sand particle size fraction (%), pH measured in water, and total nitrogen content (N, g kg-1).

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CNN is designed to take data in the form of multiple arrays. Hyperspectral data is one of the important methods for soil analysis where the classification is performed in pixel level.

The paper[2] titled **"Soil Texture Classification Using Multi Class System** The objective of this study is to process the soil images to generate a digital soil classification system for rural farmers at low cost. Soil texture is the main factor to be considered before doing cultivation. It affects the crop selection and regulates the water transmission property. The conventional hydrometer method determines the percentage of sand, silt, and clay present in a soil sample. This method is very cost and time-consuming process. In this approach, we collect 50 soil samples from the different region of west Guwahati, Assam, India. The samples are photographed under a constant light condition using an Android mobile of 13 MP cameras. The fraction of sand, silt, and clay of the soil samples are determined using the hydrometer test. The result of the hydrometer test is processed with the United State Department of Agriculture soil classification triangle for the final soil classification. Soil images are processed through the different stages like pre-processing of soil images for image enhancement, extracting the region of interest for segmentation and the texture analysis for feature vector. The feature vector is calculated from the Hue, Saturation, and Value (HSV) histogram, color moments, color auto Correlogram, Gabor wavelets, and discrete wavelet transform.

The Paper[3] Titled **"**Crop Prediction System Using Machine Learning **"** The proposed system takes into consideration the data related to soil, weather and past year production and suggests which are the best profitable crops which can be cultivated in the a propose environmental condition. As the system lists out all possible crops, it helps the farmer in decision making of which crop to cultivate. Also, this system takes into consideration the past production of data which will help the farmer get insight into the demand and the cost of various crops in market. As maximum types of crops will be covered under this system, farmer may get to know about the crop which may never have been cultivated. In the future, all farming devices can be connected over the internet using IOT. The sensors can be employed in farm which will collect the information about the current farm conditions and devices can increase the moisture, acidity, etc.

Accordingly. The vehicles used in farm like tractor will be connected to internet in future which will, in real time pass data to farmer about crop harvesting and the disease crops may be suffering from thus helping the farmer in taking appropriate action. Further the best profitable crop can also be found in light of the monetary and inflation ratio.

India being an agricultural country, its economy predominantly depends on agriculture yield growth and allied agro industry products. In India, agriculture is largely influenced by rainwater which is highly unpredictable. Agriculture growth also depends on diverse soil parameters, namely Nitrogen, Phosphorus, Potassium, Crop rotation, Soil moisture, Surface temperature and also on weather aspects which include temperature, rainfall, etc.

Thus, technology will prove to be beneficial to agriculture which will increase crop productivity resulting in better yields to the farmer. The proposed project provides a solution for Smart Agriculture by monitoring the agricultural field which can assist the farmers in increasing productivity to a great extent. Weather forecast data obtained from IMD (Indian Metrological Department) such as temperature and rainfall and soil parameters repository gives insight into which crops are suitable to be cultivated in a particular area. This work presents a system, in form of an android based application, which uses data analytics techniques in order to predict the most profitable crop in the current weather and soil conditions. The proposed system will integrate the data obtained from repository, weather department and by applying machine learning algorithm: Multiple Linear Regression, a prediction of most suitable crops according to current environmental conditions is made. This provides a farmer with variety of options of crops that can be cultivated. Thus, the project develops a system by integrating data from various sources, data analytics, prediction analysis which can improve crop yield productivity and increase the profit margins of farmer helping them over a longer run.

The paper[4] titled "Crop Prediction Based On Soil Classification Using Machine Learning**"** The In this section, we review some of the significant works done in the agriculture field for crop prediction. The authors concentrated on the use of applications of data mining techniques in the agricultural field. As data mining is a new rising technology so authors also study and examined the problem of forecasting agricultural productivity. The authors discussed the main objective of this work was finding the desired data models that give high accuracy and high generality in terms of the yield forecasting capabilities. For these different types of data mining techniques were judged on different data sets by authors. In this section, we review some of the significant works done in the agriculture field for crop prediction. In , the authors concentrated on the use of applications of data mining techniques in the agricultural field. As data mining is a new rising technology so authors also study and examined the problem of forecasting agricultural productivity. The authors discussed the main objective of this work was finding the desired data models that give high accuracy and high generality in terms of the yield forecasting capabilities. For these different types of data mining techniques were judged on different data sets by authors.

