Recommendation System for Crop, Fertilizer and Disease Detection

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Abstract - In general, rural farmers lack the knowledge and guidance required to cultivate crops that improve agricultural production. Farmers usually grow crops in the same pattern year after year, using the same fertilizers and crop types, this in turn results in the loss of nutrients and minerals required to create healthy crops. Farmers typically struggle to recognize the crop diseases and lacks knowledge in selecting the suitable to grow based on the local conditions.Government-funded initiatives and efforts have been established recently to teach farmers about crops and assist them to become more technologically aware. This study has developed a novel crop recommendation model to advice farmers about which crops to plant, where and how to prevent crop diseases, and what type of fertilizer to use. The proposed application also allows farmers to update or report crop-related issues for public access, including recommendations for certain disease cures.This application also gives advice on how to cultivate healthy crops, suggest fertilizers, and get assistance with crop disease issues by integrating various Machine Learning (ML) technologies. This study also initiates to create a blog to connect farmers globally and allows them to exchange difficulties and information on various crop diseases by using Flask.

Keywords: Deep Learning, Ensemble Model, Random Forest, SVM, Convolutional Neural Network (CNN),Classifier, Rendering templates, Linear Regression, Bayes, Random Forest, Flask.

I. INTRODUCTION

Farming is the key driver for the economic growth of a country [1]. 70% of India's population is fully dependent on agriculture. Young Indian farmers often find it difficult to select the right crop based on soil conditions. The user can predict the crop's production using basic inputs such as the proportion of gases in the air, the state and district where it is located, and the resulting output. Users have significant efficiency issues [2, 3]. According to the recent research findings, farmers need assistance to evaluate the soil quality by getting crop recommendations based on the results of a data mining technique.Machine learning algorithms can be used to analyze the previous crop production data and select the best crop in the region based on meteorological data. These algorithms can also provide information on the different types and amounts of pesticides used in agriculture. As a result, by deploying such ML and technology driven farming, producers may increase the variety of crops they produce, widen their profit potential, and prevent the destruction of the environment. ML also provides options to enable farmers to upload images of diseases plants or leaves.

II. RELATED WORKS

In an attempt to find a remedy to avoid agriculture loss, experts and manufacturers are developing various crop analysis or fertilizer prediction models [5, 12].

Table 1 shows a comparative analysis on the existing research literature.

Table 1: Literature Review

AUTHOR	METHODOLOGY	PROS	CONS
P. A. S. Chakraborty, A. Kumar and O.R. Pooniwala.	Different types of ML algorithms used in the crop recommendation system are analyzed.	Different types of algorithms for the recommendation of the system.	Performance comparison efficiency is not accurately predicted
Mrs. S. Vaishnavi., M. Shobana. , R. Sabitha. and S. Karthik	This model is purely based on the season and the crops cultivated in that season, but the system can also take many other attributes to get the crop efficiently.	Used different types of Techniques in solving the problem statement.	Failed in finding the efficient way due to not used updated algorithms.
Mr. KodimalarPalanivel and Surianarayanan, C.	Developed a model that works on Prediction using Big Data Techniques in which it is a unique way to	Methodology they have used it quite impressive and unique way of	It didn't show many good results in the accuracy and to improve that they can use the

	do these kinds of projects.	approach to this problem.	ensemble model.
S. P. Raja, G. Mariam ma, A. Surulian di and E. Poongoth ai	Developed a different type of approach based on soil with hardware using modified recursive feature elimination technique with various classifiers.	This paper idea is identical and used different kinds of algorithm s.	But had more no. of attributes which are not that much related to the crop.
Nischitha , K., Mahendr a N. Dhanush Vishwak arma, and Manjuraj u MR Ashwini	This research recommends the crop by using different kinds of algorithms but mainly based on the factor rainfall factor which isn't much recommendable.		It didn't show many good results in the accuracy and to improve that he can use the ensemble model.

III. METHODOLOGY

A. Dataset Description

Datasets on crops and fertilizers were obtained from many sources, including UCS and Kaggle. Here, the crop data is organized as chemical information vs fertilizer information. The obtained data is then organized into 12340 rows and 8 columns. The features considered from the data are: ground oxygen potential, potassium and phosphorus levels and ammonium. Hence NPK model (N = nitrogen, Ph = phosphorus, and K = potassium) can be used to determine the crop production level. The proposed system is trained and developed using 38 different plant disease. The model can also accept images of unhealthy leaves or plants as input and returns information about the disease and how to prevent it.

B. Techniques and Formulas

The proposed system has five distinctive classification algorithms to provide the most accurate results possible. For best results, an ensemble model is used. This model's output is generated by utilizing a number of algorithms that consider three unique approaches: bagging, stacking, and boosting. For crop classification, five different algorithms: Decision Tree, Random Forest, Naive Bayes Model, Support Vector Machine, and Logistic Regression are used.

The Resnet architecture utilized here includes nine inner layers detect plant diseases. ResNet is often used for performing image classification tasks that require assigning a label or category to an input image [7]. ResNet's residual connections make it easier to build deep neural networks. ResNet has been used in a variety of object recognition frameworks, including YOLO (You Only Look Once) and Faster R-CNN [10]. ResNet is capable of distinguishing objects of varying sizes and scales due to its ability to extract hierarchical properties from images [13].

C. Modules

The proposed module enables farmers to read chats, submit crop input, and start discussions on the system's website. This is possible by using Flask's micro-web framework. All data relevant to farmers or clients is saved and retrieved using SQLite3, an ORM-based database.
Flask-WTF forms are used for any input labels that need data, such as usernames, email addresses, passwords, and so forth. The SQLite3 repository is used to obtain data for various purposes such as user authentication using the session ID.

