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CROP PREDICTION USING SOIL CONDITION AND DEEP LEARNING APPROACH

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ABSTRACT

India has a big agriculture industry. It is essential for the survival and growth of the Indian economy. India is a major producer of numerous agricultural products. Soil is important for the cultivation of crops. Soil is a dynamic, non-renewable natural resource that is necessary for life. Young Indian farmers frequently struggle with choosing the proper crop depending on the requirements of the soil. As a result, they see a huge drop in productivity. Farmers with practical experience used to cultivate crops in the past. Farmers can no longer choose the best crop based on the characteristics and attributes of the soil. In order to suggest the crop that can be harvested in that particular soil, a recommendation system that makes use of a machine learning algorithm has been created. The user-supplied image of the soil is processed in the proposed system and divided into one of four soil types: clay, alluvial, red, and black. This is achieved using a MobileNetV2 Architecture model. When the soil type is predicted, a number of crops that can be produced there are advised. Our proposed approach maps the soil and crop data to predict the list of crops that will grow well in a given soil. The farmers will therefore find our suggested approach helpful in guiding them to select the best crops for their soil and in educating Our proposed system achieved Training accuracy of 97.34% and validation accuracy of 99.21%.

Keywords:- soil condtions,cultivation,image processing,CNN, MobileNetV2

1 INTRODUCTION

One of the most significant professions in our nation is agriculture. It is the most diverse economic sector and is crucial to the overall growth of the nation. To meet the demands of 1.2 billion people, almost 60% of the country's land is used for agriculture. Therefore, modernizing agriculture is crucial and will help our nation's farmers make money. The process of studying data sets to make inferences about the information they contain is known as data analysis (DA), and it is increasingly done with the aid of specialized hardware and software. In the past, yield prediction was done by taking into account the farmer's prior experience with a certain field and crop. However, given how quickly the weather varies day to day, farmers Farmers are compelled to grow an increasing number of crops. Due to the existing circumstances, many of them are unaware of the advantages of growing the new crops and lack sufficient understanding about them. Understanding and predicting crop performance under various environmental situations can also boost farm output. The data on soil quality and weather-related information are thus inputs into the proposed system.

The soil's composition, including its levels of nitrogen, phosphorus, potassium, and pH. information about the weather, such as temperature, humidity, and rainfall. We are using the datasets from the Kaggle website in our study. A common issue that arises is crop forecast. A farmer was curious to know how much production he should anticipate throughout the growing season. In the past, this yield projection was based on the farmer's extensive knowledge of a particular yield, crop, and weather circumstances. Instead of worrying about crop prediction with the current method, farmers immediately go for yield prediction. Pesticides, environmental factors, and meteorological factors related to crops are not taken into account unless the correct crop is chosen and it is anticipated how much more will be produced with the current systems and the correct crop. One of the key elements for agricultural improvement is to encourage and stabilize agricultural production at a faster rate. Production of any crop indicates the way either through the interest of domain, a yield improvement, or both. The only way to expand the district under any crop in India is by re-establishing to boost crop strength or crop replacement. So, crop productivity differences continue to bother the region and cause severe misery. Therefore, in order to solve the current issue, it is necessary to try good crop forecast techniques.

2 LITERATURE SURVEY AND RELATED WORK

software model for precision agriculture for small and marginal farmers

In industrialized nations, precision agriculture (PA) was initially created to address the variability in soil and crop factors. Small and marginal farmers in Developing Countries can use farm-based agriculture by adapting the general PA concepts. This method is distinguished by a farmer-soil-crop database collected from the field, crop calendars provided by agricultural experts, real-time parameter acquisition through sensors, and an analytical model that simulates the crop calendar using static, semi-static, and dynamic inputs, leading to farmer- and crop-level support advisories delivered through gadgets like mobile phones and tablets [1].