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III. DATA AND METHODOLOGY

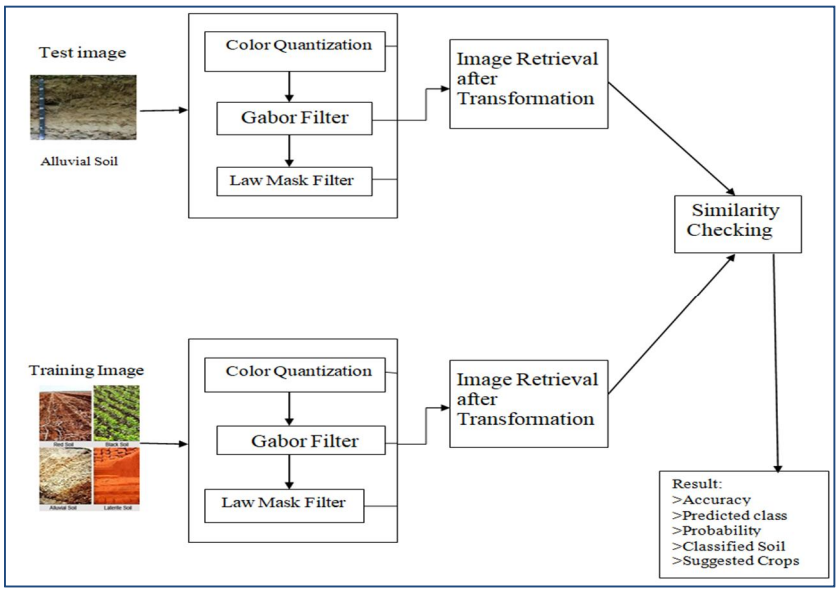
A. *Major Modules*

1) Image Pre-Processing The nature of the image is definitive for the outcomes of examination, influencing the capacity to recognize quality under examination and accuracy of consequent estimations. Therefore, the accompanying techniques are connected to obtain error free picture.

2) Shade Correction Few images, basically taken by advanced cameras, display uneven brightening, termed shade. Part of image is intense and some other parts are not illuminated than mean value. This marvel is result of mistake in framework as a matter of first importance and non-homogeneous light source. Exact modulating the amazing cameras will make smaller this impact. The primary issue brought about by the nearness of shade, it can broadly influence the consequences of binarization, particularly of phase with gray level near the background of image. Along these lines, exertion is consumed with a specific end goal to right this mutilation.

3) Removing Artifacts Certain images frequently consist of few artifacts convinced at the time of pattern arrangement, as claw mark, blur, put-outs, alleviation, lapping tracks or comet tails. These components evacuation is typically exceptionally troublesome, other than incomprehensible. At the same time, image rectification will influence the components dissected this results to chance falling discipline over the entire examination methods. Along these lines, to result high quality initial images.

Flow Diagram



Flow Diagram for Soil Prediction using Classification

This Proposed Block diagram is used to classify the soil. The soil type is classified using color, texture, boundary features. These three are the primary values necessary for identification of the crop to grow well and produce an efficient yield. The works includes processing of images for dissimilar types of soil sample, extracting features of soil samples and then develops acceptable model which recognize the dissimilar types of soil images.

Implementation is the stage in the project where the theoretical design is turned into a working system and is giving confidence on the new system for the users that it will work efficiently and effectively. It involves careful planning, investigation of the current system and its constraints on implementation, design of methods to achieve the changeover, an evaluation of change over method**.** Apart from planning major task of preparing the implementation are education and training of users. The implementation process begins with preparing a plan for the implementation of the system. According to this plan, the activities are to be carried out, discussions made regarding the equipment and resources and the additional equipment has to be acquired to implement the new system. Implementation is the final and the most important phase. The most critical stage in achieving a successful new system is giving the users confidence that the new system will work and be effective. The system can be implemented only after thorough testing is done and if it is found to be working according to the specification. This method also offers the greatest security since the old system can take over if the errors are found or inability to handle certain type of transactions while usingthe new system.