IV. PROPOSED SYSTEM

The proposed method improves yields by utilizing classification algorithms. Customers get easy access to the proposed framework. It works with a variety of models, including decision trees, random forest classifiers, SVM, Naive Bayes, and logistic regression. Since it produces the most accurate results of the methods used, an ensemble model is created from it. When accuracy is critical, the ensemble model is used, and depending on the machine learning process type, it consistently produces better, or average, outcomes than other methods.

The proposed method analyzes data sent by users or farmers. It predicts the best crops for that type of soil based on the user's selection of some of the most important characteristics, such as potassium, nitrogen levels, and rainfall. In addition to the aforementioned and fertilizer, a prediction can be made based on the projected crop production and another factor, soil erosion. Technology enables farmers to increase their produce and expand their commercial activities. Interesting features include the ability to detect practically any plant disease based on a picture of a leaf, as well as repetitive fertilizer treatments and advice on how to keep the plant healthy in the future. All of these also benefit from a Flask-developed webpage that is less complex for end users and simpler for clients to use when this strategy is put into practice.

Flask can help to construct a farmer-focused blog, allowing farmers to engage and discuss different agriculture topics. This website uses multiple module types and authentications and is totally Flask-designed. Using internet tools to produce crops can help farmers to make better decisions, enhance efficiency, output, cost-effectiveness, accessibility, and seek professional assistance. Farmers may easily use the system via the online application, which is a responsive website. Farmers will also be able to submit feedback on the system's forecasts and recommendations via an integrated feedback mechanism. Farmers could readily access all the data they want if a single web platform includes all of the tools required for crop, fertilizer, and disease identification.

V. RESULTS AND DISCUSSION

When the farmer provided information about soil type, climate, city, and state, the recommendation algorithm will recommend crops while identifying pests and cropping methods. The proposed system's fertilizer suggestions have shown to be effective based on the land's inputs and the chemical components present in the substrate. The disease detection component provides effective treatment options by accurately identifying common crop diseases. Farmers may communicate with one another via the interactive platform by sharing their experiences and learning from one other.

The accuracy of the results produced by the five different types of ML techniques is as follows.

Table 5.1 Accuracy of prediction models.

ALGORITHM	ACCURACY (%)
Naive Bayes	96%
Random Forest (RF)	99%
Decision Tree (DT)	86%
SVM	94%
Logistic Regression	91%

```
Ensemble model's Accuracy is:  0.9840909090909091
              precision    recall  f1-score   support

       apple       1.00      1.00      1.00        13
      banana       1.00      1.00      1.00        17
   blackgram       0.76      1.00      0.86        16
    chickpea       1.00      1.00      1.00        21
     coconut       1.00      1.00      1.00        21
      coffee       0.96      1.00      0.98        22
      cotton       1.00      1.00      1.00        20
      grapes       1.00      1.00      1.00        18
        jute       0.84      0.96      0.90        28
 kidneybeans       0.93      1.00      0.97        14
      lentil       1.00      0.91      0.95        23
       maize       1.00      1.00      1.00        21
       mango       1.00      1.00      1.00        26
   mothbeans       1.00      0.84      0.91        19
    mungbean       1.00      1.00      1.00        24
   muskmelon       1.00      1.00      1.00        23
      orange       1.00      1.00      1.00        29
      papaya       1.00      1.00      1.00        19
  pigeonpeas       1.00      0.94      0.97        18
 pomegranate       1.00      1.00      1.00        17
        rice       1.00      0.69      0.81        16
  watermelon       1.00      1.00      1.00        15

    accuracy                           0.97       440
   macro avg       0.98      0.97      0.97       440
weighted avg       0.98      0.97      0.97       440
```

Fig.5.1 Accuracy of ensemble model.

The Random Forest Algorithm obtained the highest accuracy when compared to all other models examined. While using an ensemble model might help us get zero error precision results and is also a superior option when working with sensible data, using an individual model can also offer high accuracy yields.

```
%%time
history += fit_OneCycle(epochs, max_lr, model, train_dl, valid_dl,
                        grad_clip=grad_clip,
                        weight_decay=1e-4,
                        opt_func=opt_func)
Epoch [0], last_lr: 0.00812, train_loss: 0.7466, val_loss: 0.5865, val_acc: 0.8319
Epoch [1], last_lr: 0.00000, train_loss: 0.1248, val_loss: 0.0269, val_acc: 0.9923
CPU times: user 11min 16s, sys: 7min 13s, total: 18min 30s
Wall time: 19min 53s
```

Fig.5.2 Accuracy of disease model.

Thus, 99.2% accuracy was achieved. which, after going through several training and modeling stages, is quite accurate. When certain parameters are adjusted and methods such as gradient clipping, scheduling learning rate, and weight decay are used, ResNets perform well in all image classification tasks. All of the test sets' images can be predicted by the proposed model.

VI. CONCLUSION AND FUTURE WORK

The proposed model has delivered personalized recommendations on crops, fertilizer products, and disease detection. The system's utilization on image recognition and machine learning algorithms improved the accuracy of the recommendations, allowing farmers to enhance their quality of life and improve agricultural production. Furthermore, the interactive platform enables farmers to connect and interact with one another. The proposed system may be improved further by including more data sources, such as satellite images, which might offer more precise information on crop growth and soil conditions.

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