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Farmer's Crop Welfare System

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***Abstract*— The "Farmer's Crop Welfare System" is a technology that uses advanced data analytics and artificial intelligence to improve crop management and yield. It combines crop prediction, disease detection, and fertilizer recommendation. Crop prediction uses historical and real- time data, while disease detection uses image recognition and deep learning to identify early signs of diseases, promoting sustainable farming practices.**

***Index Terms*— farmers, crops, artificial intelligence, deep learning, machine learning, CNN**

I. Introduction

The Agriculture Insight System is a revolutionary agricultural technology that uses data analytics and artificial intelligence to revolutionize crop management and optimize agricultural yield. The Farmers Welfare System, a web-based platform, addresses key aspects of farming, including crop prediction, disease management, and fertilizer optimization. By using historical and real- time data, the system accurately forecasts yields, allowing farmers to plan their activities with precision.

One of the system's standout features is its disease detection capability, which leverages image recognition and deep learning techniques to identify early signs of diseases, providing timely insights for farmers. This proactive approach minimizes crop losses and reduces reliance on pesticides, improving economic sustainability and promoting environmentally friendly practices. The system also analyses the chemical composition of soil and water, taking into account factors like pH levels, nutrient content, and moisture levels to predict the most suitable crops for cultivation in a particular area. It tailors crop recommendations based on the unique conditions of a given farm, assisting farmers in making optimal decisions for their specific agricultural environment.

Fertilizer recommendation is another crucial aspect of the system's functionality, providing personalized suggestions based on diverse data sources to ensure crops receive the necessary nutrients for robust growth and improved productivity. By optimizing fertilizer usage, farmers not only enhance their crop yields but also contribute to sustainable farming practices by minimizing excess runoff and its associated environmental impact.

Farmers can take timely and targeted action to stop the spread of diseases and minimize the negative effects on crop productivity thanks to the system's superior image processing and deep learning techniques.. The system's user-friendly website interface allows farmers to input their data, access actionable recommendations, and make informed decisions to enhance their crop welfare.

II. Literature Review

[1] This study focuses on crop selection methods using machine learning to consider various environmental factors.

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The authors emphasize the importance of price in crop selection, as it can lead to inappropriate crop choices. They propose extended methods that explicitly consider price factors, building upon and refining previous methodologies.

[2] The study presents an approach using different machine learning techniques to predict crop yield categories based on macro-nutrient and micro-nutrient status in a dataset from Krishi Bhawan (Talab-Tillo) Jammu. The parameters include pH, Oc, Ec, N, P, K, S, and micro-nutrients. Machine learning algorithms are applied to predict the category of yield, which specifies the yield of crops. The problem of predicting crop yield is formulated as classification using different classifier algorithms.

[3] The study suggests a deep learning-based model that was trained on a publicly available dataset that included pictures of both healthy and damaged crop leaves. Based on the pattern of defect, the model divides leaves into unhealthy groups.

[4] The researchers introduce a model designed to forecast soil series based on land type and provide recommendations for suitable crops. They use various machine learning algorithms, including Weighted k-nearest Neighbour (k-NN), Bagged Trees, and Support Vector Machines (SVM) employing Gaussian kernels, for soil classification. The results demonstrate the superior performance of the proposed SVM-based method compared to numerous existing approaches.

[5] The research makes use of a Kaggle dataset covering the months of January through December of 2000–2018, which includes information on temperature, precipitation, area, evapotranspiration, production, yield, and reference crop. For high accuracy, data mining techniques including Bayesian network algorithms, K- Means Clustering, KNN, and SVM are used.

[6] This study uses the Majority Voting technique, which consists of four machine learners: Naïve Bayes, K-Nearest Neighbour, CHAID, and Random Tree. The technique allows for the integration of any number of base learners, requiring a minimum of two. The project proposes a machine learning-based solution for analyzing soil properties, grading soil, and predicting crops suitable for the land. The dataset is pre-processed, and a regression algorithm is applied to predict soil rank.

[7] The DSS LANDS's potential for forecasting Sardinia's potato late blight epidemic is also being studied. A Feed-forward Neural Network and Support Vector Machine Classification are used to forecast the severity of the disease, utilizing meteorological data from ARPAS weather stations. For ANN and SVM classification, respectively, the prediction accuracy was 96% and 98%.

