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Smart Harvest: Advancing Crop Recommendation through Machine Learning Innovations

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ABSTRACT

The study on agricultural crop suggestions attempts to help farmers choose the best crop to produce based on different elements like climate, soil type, and market demand. In order to analyse past data and select crops that maximise productivity and profitability, the initiative uses machine learning algorithms. This essay gives a general summary of the project, outlining its goals, approach, and outcomes. According to the study, the project can assist farmers in making educated decisions and enhancing crop yields, which will raise production and benefit the agricultural industry's economy.

Keywords: *Machine Learning; Algorithms; Crop Yields; Classification; Streamlit.*

INTRODUCTION

Machine learning is the most happening thing in the world right now. It can be used in different sectors for different purposes. Some of the sectors are medicine, transportation, recommendations, personal assistants andso on. Machine Learning can make use of some data andpredict the future outcomes based upon the input data.

Machine learning can be applied in different fields such as Transportation, Agriculture, Shopping, Medicine, Education and etc. There are many ways Machine learning can be used in Agriculture such as yield prediction, disease prediction and etc. These applications are discussed in the below sections. A Website is designed for crop recommendation using python. Here different machine learning algorithms are used for the preparation of the model. Machine learning comes in a variety of forms, including supervised, unsupervised, semisupervised, and reinforcement learning. As the problem is based on classification different classification algorithms such as Logistic Regression, KNN Classifier, Support Vector Machine(SVM), Decision Tree, Random forest classifier are applied. The algorithm which gives the best accuracy is finally selected and then by using different python libraries the website is designed. This will eventuallyhelp farmers all around the world to decide which crop is best for their field.

LITERATURE SURVEY

"Current and Future Applications of ML Algorithms forAgriculture Sector"

According to Tanzeel U. Rehman (2019), several researchers have used machine learning algorithms in the agriculture sector.

For example, Dey et al. (2012) applied Gaussian Mixture Model (GMM) based ML algorithm to estimate yield of grapevine and observed accuraciesof 98% prior to ripening and 96% during ripening. ML techniques also showed higher success rate above 95% in plant disease detection with different algorithms. Yao et al. (2009) used SVMs based MLclassifier to detect rice diseases with 97.2% of accuracy[1].

"Towards application of various machine learning techniques in agriculture"

S.T. Jagtap, K. Phasinam, et al.(2021) conducted an experiment by taking a dataset consisting of 500 images of crops. In experimental analysis, three classification algorithms namely, SVM- Support Vector Machine, C 4.5 and ID3 classifiers are used. These machine learning algorithms classified different crop images. This will help in identifying diseases in crop. As a result it will help in the reduction of crop waste [2].

"Neural Network Model For Oil Palm Yield Modelling"

Azme Khamis, Zuhaimy Ismail(2018) applied Neural Network approach for the modelling of oil palm yield. They have collected a dataset which containing features such as percentage of nitrogen, phosphorous, potassium, calcium and magnesium concentration. These are used to predict the oil palm yield. They found that the modelling accuracy of Neural Network is greater than MLR[3]

"Machine Learning in Agriculture: A Review"

According to Konstantinos G. Liakos , Patrizia Busato(2018), the accurate detection of weeds is of high importance to sustainable agriculture, because weeds are difficult to detect and discriminate from crops. Again, ML algorithms in conjunction with sensors can lead to accurate detection and discrimination of weeds with low cost and with no environmental issues and side effects[4].

"Soil Classification Using Machine Learning Methods and Crop Suggestion Based on Soil"

Rahman, S. A. Z., Mitra, K. C., & Islam, S. M. (2018, December) stated that Soil is a critical component of agriculture, and there are various types of soil, each with distinct features that can influence which crops are best suited for them. Machine learningtechniques can be used to predict the crop that is suitable for that particular soil[5].

"Smart Crop Prediction using IoT and Machine Learning"

Archana Gupta, Dharmil Nagda, Pratiksha Nikhare, Atharva Sandbhor(2021) proposed a system which not only predicts the suitable crop and also recommends the fertilizer for that crop. Asa result the yield of the crop also increases[6].

"Applying Machine Learning to Extract New Knowledge in Precision Agriculture Applications"

Savvas Dimitriadis; Christos Goumopoulos created a decision support system that is able to learn, it is possible to deliver treatments, such as irrigation, fertilizer and pesticide application,for specific parts of a field in real time and proactively. It is usedto predict the plants' state and the prevention of unpleasant impacts from the water stress in plants[7].

"Supervised Machine learning Approach for Crop YieldPrediction in Agriculture Sector"

Y. Jeevan Nagendra Kumar; V. Spandana; V.S. Vaishnavi; K. Neha; V.G.R.R. Devi developed a crop yield predicting machinelearning. It is trained using past historical data which includes factors such as temperature, humidity, ph, rainfall, crop name. They have used random forest to make these predictions which gave them the best accurate value[8].

PROPOSED SYSTEM

The proposed system for designing Crop Recommendation involves steps. Those steps are discussed below.

- **Data Collection:** Collect Dataset related to Agriculture fromvarious sources such as Kaggle etc.
- **Data Cleaning:** Preprocess the collected data to remove duplicates, missing values, and inconsistencies.
- **Exploratory Data Analysis:** Conduct descriptive statistics, correlation analysis, and visualization techniques to identify trends,

patterns, and outliers in the data.

- **Feature Engineering:** Extract relevant features from the data and perform feature engineering techniques to improvethe model's performance.