Crop recommendation system for precision agriculture

Data mining is the process of looking through data and extracting useful information from it. Data mining is used in a variety of industries, including finance, retail, medicine, and agriculture. In order to analyze the many biotic and abiotic components, data mining is employed in agriculture. India's economy and employment are heavily reliant on agriculture. The primary issue facing Indian farmers is that they frequently fail to select the appropriate crop for their soil. They thus see a significant decline in production. Precision agriculture has been used to solve this issue for farmers. A sophisticated agricultural method known as precision agriculture offers to farmers the best crop based on their site-specific soil features, soil types, and crop production statistics.[2]

Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique

India's economy and jobs are significantly influenced by agriculture. The main issue facing Indian farmers is that they frequently choose the wrong crop for their soil's requirements. Productivity is impacted as a result. Precision agriculture has been used to address this issue for farmers. This approach is distinguished by the use of a soil database gathered from farms, crops supplied by agricultural specialists, and soil testing lab datasets to achieve metrics like soil. The recommendation system will use the data from the soil testing lab to gather data, create an ensemble model using majority voting, and employ support vector machine (SVM) and ANN as learners to efficiently and accurately recommend a crop for a site-specific parameter.[3]

Soil Classification and Crop Suggestion using Machine Learning

One of the most crucial aspects of our society is agriculture. For agriculture to be successful, soil is essential. Each type of soil has a unique composition. These chemical characteristics of the soil have an impact on crop growth. It's crucial to choose the correct crops for that specific type of soil. The data from the soil series can be classified using machine learning algorithms. To anticipate the crops that are most suited for a specific region's soil series and climatic circumstances, the findings of this categorization can also be paired with crop datasets. Both the crop and the soil datasets are used. The files include geographical and chemical characteristics of soil and crop features. SVM and the ensembling approach are examples of algorithms[4]

Survey of classification algorithms for formulating yield prediction accuracy in precision agriculture

The application of modern technologies in agriculture is known as precision agriculture. A significant amount of data is gathered in agriculture, and several data mining techniques are employed to effectively utilize it. We have covered a number of methods relevant to data mining classification approaches in this work. On a data collection that has been accumulated over time for the prediction of soybean crop yield, these algorithms are applied. In addition, a comparison of classification algorithms is conducted to demonstrate which algorithm is most effective in forecasting yield.[5]

3 PROPOSED WORK AND ALGORITHM

The suggested system outlines a soil analysis and crop prediction mechanism that makes use of a MobileNetV2 Architecture to address some of the country's agriculture sector's long-standing issues and boost profitability for the typical farmer. Additionally, we use the Flask web framework to create a web page that connects to our suggested model on the backend so that farmers can easily check the soil image and the recommended crop for it. The suggested system suggests crops that are best suited for a specific soil type and region while also taking into account the crops' potential for success with the projected soil. Red soil, Black soil, Clay soil, and Alluvial soil photos are included in the dataset used to train the parameters of this method. Both the training set and the test set of the dataset contain photos of each type of soil. The Soil Classification Image Dataset on Kaggle and related web sources are where this information is gathered. Since the photos in the dataset are different shapes and sizes, they must first be pre-processed and resized before being fed into the model. MobileNetV2 Architecture is the machine learning model that was used to categorize these photos into the various soil types. The user is prompted to upload an image of their soil. The values are fed into the MobileNetV2 Architecture machine learning model. The precise soil forecast is generated from the aforementioned input variables, and the outcome is displayed on the prediction page. When it comes to crop suggestion, the user also receives the appropriate crops along with the projected soil type, which simplifies and improves the user process by our proposed method.

