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Crop Yield Recommender System based on Classification of Soil Type using AI and Deep Learning

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ABSTRACT: Agriculture relies heavily on soil quality, crucial for crop selection and production. Predicting soil texture aids in optimal land use. Current methods—chemical and image analysis—have drawbacks in cost and accuracy. Leveraging deep learning, a convolutional neural network (CNN) is proposed for soil classification, distinguishing six types: Clay, Clayey Peat, Clayey Sand, Humus Clay, Peat, Sandy Clay, and Silty Sand. This approach offers real-time applicability, assisting farmers in maximizing yield. Experimental results demonstrate superior performance compared to traditional image-based methods, enhancing accuracy, precision, F1_score, and recall scores.

KEYWORDS: Agriculture, soil classification, convolutional neural network, crop production, deep learning.

I.INTRODUCTION

Soil is a natural body comprised of solids (minerals and organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following: horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment. The upper limit of soil is the boundary between soil and air, shallow water, live plants, or plant materials that have not begun to decompose. Areas are not considered to have soil if the surface is permanently covered by water too deep (typically more than 2.5 meters) for the growth of rooted plants.The lower boundary that separates soil from the non-soil underneath is most difficult to define. Soil consists of horizons near the Earth's surface that, in contrast to the underlying parent material, have been altered by the interactions of climate, relief, and living organisms over time. Commonly, soil grades at its lower boundary to hard rock or to earthy materials virtually devoid of animals, roots, or other marks of biological activity. For purposes of classification, the lower boundary of soil is arbitrarily set at 200 cm.

II.DEEP LEARNING

Deep Learning is a part of machine learning, which is a subset of Artificial Intelligence. It enables us to extract the information from the layers present in its architecture. It is used in Image Recognition, Fraud Detection, News Analysis, Stock Analysis, Self-driving cars, Healthcare like cancer image analysis, etc. By inputting more data in the network the layers get trained very well. They can be classified into Supervised, Semi-Supervised and Unsupervised categories. Each layer is known for extracting information specifically. For example, in Image recognition, the first layer will find the edge, lines, etc, second layer like eye, ear, nose, etc. To help improve the efficiency of predictions, to find the best possible outcomes and for model optimization. When the data is huge, to reduce the cost in the company in terms of insurance, sales, profit, etc. Deep learning can be very useful when there is no particular structure to data means to analyse data from audio, video, image, numbers, document processing, etc.

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III.PROPOSED METHODOLOGY

The procedure for CNN modelling of soil properties using spectral data is sketched in Fig. 3.1. First, soil spectral data are organized as a matrix to fit the learning architecture of the CNN model. Next, the convolutional layer extracts the features of the input data via multiple convolutional kernels of a certain size and corresponding step size. The pooling layer, also called the down sampling layer, then replaces the values of the original range with the maximum or mean values of a certain size-sampling range. This step lessens the data for processing, while retaining key feature information. Finally, the fully connected layer, coming after the convolutional and pooling layers, non-linearly combines the extracted features to produce the output results. The hyper parameters are mainly the number of neurons used, and the output layer comprises the regression values or classification classes of the predicted soil properties.