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IV. DATA SET

The dataset used for the evaluation of the proposed method is the Image dataset, which consists of about more than 50 images that include physical properties like the coarse fragments, the particle size distributions clay, black, alluvial soil and red soil. Additionally, this dataset includes continuous reflectance spectra from 400 nm to 2500 nm, referred to as hyper spectral data Dataset is divided into two, Train Dataset and Test Dataset.

A. Train Dataset

Train data set contains four types of soil images
Alluvial soil :- The folder contains different types of Alluvial soil images.
Clay soil :- The folder contains different types of Clay soil images.
Black soil :- The folder contains different types of Black soil images.
Red Soil :- The folder contains different types of Red soil images.

B. Test Dataset

Test data set contains four types of soil images
Alluvial soil :- The folder contains different types of Alluvial soil images.
Clay soil :- The folder contains different types of Clay soil images.
Black soil :- The folder contains different types of Black soil images.
Red Soil :- The folder contains different types of Red soil images.

V. RESULTS AND ANALYSIS

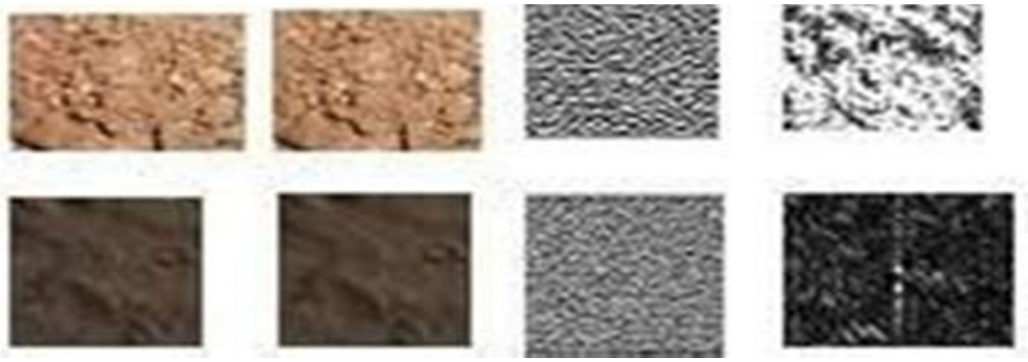
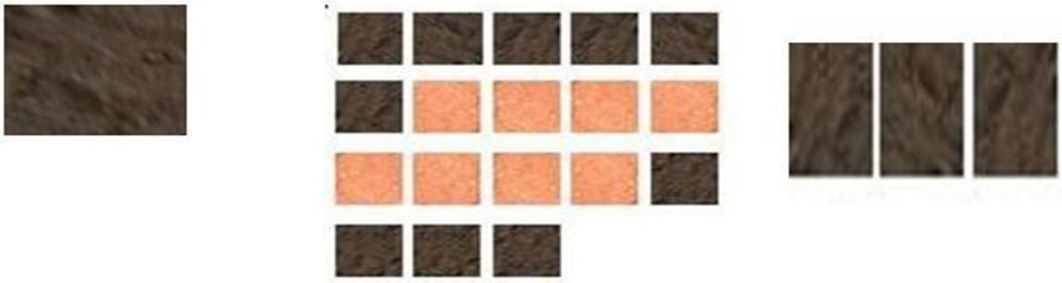


Fig a) Original image of clay soil b) color quantized c) law mask filter d) Gabor filter e) Original image law masks of alluvial soil f) color quantized alluvial soil g) Gabor filter alluvial soil



i) Query Image ii) Retrieved Image iii) Closed Match Image

Above fig i. describes the query image to find a match. Fig ii. describes retrieved images from the folder and fig iii. shows the closed matches of query image. From the above analysis, the proposed method using Gabor filter is an efficient method to retrieve more number of similar images. It is an efficient method to retrieve more number of similar images.

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VI. METHODOLOGY

A. *Implementation CNN Model*

1) Convolutional layer: Filters are used as feature detectors of the input image. The filter size used in this model is 3*3 which maps the local region of the input image and exploits the spatial relationship between the pixels. Spatial relationship refers to location based information with the neighboring pixels.

2) Max pool layer: This layer is used to reduce the dimensionality of image by reducing the number of pixels in the output from the previous convolution layer. It also reduces the overfitting scenario

3) Independent processing of each feature map is performed in pooling layer. It is used after the convolutional layer. Max pooling layer with size 3x3 is used in this model.