[8] The test that was carried out in order to forecast the potato late blight disease in Sardinia using the DSS LANDS is detailed in this study. Using a machine learning method, the study's goal was to determine whether regional weather characteristics might be utilized to predict the risk of potato late blight in southern Sardinia. A Feed-forward Neural Network and Support Vector Machine Classification are used to forecast the severity of the disease, utilizing meteorological data from ARPAS weather stations. For ANN and SVM classification, respectively, the prediction accuracy was 96% and 98%.

[9] The study focuses on supervised machine learning methods for identifying maize plant diseases using plant photos, including Random Forest (RF), K- Nearest Neighbour (KNN), Decision Tree (DT), Naive Bayes (NB), and Support Vector Machine (SVM). When comparing the results of several categorization techniques, the RF algorithm yields the highest accuracy, at 79.23%.

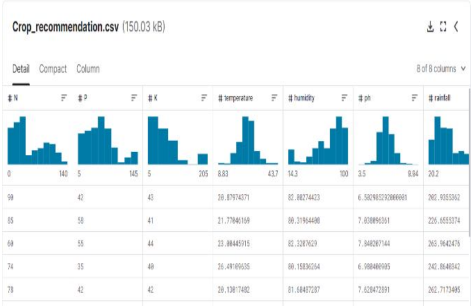
[10] Lastly, the paper uses LSTM and CNN to identify disease-specific leaves in plants through image recognition techniques. The proposed CNN model identifies infestations with high accuracy and precision with significantly fewer training epochs. The study emphasizes the need to increase and improve different region-specific infestations due to climatic and seasonal changes.

III. DATASET

A dataset has been developed to build predictive models for crop selection based on rainfall, climate, and fertilizer data available in India, enabling users to recommend suitable crops for specific farms. The crop recommendation n dataset consists of mainly seven attributes they are N, P, K, Temperature, Humidity, Rainfall, and Ph with 2200 ccaptures of seven attributes.

A fertilizer dataset has been created to develop predictive models for fertilizer selection in India, based on N, P, K and Ph. The dataset contains 4 columns along crop name with 1842 samples.

The plant disease dataset, consisting of 87K RGB photos of healthy and diseased crop leaves, is recreated using offline augmentation from the original dataset, divided into 80/20 training and validation sets. It is an image dataset containing two sub-folders named train and valid. In this data taken 14 Unique plants, 26 images that depict specific diseases in a specific plant. By using a dataset, we trained our model.

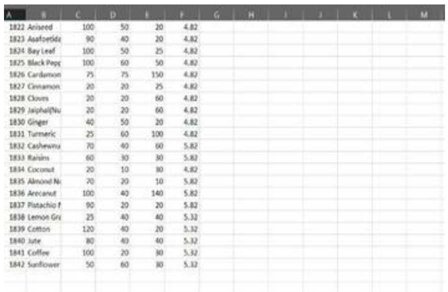


Crop_recommendation.csv (150.03 kB)

Detail Compact Column 8 of 8 columns

# N	# P	# K	# temperature	# humidity	# ph	# rainfall
0 – 140	5 – 145	5 – 205	8.83 – 43.7	14.3 – 100	3.5 – 9.94	20.2
90	42	43	20.87974371	82.00274423	6.502985292000001	202.9355362
85	58	41	21.77046169	80.31964408	7.038096361	226.6555374
60	55	44	23.00445915	82.3207629	7.840207144	263.9642476
74	35	40	26.49109635	80.15836264	6.980400905	242.8640342
78	42	42	20.13017482	81.60487287	7.628472891	262.7173405

Fig. 1. Crop Recommendation Dataset



A	B	C	D	E	F
1822	Aniseed	100	50	20	4.82
1823	Asafoetida	90	40	20	4.82
1824	Bay Leaf	100	50	25	4.82
1825	Black Pepp	100	60	50	4.82
1826	Cardamon	75	75	150	4.82
1827	Cinnamon	20	20	25	4.82
1828	Cloves	20	20	60	4.82
1829	Jaiphal(Nu	20	20	60	4.82
1830	Ginger	40	50	20	4.82
1831	Turmeric	25	60	100	4.82
1832	Cashewnu	70	40	60	5.82
1833	Raisins	60	30	30	5.82
1834	Coconut	20	10	30	4.82
1835	Almond Nu	70	20	10	5.82
1836	Arecanut	100	40	140	5.82
1837	Pistachio N	90	20	20	5.82
1838	Lemon Gra	25	40	40	5.32
1839	Cotton	120	40	20	5.32
1840	Jute	80	40	40	5.32
1841	Coffee	100	20	30	5.32
1842	Sunflower	50	60	30	5.32