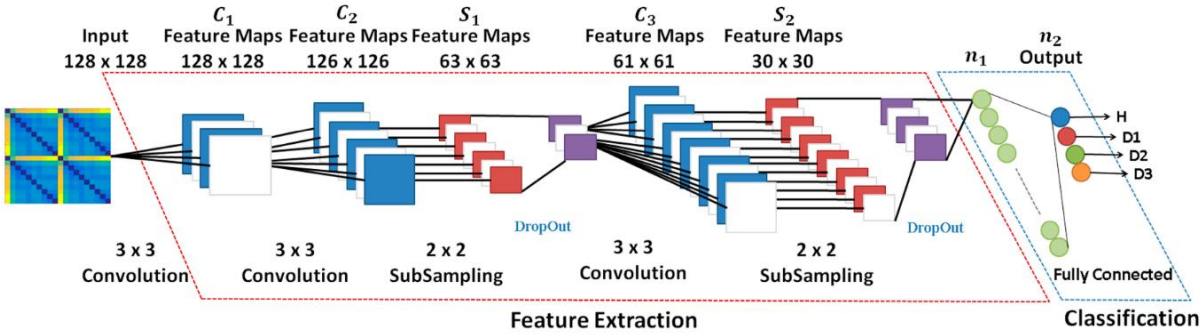

Figure .1. Architecture of CNN

IV.RESULT & DISCUSSION

The procedure for CNN modelling of soil properties using spectral data is sketched in Fig. 3.1. First, soil spectral data are organized as a matrix to fit the learning architecture of the CNN model. Next, the convolutional layer extracts the features of the input data via multiple convolutional kernels of a certain size and corresponding step size. The pooling layer, also called the down sampling layer, then replaces the values of the original range with the maximum or mean values of a certain size-sampling range. This step lessens the data for processing, while retaining key feature information. Finally, the fully connected layer, coming after the convolutional and pooling layers, non-linearly combines the extracted features to produce the output results.