4) Drop out layer : This layer is used to drop out the units(hidden or visible) in network. This layer will be implemented on any hidden layers as well as visible layers in the network. This layer cannot be used on the output layer.

5) Flatten layer : It is used to make one dimensional array, since rectangular or cubic shapes cannot be direct inputs.

6) Dense layer : This layer is fully connected by the neurons in a network layer. Each neuron in a layer receives the input from all the neurons present in the previous layer. This layer is used because this will consider all the features for classification

7) After many hidden layers of convolutional and pooling, six middle level branching is used to avoid separate preprocessing steps followed by convolutional layer and fully connected layer for each branching layer

8) The final output layer is the regression value of six soil properties.

We are using four labels namely:

a) Alluvial soil
b) Black soil
c) Clay soil
d) Red soil

Image data is sent as input to the convolutional and pooling layers of the CNN model. The data is passed to the series of convolutional and pooling layers where it learns the features of input data. The general representation of the data is learned in the first few layers and the network is branched to learn the six soil properties. Each branch learns the specific properties and passed to deeper convolutional layer. Finally, it is passed to the fully connected layer where it is flattened to one dimensional data and then to the output layer.

B. *Development Environment*

Convolutional Neural Network architecture is implemented using Tensor flow and Keras with python as the programming language. Tensorflow is a free and open source library, mainly used for deep learning applications. Keras is a open source neural network library which can run on top of Tensorflow and it is designed to be fast and easy to use Image data is sent as input to the convolutional and pooling layers of the CNN model. The data is passed to the series of convolutional and pooling layers where it learns the features of input data. The general representation of the data is learned in the first few layers and the network is branched to learn the six soil properties. Each branch learns the specific properties and passed to deeper convolutional layer. Finally, it is passed to the fully connected layer where it is flattened to one dimensional data and then to the output layer.

VII. RESULTS

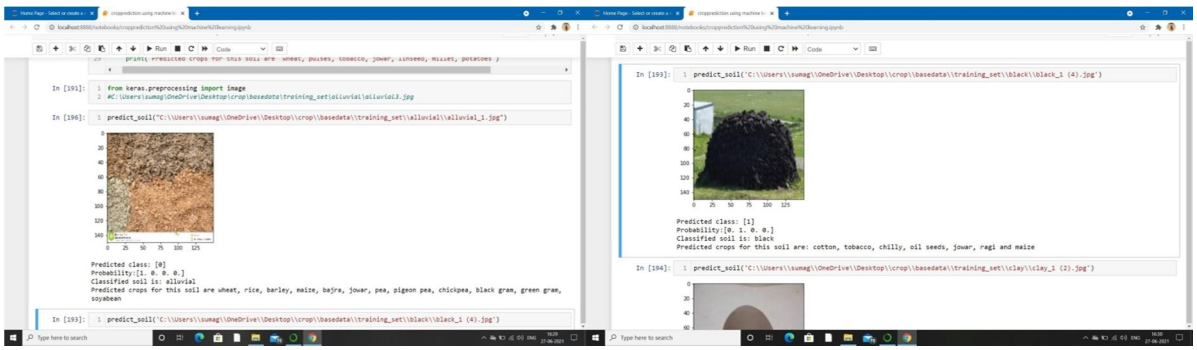


Fig 9.1: Alluvial soil with its suitable crops Fig9.2 Black soil with its suitable crops

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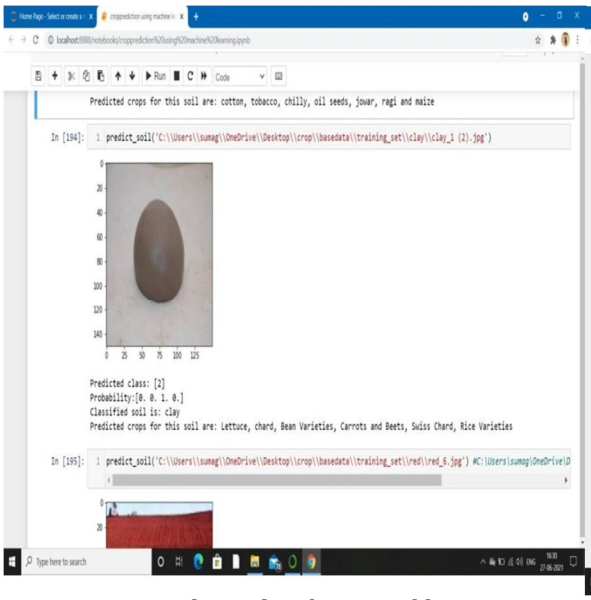


