Soil Nutrient Analysis and Crop Fertility Prediction using Deep Learning

Diksha D. Kharat¹, Medha A. Shah²

¹Scholar, ²Assistant Professor, Department of Computer Science and Engineering, Walchand College of Engineering, Sangli, India.
Email: ¹ diksha.kharat@walchandsangli.com, ² medha.shah@walchandsangli.ac.in

Abstract - Farming is done by traditional methods, farmers plant crops by using the old common method without knowing the properties of soil and quality of that soil. In the end, the farmer will not gain sufficient profit from their farming. It is necessary to know various soil parameters and based on that provide specific crop. Existing system provides a suggestion model with fewer soil parameters and low accuracy, Hence it aims to propose a convolutional neural network model to estimate soil nutrients and crop fertility with better accuracy and convert the same in a local language.

Keywords - Plant Disease, Convolutional Neural Network (CNN), Natural Language Processing (NLP), Soil Properties, Prediction.

1. INTRODUCTION

Analysis of soil is a crucial methodology, quality of soil is the major need as it gives various nutrients parameters present in the soil. In very traditional methods laboratories take samples and it will take 10-15 days to generate results so there might be a chance that they were not using the fresh soil for testing in that case model reduce the chances of accuracy that’s why it’s necessary to move further new technology. Soil contains physical, chemical and biological properties. Soil is useful to evaluate its fertility, to predict the increase in yields and profitability of fertilization it does not only estimation of various soil parameters but also used to provide suggestions on crops, for this purpose use multiple methods, there are various soil-based crop suggestion systems are available in the market but it has some limitations as well as for the determination of the soil, PH value, mostly pH sensors are used. But, they are not always feasible as they add to the cost for production. To overcome this issue, this research aims to provide such a model in an efficient way.

With the increase in technology the priority to educate them. This will make farming simpler and avails different features at ease to the farmer. Hence it becomes important to educate farmers in many ways like predicting disease in advance and taking precautions to avoid loss, soil pH values can be predicted without the farmers to visit the laboratories, crop recommendation is also possible and made available through modern technologies, weather information and also marketing information is provided for the field. The modern technique also provides a helping hand to the farmers in exporting field products and maintaining fields.

Image processing helps in various technologies to determine soil pH value. Accurate results are produced with processing.

2. LITERATURE SURVEY

Mrs. K.R.Sri Preetha etal.[1] developed Soil TestKit. It is a device that can use colorimetry to determine the Nitrogen, Phosphorus, and Potassium content and pH of the soil. LDR color and TCS3471 sensors are used to extract RGB values. The device was tested pH with ten trials. Shakil Ahamed et al. [2] proposed crop yield prediction and it suggests suitable crops and it also helps to increase profitability. The system considers various terms like soil type, temperature of the soil, humidity, water level present in soil, spacing and depth of soil, pH, and various fertilizer predictions by using the Bayesian algorithm where high accuracy in the prediction is obtained. Aakunuri et al.[3] create an extensible Crop Yield Prediction Framework. that can give selection of crop, for crop yield prediction provide a dataset for precision agriculture.

Srunitha k. et al[4] mentioned classification algorithms such as Support Vector Machine for the types of soil. It contains some steps like image acquisition, image preprocessing, feature extraction, and classification. Low pass filter, Gabor filter, and using color quantization techniques are used to extract texture features from the soil. Paper [5] It developed digital image processing based methods for detection of soil color by using MATLAB code. Shima Ramesh Maniyath et al.[6] implement an algorithm using digital image processing for soil color detection with the help of the MatLab code. Separate the soil portion from the background by using HSV segmentation. Classifies the images based on the KNN classifier.
Government application as follows:

**Kisan Suvidha:** Kisan Suvidha app provides various data from district level agriculture experts that provides advice, soil health card, weather, plant protection market price, etc.

**Soil Health Card:** provides a report to the former. It will contain the current status of soil with various parameters i.e., Macronutrients (N, P, K), Micronutrients Zx, Fe, Cu, Mn, Bo, and Physical Parameters pH, EC, OC.

**Agren Soil Calculator:** Agren Soil Calculator used to estimate soil erosion helps to manage soil as per current parameters available in the soil.

3. **EXISTING SYSTEM**

Recommendation for crop was done with the help of previous methods like CHAD, K-Nearest Neighbour and Naive Baye’s. It was done with field sensors, moisture, temperature etc. collected with the help of sensors. Then after all method processing according to the collected data by the user also after that further procedure was to suggest suitable crop based on that. Apart from that for the determination amount of potassium, phosphorous, nitrogen they were used colorimetry.

4. **METHODOLOGY**

**A. Preprocessing of Data**

Before processing the image, pre-processing is done on the image as shown in Fig. 2. Initially a collection of datasets from various sources and creates a new dataset are collected. After the collection of datasets, image segmentation process is done as the important step in precessing the image. The general framework of the process is shown in Fig.1.

**B. Building a Classifier Model**

In this step, we aim to build a CNN model for the classification of various soil parameters. As this step involves a complex learning and classification process, this has been planned to run with the help of a GPU, with the support of Cuda, for faster execution.

**C. Improving the Accuracy of Model**

In this step, CNN-VGG is used during the evaluation process. It is particularly used to improve the accuracy of the classification model.

**D. Recommend Model Evaluator**

This module takes in the soil parameters as input and also uses the Recommendation Model to recommend the crop suitable for the data provided. The output of this module is given as input to model evaluator.

**E. Training and Testing Datasets**

Dataset contains two types of datasets namely soil dataset in the form of images and crop dataset in the form of CSV file. Soil images have been collected from various government sources. Crop dataset refers for crop suggestion and soil images refer for prediction of soil pH value. During the training phase 80 percent of data and testing phase 20 percent of data are used.

**F. Natural Language Processing**

The next step in this process is the Natural Language Processing. In this process, converting the results into a local language that is in Marathi language. Encoder and Decoder are used to achieve this appropriately.
5. RESULTS

A. Model Accuracy on Soil Dataset

Table 1. Soil Dataset Result

<table>
<thead>
<tr>
<th>Model</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNN</td>
<td>60%</td>
</tr>
<tr>
<td>VGG</td>
<td>70%</td>
</tr>
</tbody>
</table>

As mentioned in the above table 1, it contains some models such as CNN (Convolution Neural Network) and VGG Model. Both models are used for training purposes with 60 and 70 percent accuracy, for simple convolutional neural network batch size is 1 and epochs contain the size of training data, same used for VGG Model.

B. Model Accuracy on Crop Dataset

Table 2. Crop Dataset Result

<table>
<thead>
<tr>
<th>Model</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML</td>
<td>90.74%</td>
</tr>
<tr>
<td>CNN</td>
<td>97.94%</td>
</tr>
</tbody>
</table>

Table 2 shows a crop dataset that contains calculated soil pH value, labeled crop name in a predefined format. For the training purpose Convolutional neural network is used with 97 percent accuracy with 150 epochs and 10 batch size. After prediction of soil pH value based on that model able to predict suitable crop, after that it will convert the same in a local language by using NLP.

6. CONCLUSION

Deep learning models are used to predict soil properties in this model its predict soil pH value based on that pH value it suggest a proper crop for given an image of the soil and the parameters and display results in a local language for better understanding.
REFERENCES