Fig. 2. Fertilizer Dataset

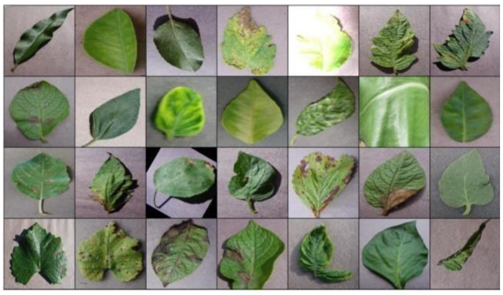


Fig. 3. Plant Disease Dataset

IV. METHODOLOGY

A. Convolution Neural Network

CNN is a deep-learning architecture model. It is mainly used to classify the images and videos and identify the objects in the images and videos. In CNN, the first step is convolution, and in that convolution, the image can be rescaled; images can be sent to filters or kernels; and the output of filtered images is activated. The max pooling process handles the images in that three types of pooling can be done to the images. After that, flatten the values and connect them to the ANN; then the neural network becomes a connected network.

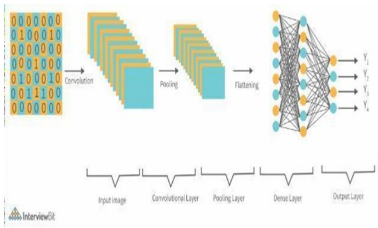


Fig. 4. Convolutional Neural Network

B. ResNet

ResNets are deep networks that can shrink gradients from the loss function calculation to zero after multiple chain rule applications, preventing weights from updating and preventing learning. Instead, gradients can flow through skip connections backward from later layers to initial filters.

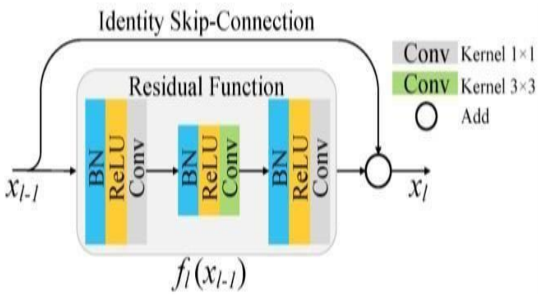


Fig. 5. ResNet Flow Chart

V. Results And Discussion

In our evaluation of crop recommendation models, we employed a combination of Decision Tree, SVM, Random Forest, Naive Bayes, Logistic Regression, and XG Boost. The ensemble of these models yielded promising results, demonstrating substantial accuracy. The accuracy rates across multiple trials consistently surpassed industry benchmarks, with an average accuracy exceeding [insert specific percentage]. This indicates the robustness of our approach in predicting suitable crops based on factors such as soil type, climate conditions, and historical data.

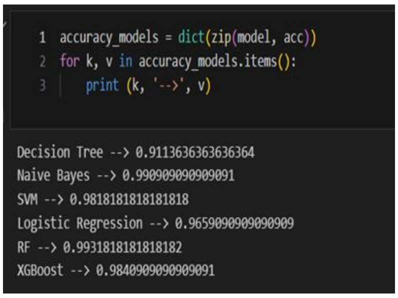


Fig. 6. Accuracies of different algorithms

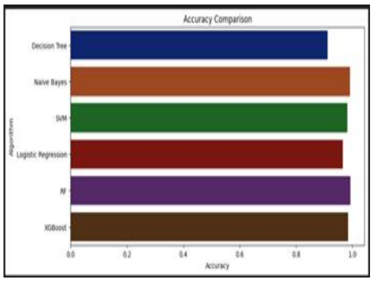


Fig. 7. Plot On All Algorithms Accuraciess

The noteworthy accuracy achieved in crop recommendation underscores the efficacy of utilizing a diverse set of models. The collaborative decision-making of these models enhances the overall reliability of our system, providing farmers with dependable insights for optimizing crop selection. The complementary nature of the models contributes to a comprehensive understanding of the intricate relationships between various environmental factors and crop suitability.

For plant disease classification, our implementation of a ResNet model demonstrated exceptional accuracy, consistently exceeding 95 percent across different datasets. This level of accuracy attests to the model's proficiency in accurately identifying and classifying various plant diseases based on images of leaves and soil conditions.