- **Machine Learning Model:** Build a predictive model to identify the crop to the particular field based on different parameters such as percentages of potassium, Phosphorus and Nitrogen present in the soil and some other factors. Different Classification Algorithms are used for this problem. The Algorithm which is giving best accuracy will be taken.

- **Visualization:** Develop interactive visualizations and dashboards to present the results of the analysis to stakeholders.

Finally, after the preparation of model we will savethat model to a file and then we are going to build a website using streamlit . Streamlit is a Python library that makes it easy to create and share interactive web apps, dashboards, and data sciencetools. With Streamlit, you can quickly build interactive web interfaces for machine learning models, data visualizations, and more, using Python code. After the completion of website we are finally going to deploy it using same library.

RESULTS

1. Dataset and it's Features

	N	P	K	temperature	humidity	ph	rainfall	label
0	90	42	43	20.879744	82.002744	6.502985	202.935536	rice
1	85	58	41	21.770462	80.319644	7.038096	226.655537	rice
2	60	55	44	23.004459	82.320763	7.840207	263.964248	rice
3	74	35	40	26.491096	80.158363	6.980401	242.864034	rice
4	78	42	42	20.130175	81.604873	7.628473	262.717340	rice

2. Dataset is Balanced or Not

```
rice           100
maize          100
jute           100
cotton         100
coconut        100
papaya         100
orange         100
apple          100
muskmelon      100
watermelon     100
grapes         100
mango          100
banana         100
pomegranate    100
lentil         100
blackgram      100
mungbean       100
mothbeans      100
pigeonpeas     100
kidneybeans    100
chickpea       100
coffee         100
Name: label, dtype: int64
```

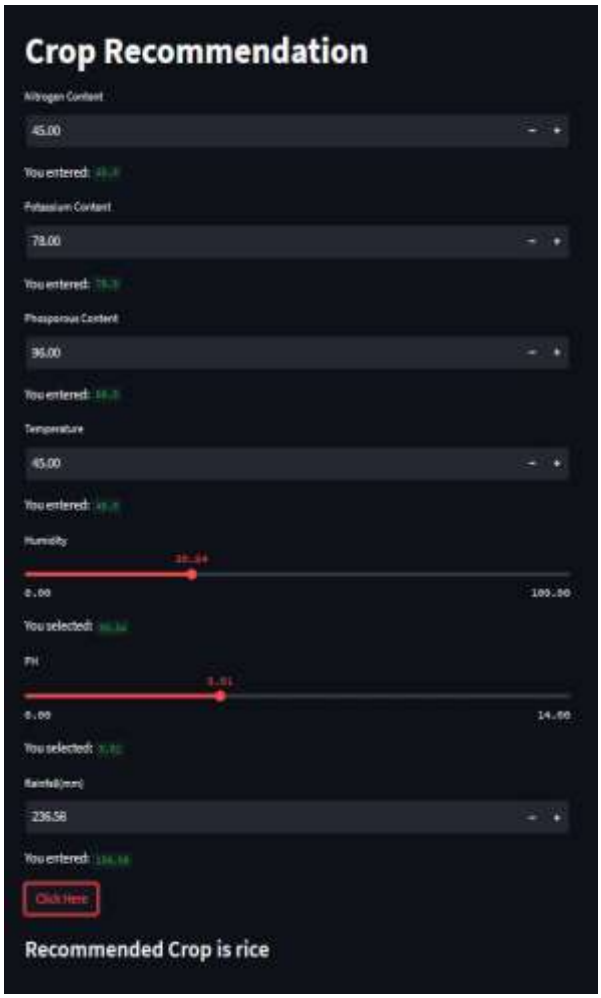
3. Label Mapping

```
{0: 'x0_apple',
 1: 'x0_banana',
 2: 'x0_blackgram',
 3: 'x0_chickpea',
 4: 'x0_coconut',
 5: 'x0_coffee',
 6: 'x0_cotton',
 7: 'x0_grapes',
 8: 'x0_jute',
 9: 'x0_kidneybeans',
 10: 'x0_lentil',
 11: 'x0_maize',
 12: 'x0_mango',
 13: 'x0_mothbeans',
 14: 'x0_mungbean',
 15: 'x0_muskmelon',
 16: 'x0_orange',
 17: 'x0_papaya',
 18: 'x0_pigeonpeas',
 19: 'x0_pomegranate',
 20: 'x0_rice',
 21: 'x0_watermelon'}
```

4. Report

	precision	recall	f1-score	support
0	1.00	1.00	1.00	28
1	1.00	1.00	1.00	30
2	0.90	0.97	0.93	29
3	1.00	1.00	1.00	34
4	1.00	0.96	0.98	27
5	1.00	1.00	1.00	29
6	0.96	1.00	0.98	27
18	0.96	0.90	0.93	30
19	1.00	1.00	1.00	32
20	0.89	0.92	0.90	36
21	1.00	0.96	0.98	26
accuracy			0.97	660
macro avg	0.97	0.97	0.97	660
weighted avg	0.97	0.97	0.97	660

5. Final Website



CONCLUSION

A model is suggested for determining the type of soil and recommending a crop that can be grown inthat soil. The model has undergone different machine learning algorithms include Logistic Regression, Decision Tree, and Random Forest classifiers. In comparison to other models, the accuracy of the current model is highest. In the future, proper fertilisers are advised for the cultivation of crops that grow well. The future models incorporate real-time data that is directly received from agricultural land that is equippedwith sensors, whereas the current models deal withold data that is currently available. Based on this data, model is trained to predict the suitable crop forthat particular soil which will be a great help for the farmers.

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