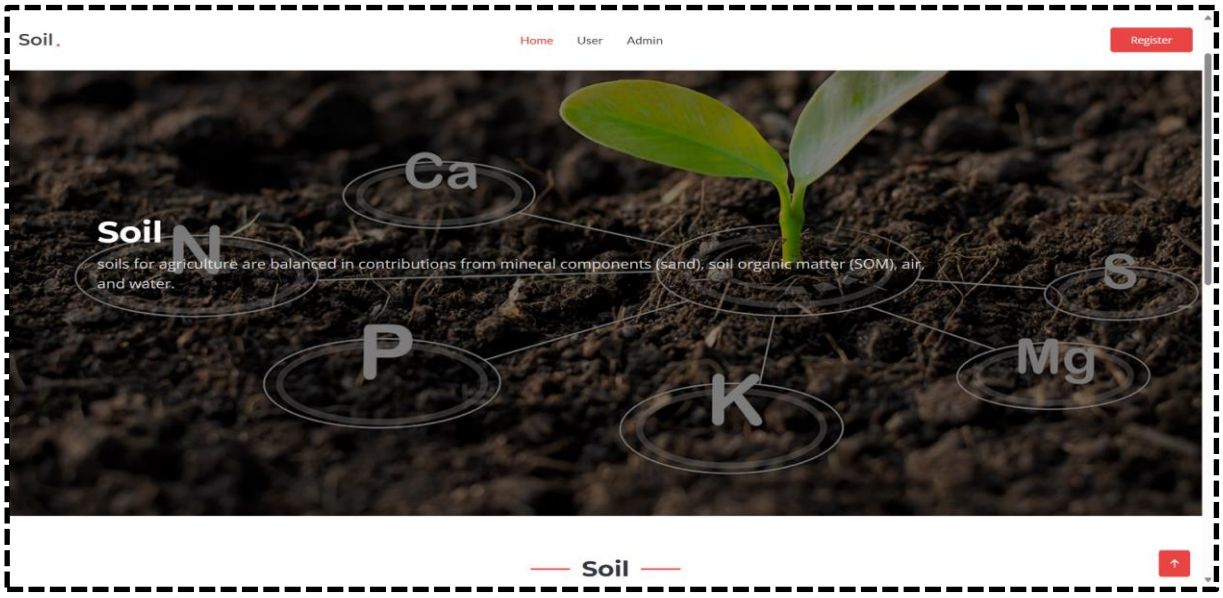

Figure.2. Soil

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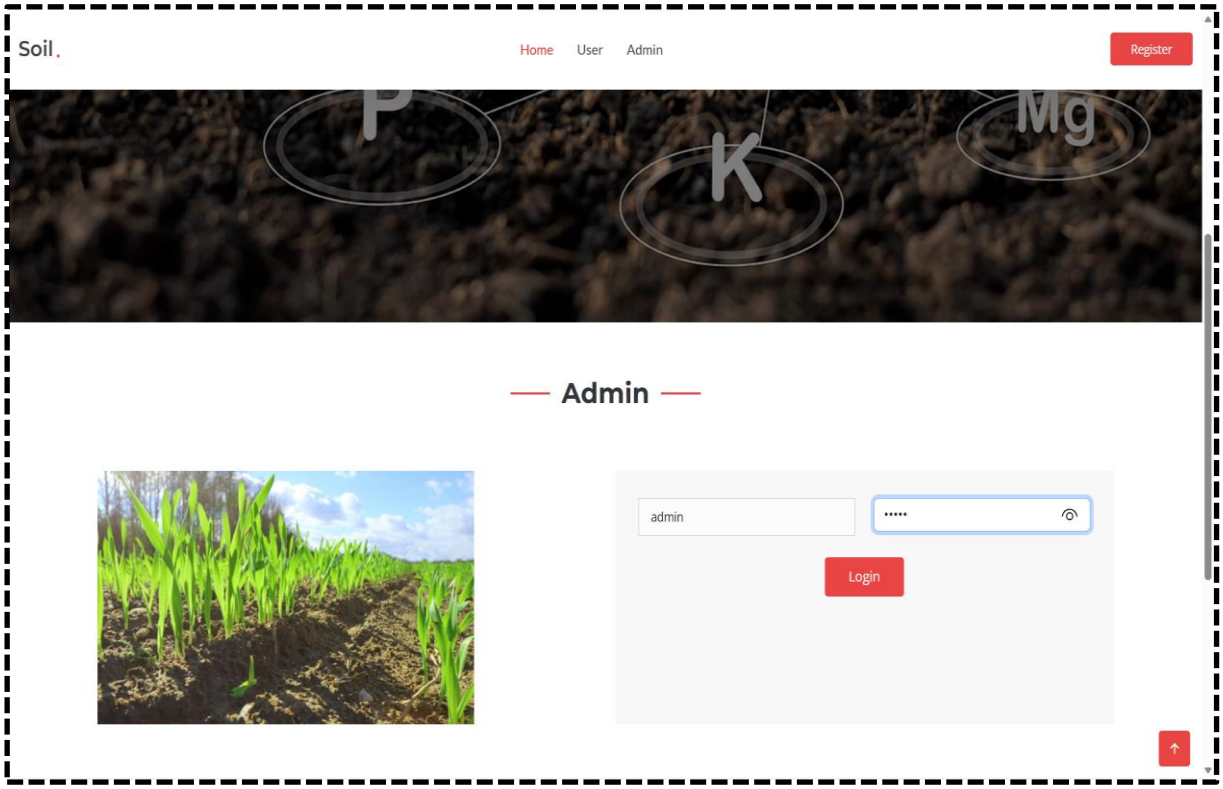