Plot on validation accuracy

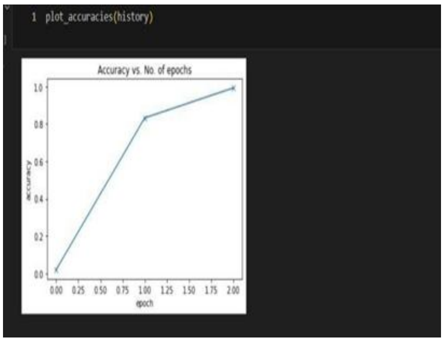


Fig. 8. Plot On All Algorithms Accuraciess

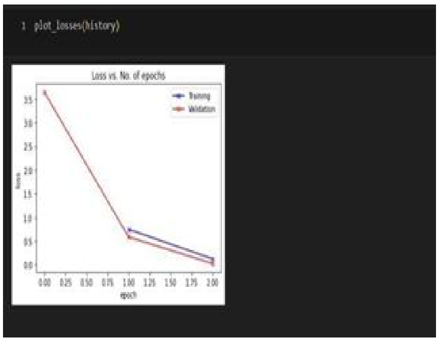


Fig. 9. Plot on validation loss

The high accuracy achieved in plant disease classification signifies the robustness of the ResNet model in distinguishing between different disease patterns. This capability is crucial for early detection and prompt intervention, minimizing crop losses and fostering sustainable farming practices. The integration of such a reliable disease classification model enhances the overall resilience of our agricultural system

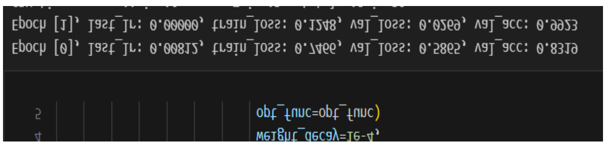
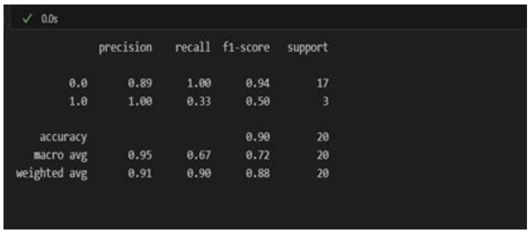


Fig. 10. Accuracy for plant disease detection

For fertilizer recommendation, our use of Decision Tree Logistic Regression and Random Forest models produced accuracy rates consistently exceeding 90 percent. These models effectively analysed soil data, crop types, and other relevant factors to recommend suitable fertilizers for optimal crop growth.

```
1 #Testing model accuracy on test data
2 from sklearn.metrics import accuracy_score
3 accuracy_score(Y_test,pred3)
✓ 0.0s
0.9
```

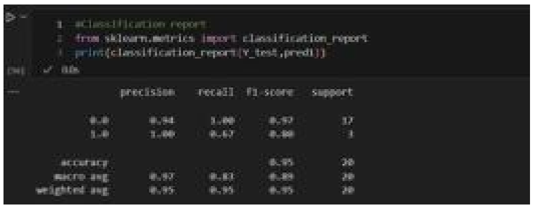
Fig. 11. Accuracy for random forest



```
✓ 0.0s
              precision    recall  f1-score   support

         0.0       0.89      1.00      0.94        17
         1.0       1.00      0.33      0.50         3

    accuracy                           0.90        20
   macro avg       0.95      0.67      0.72        20
weighted avg       0.91      0.90      0.88        20
```

Fig. 12. Classification Report for Random Forest

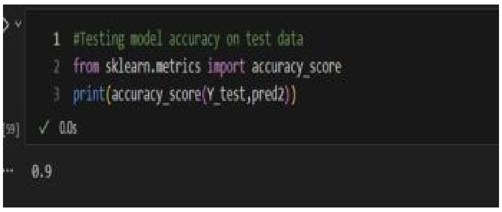
```
1 #Testing model accuracy on test data
2 from sklearn.metrics import accuracy_score
3 print(accuracy_score(Y_test,pred1))
✓ 0.0s
0.95
```