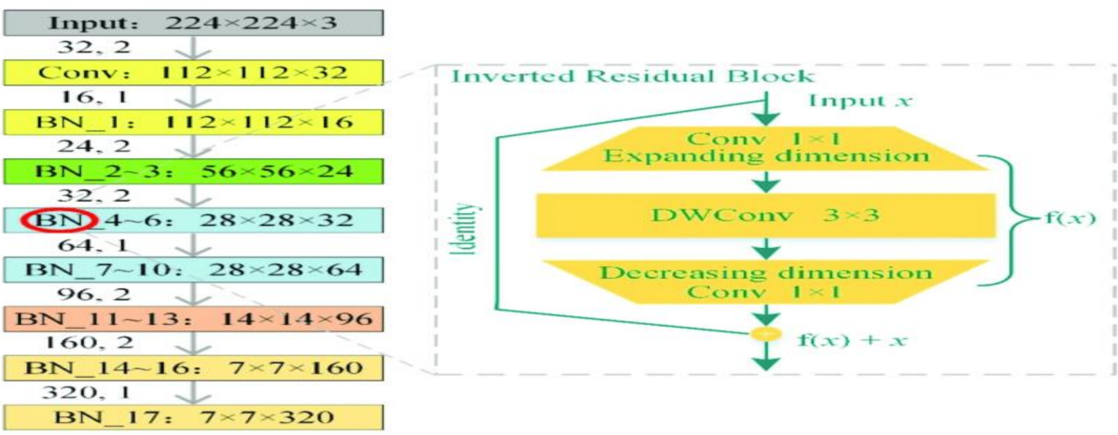

Fig 1 : proposed mobile v2 network for crop prediction

4 METHODOLOGIES

4.1 Dataset:

In the first module, we developed the system to get the input dataset for the training and testing purpose. The dataset is given in the model folder. The dataset consists of 1,553 Soil images. The dataset is referred from the popular dataset repository kaggle. The following is the link of the dataset.
Kaggle Dataset link:
https://www.kaggle.com/datasets/jayaprakashpondy/soil-image-dataset

4.2 Importing the necessary libraries:

We will be using Python language for this. First we will import the necessary libraries such as keras for building the main model, sklearn for splitting the training and test data, PIL for converting the images into array of numbers and other libraries such as pandas, numpy ,matplotlib and tensorflow.

4.3 Retrieving the images:

We will retrieve the images and their labels. Then resize the images to (128,128) as all images should have same size for recognition. Then convert the images into numpy array.

4.4 Splitting the dataset:

Split the dataset into train and test. 80% train data and 20% test data.

4.5 Building the model:

The concept of convolutional neural networks is very successful in image recognition. The key part to understand, which distinguishes CNN from traditional neural networks, is the convolution operation. Having an image at the input, CNN scans it many times to look for certain features. This scanning (convolution) can be set with 2 main parameters: stride and padding type. As we see on below picture, process of the first convolution gives us a set of new frames, shown here in the second column (layer). Each frame contains information about one feature and its presence in scanned image. Resulting frame will have larger values in places where a feature is strongly visible and lower values where there are no or little such features. Afterwards, the process is repeated for each of obtained frames for a chosen number of times. In this project I chose a classic MobileNet model which contains only two convolution layers.
The latter layer we are convolving, the more high-level features are being searched. It works similarly to human perception. To give an example, below is a very descriptive picture with features which are searched on different CNN layers. As you can see, the application of this model is face recognition. You may ask how the model knows which features to seek. If you construct the CNN from the beginning, searched features are random. Then, during training process, weights between neurons are being adjusted and slowly CNN starts to find such features which enable to meet predefined goal, i.e. to recognize successfully images from the training set.mBetween described layers there are also pooling (sub-sampling) operations which reduce dimensions of resulted frames. Furthermore, after each convolution we apply a non-linear function (called **ReLU**) to the resulted frame to introduce non-linearity to the model. Eventually, there are also fully connected layers at the end of the network. The last set of frames obtained from convolution operations is flattened to get a one-dimensional vector of neurons. From this point we put a standard, fully-connected neural network. At the very end, for classification problems, there is a softmax layer. It transforms results of the model to probabilities of a correct guess of each class

4.6 Algorithm Step

- In MobileNetV2, there are two types of blocks. One is residual block with stride of 1. Another one is block with stride of 2 for downsizing.
- There are 3 layers for both types of blocks.
- This time, the **first layer** is **1×1 convolution with ReLU6.**
- The **second layer** is the **depthwise convolution**.
- The **third layer** is another **1×1 convolution but without any non-linearity.** It is claimed that if ReLU is used again, the deep networks only have the power of a linear classifier on the non-zero volume part of the output domain.
- The network consists of 28 convolutional layers and 1 fully connected layer followed by a softmax layer.
- It is noted that batch normalization and ReLU is applied after convolution **Width Multiplier**