FIGURE.3.Admin

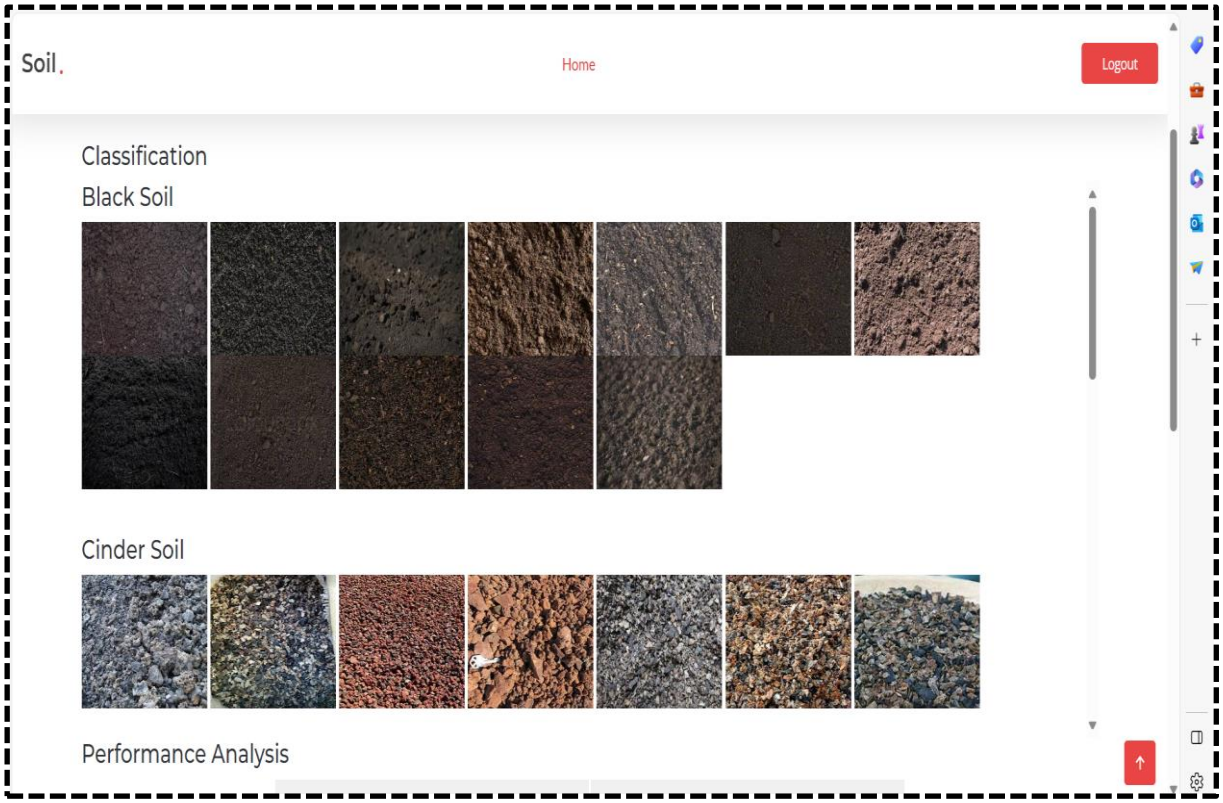

FIGURE.4 Classification

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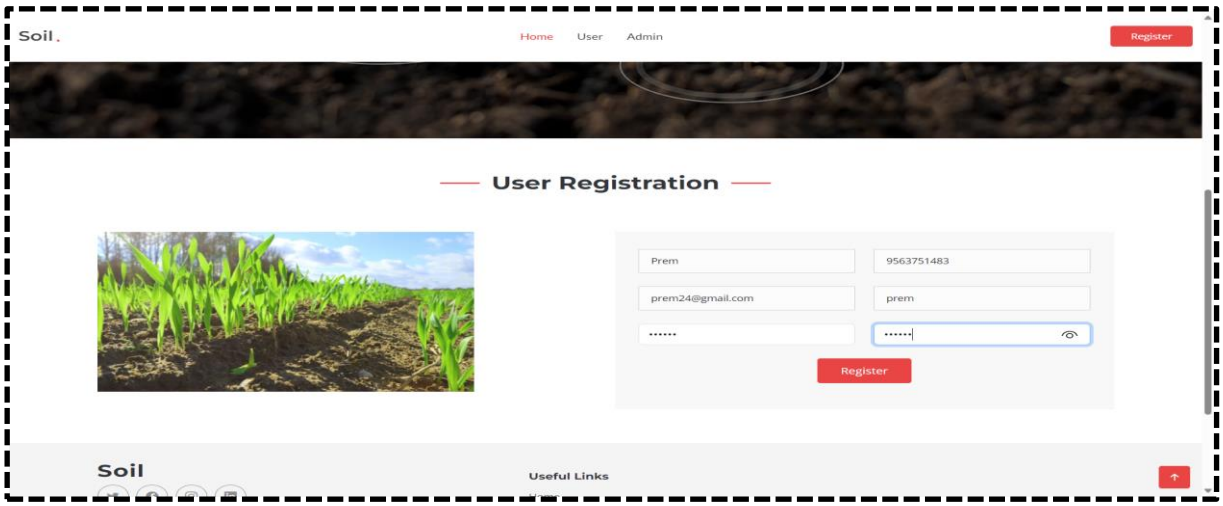