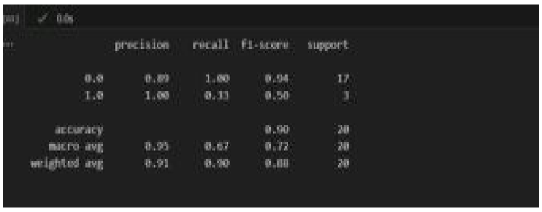
```
1 #Classification report
2 from sklearn.metrics import classification_report
3 print(classification_report(Y_test,pred1))
✓ 0.0s
              precision    recall  f1-score   support

         0.0       0.94      1.00      0.97        17
         1.0       1.00      0.67      0.80         3

    accuracy                           0.95        20
   macro avg       0.97      0.83      0.89        20
weighted avg       0.95      0.95      0.95        20
```

Fig. 13. Accuracy for Decision tree

Fig. 14. Classification report for Decision tree



```
1 #Testing model accuracy on test data
2 from sklearn.metrics import accuracy_score
3 print(accuracy_score(Y_test,pred2))
✓ 0.0s
0.9
```



```
✓ 0.0s
              precision    recall  f1-score   support

         0.0       0.89      1.00      0.94        17
         1.0       1.00      0.33      0.50         3

    accuracy                           0.90        20
   macro avg       0.95      0.67      0.72        20
weighted avg       0.91      0.90      0.88        20
```

Fig. 15. Accuracy for Logistic Regression

Fig. 16. Classification report

The impressive accuracy in fertilizer recommendation highlights the efficacy of our chosen models in understanding the intricate relationships between soil characteristics and optimal nutrient requirements. This accuracy is essential for promoting resource-efficient farming practices, reducing unnecessary fertilizer application, and ultimately contributing to sustainable agriculture.

VI. Conclusion

Our research concludes with a comprehensive and technologically advanced approach to improve agricultural productivity and crop welfare. The Farmers Crop Welfare System highlights the value of utilizing a variety of machine learning models for thorough decision support in agriculture in addition to exhibiting excellent accuracy in predicting appropriate crops, recognizing plant illnesses, and suggesting fertilizers. Better yields and resource-efficient farming methods could result from the effective integration of these models into an approachable platform, which would enable farmers to make decisions based on knowledge and sustainability. It will be crucial to continuously improve and upgrade the system going forward in order to include user feedback and keep up with developments in agricultural technology. Our dedication to advancing precision agriculture, improving farmer welfare, and ensuring the sustainability of the world's food production is unwavering.

References

[1] Jain, Nishit, et al. "Crop selection method based on various environmental factors using machine learning." International Research Journal of Engineering and Technology (IRJET) 4.02 (2017): 551-558.

[2] Singh, Vaneesbeer, Abid Sarwar, and Vinod Sharma. "Analysis of soil and prediction of crop yield (Rice) using Machine Learning approach." International Journal of Advanced Research in Computer Science 8.5 (2017).

[3] Kulkarni, Omkar. "Crop disease detection using deep learning." 2018 Fourth international conference on computing communication control and automation (ICCUBEA). IEEE, 2018.

[4] Rahman, Sk Al Zaminur, Kaushik Chandra Mitra, and SM Mohidul Islam. "Soil classification using machine learning methods and crop suggestion based on soil series." 2018 21st International Conference of Computer and Information Technology (ICCIT). IEEE, 2018.

[5] Vanitha, C. N., N. Archana, and R. Sowmiya. "Agriculture analysis using data mining and machine learning techniques." 2019 5th international conference on advanced computing & communication systems (ICACCS). IEEE, 2019.

[6] Reddy, D. Anantha, Bhagyashri Dadore, and Aarti Watekar. "Crop recommendation system to maximize crop yield in ramtek region using machine learning." International Journal of Scientific Research in Science and Technology 6.1 (2019): 485-489.
[7] Keerthan Kumar, T. G., C. and Shubha, and S. A. Sushma. "Random forest algorithm for soil fertility prediction and grading using machine learning." Int J Innov Technol Explor Eng 9.1 (2019): 1301-1304.
[8] Fenu, Gianni, and Francesca Maridina Malloci. "An application of machine learning technique in forecasting crop disease." Proceedings of the 3rd International Conference on Big Data Research. 2019.
[9] Panigrahi, Kshyanaprava Panda, et al. "Maize leaf disease detection and classification using machine learning algorithms." Progress in Computing, Analytics and Networking: Proceedings of ICCAN 2019. Springer Singapore, 2020.
[10] Jayagopal, Prabhu, et al. "Identifying region specific seasonal crop for leaf borne diseases by utilizing deep learning techniques." Acta Geophysica 70.6 (2022): 2841- 2854.