Fig 9.3 Clay soil with its suitable crops

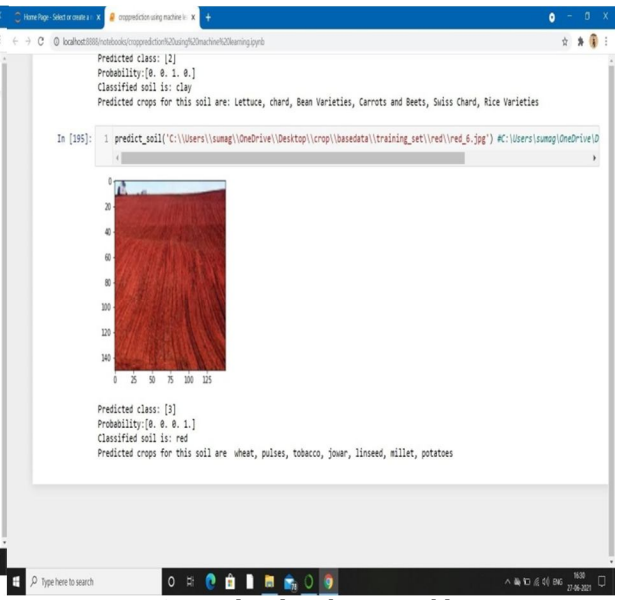


Fig 9.4 Red soil with its suitable crops

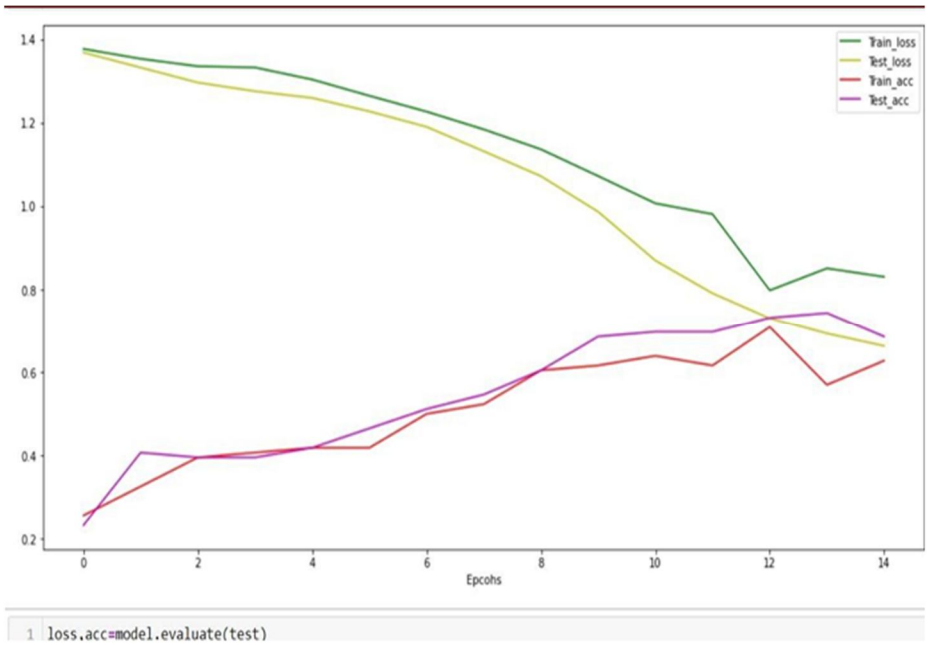


Fig 9.5 Accuracy of the Model

VII CONCLUSION

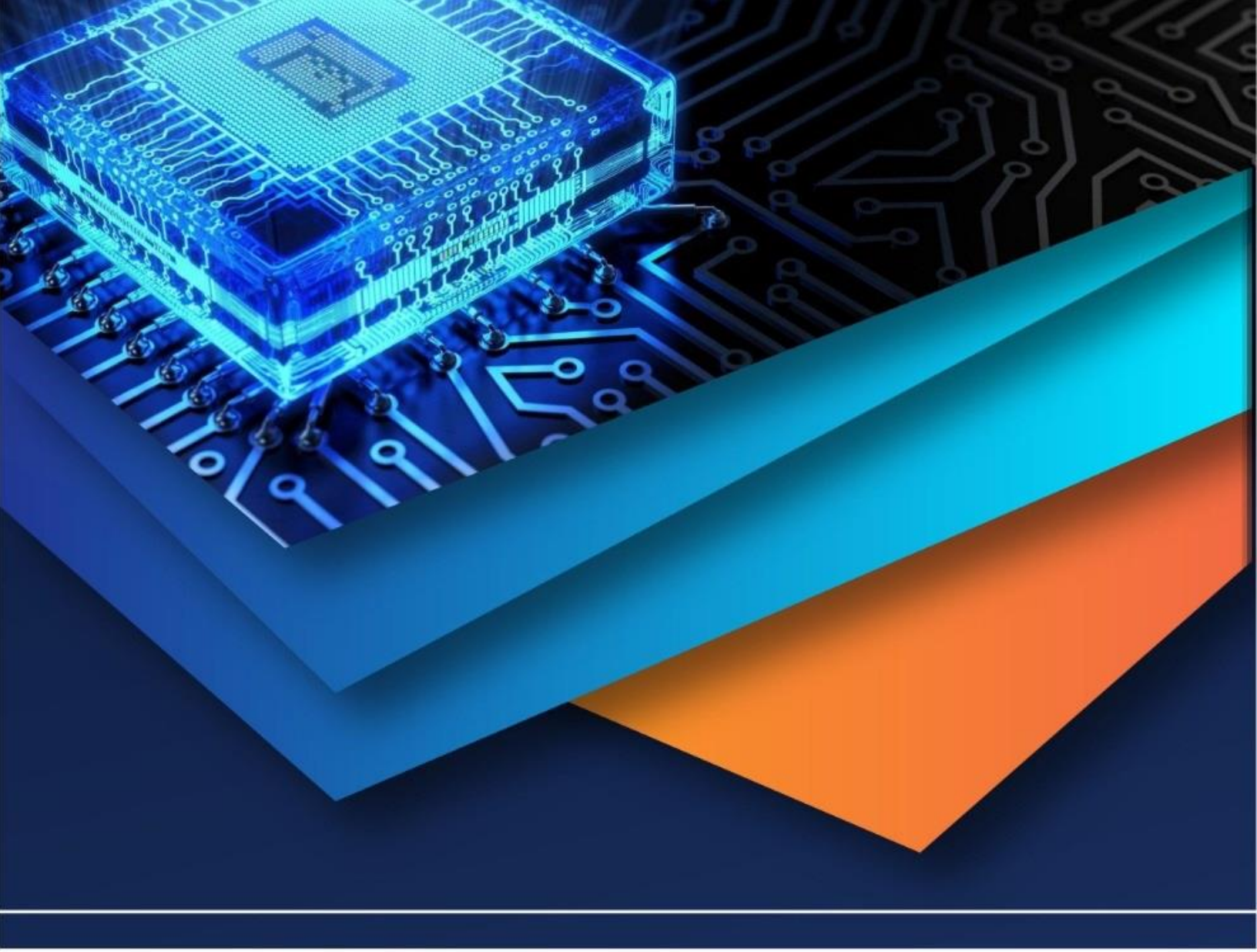
The proposed system takes into the consideration the data related to soil and suggest which are the best profitable crops which can be cultivated in environmental conditions as the system predicts the suitable crop. A dataset composed of soils in order to attempt to develop a model for predicting the quality of soil. It is essential to note that the soil images set consists of a choice of distinct soils. By considering the different types of soil images. Through, this we get the accuracy values by which we can plot the graph to know the accurate values. This will help the farmers to choose the best crop for the cultivation.

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[11] Determining Composition of Grain Mixtures by Texture Classification Based on Feature Distributions Ojala, Matti Pietikäinen
[12] Role of Soil in Groundwater Protection by Carl F. Engle, Craig G. Cogger, and Robert G. Stevens

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