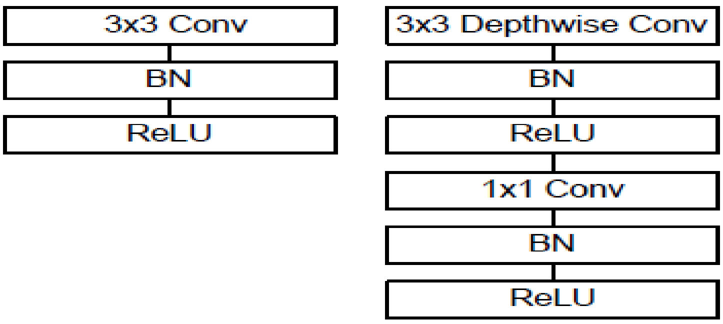

Fig 2:- layers description in mobile v2 Model

5. RESULTS AND DISCUSSION

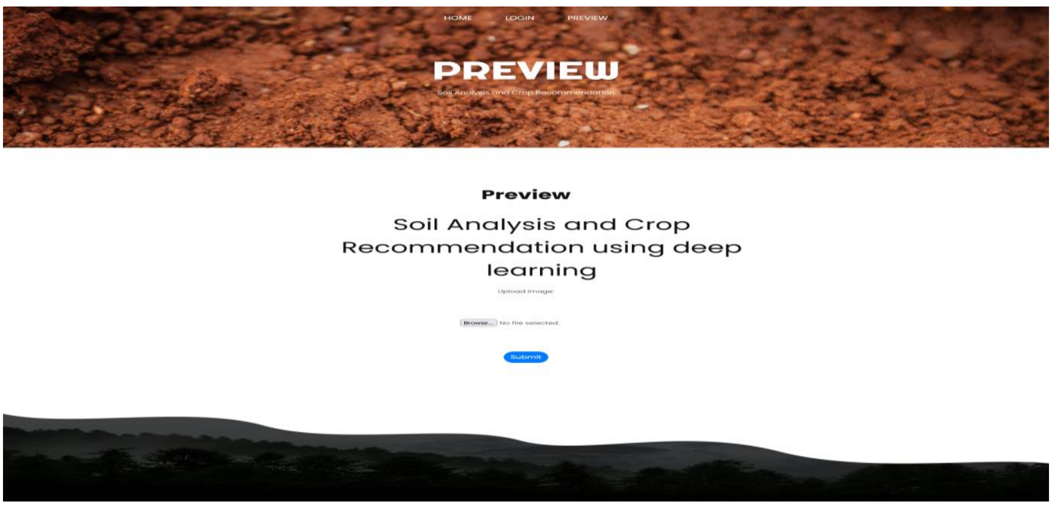

Fig 3:- here in this screen the user inputs the image for prediction

Fig 4:- here we can preview the uploaded image

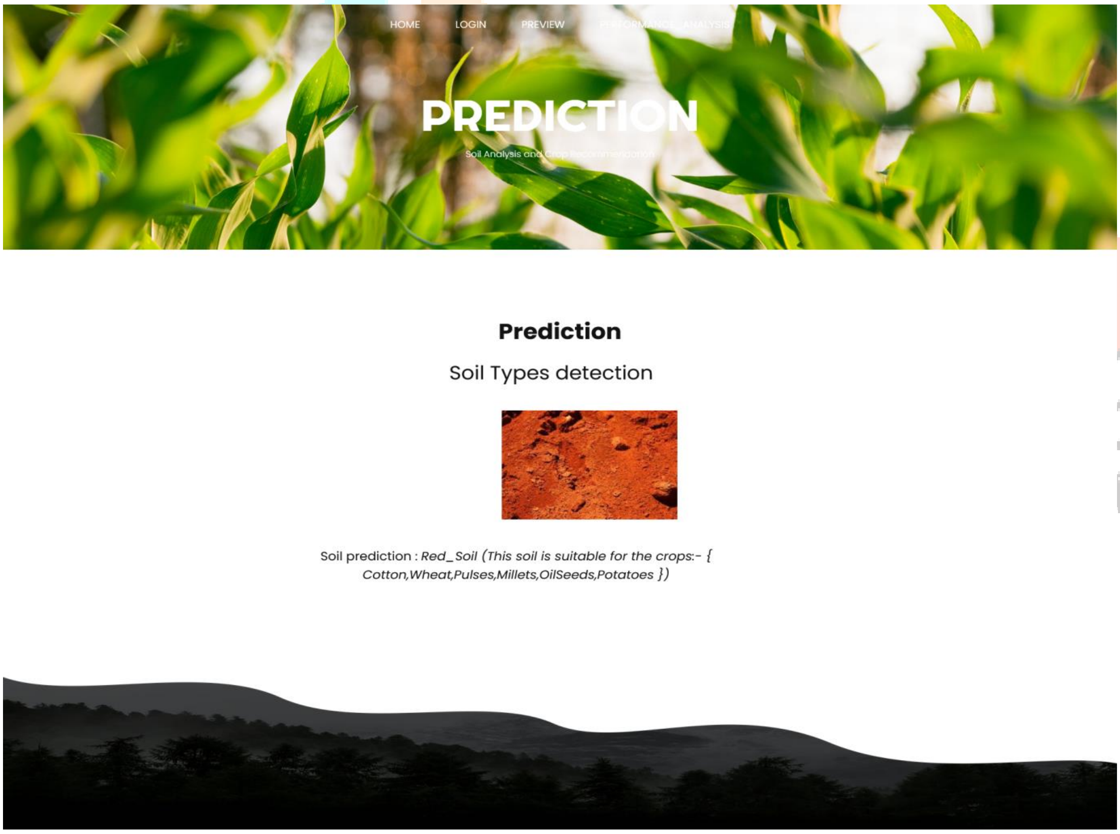

Fig 5:- the predicated result of the soil and the crop

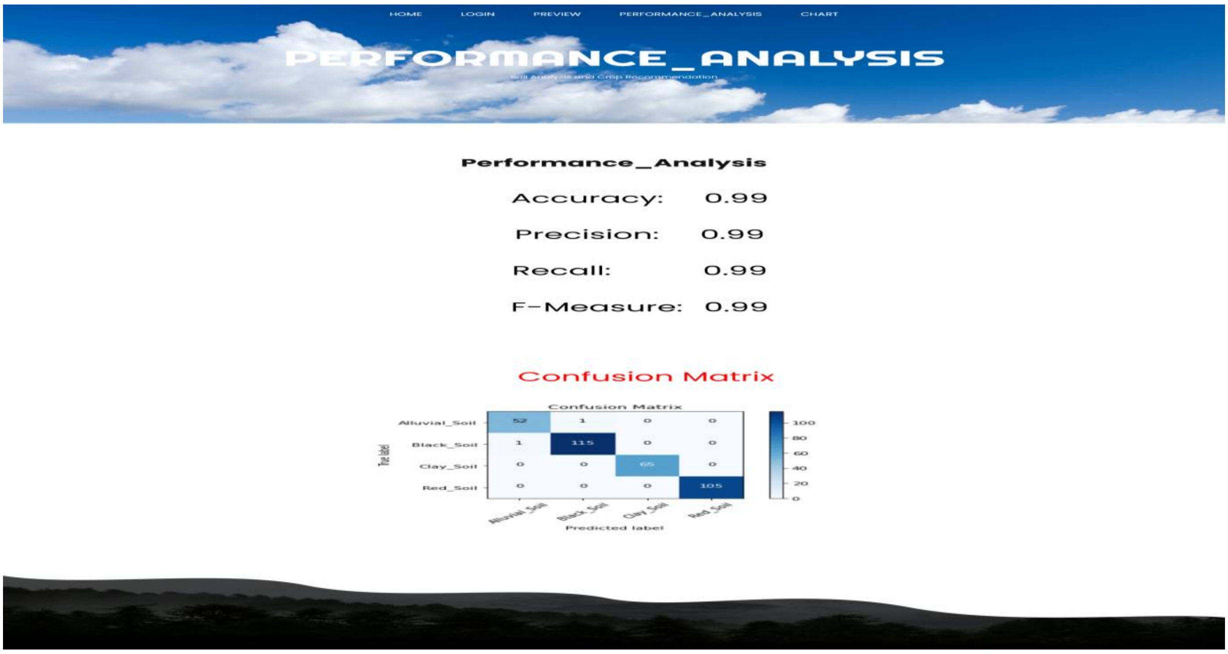

Fig 6:- performance analysis of the result using mobilev2 where we achieved an accuracy of 99%

6. CONCLUSION

India needs a thriving agricultural sector if it wants to experience long-term economic growth. By boosting profitability and enhancing agricultural productivity, our goal was to give small-scale farmers more leverage. In our tests, the MobileNetV2 Architecture greatly outperformed the soil classification dataset in terms of picture categorization. Amazing Training accuracy of 97.34% and Validation accuracy of 99.21% were achieved by the final MobileNetV2 Architecture.

By taking into account the composition found in the minority of the mixture, future research can modify this method to work with a variety of soil types. To further enhance the system and provide more precise yield prediction findings, the crop production dataset can be expanded.

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