FIGURE.5.User Registration

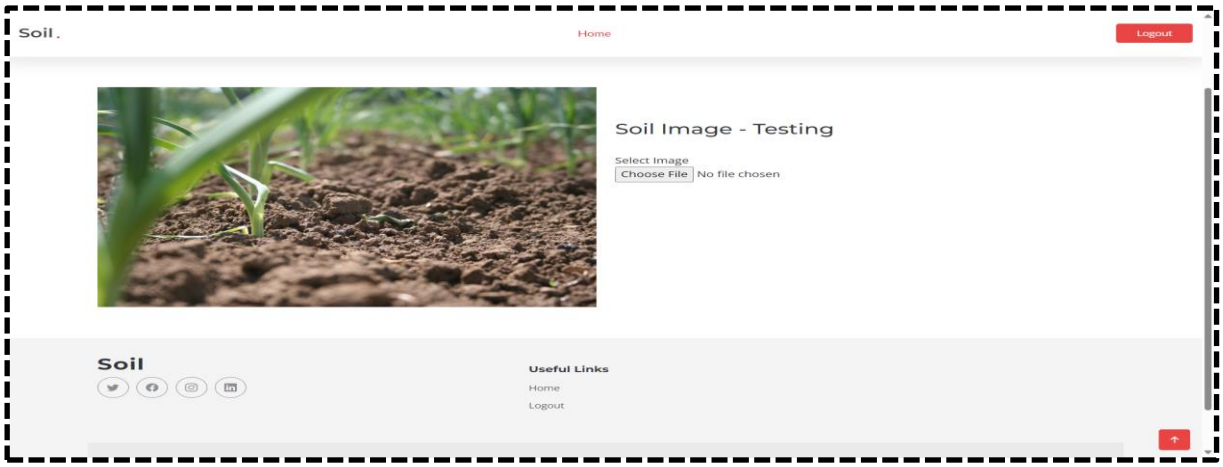

FIGURE.6.Soil Testing

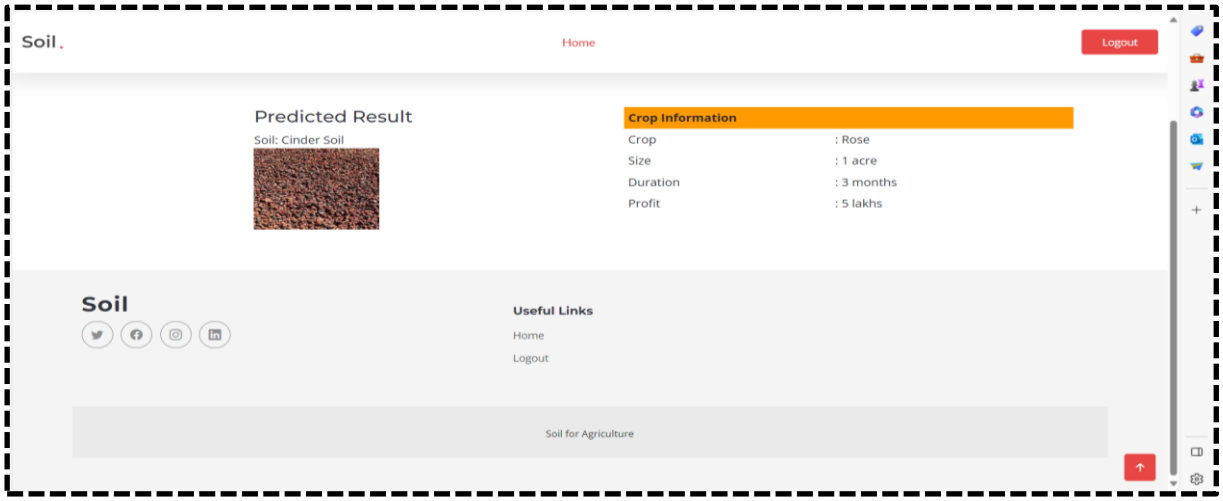

Figure.7.Soil Result.

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V.CONCLUSION

Soil Type is one of the main factors in agricultural production, and its precise prediction is important for the Crop Yield Prediction. Various studies have proposed different techniques to deal with the issues, including rule-based, statistical, and traditional learning methods. However, it takes a lot of time and effort to classify the soil type. In this project, Deep learning model is used to predict the different soil properties from RGB data. This project used CNN to build a soil type classification model to produce a higher accuracy with tiny loss. Using the proposed model, we used CNN's algorithm because classifying the soil type does not take time and effort to determine classification results. Convolutional Neural Network is used for building the neural network model where pre-processing is done by the network and performs the regression prediction of five soil properties. The automatic feature learning by Convolutional Neural Network increases the prediction accuracy of the proposed methodology. Based on the experiment results, we achieve trade-offs between accuracy and performance time by adjusting the hyper parameter to optimize model performance. We set epoch = 80, batch size=32, and learning rate=0.6. In the training process, the model can produce an accuracy = 98% and loss = 0.1877. The classification model can be a promising solution to address soil type classification. In addition, our propose model can get TP = 46 and TN = 44.

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