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CROP RECOMMENDATION FERTILIZATION PLANT USING MACHINE LEARNING

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Abstract -

In terms of population India is the second largest country in the world. Numerous people are dependent on husbandry, but the sector lacks effectiveness and technology especially in our country. By bridging the gap between traditional husbandry and data wisdom, effective crop civilization can be achieved. Country like India, which is developing, husbandry and agriculture is the main or major source of earning for numerous people. In ultramodern times, agrarian development and growth is happening or engaged due to many factors like inventions, surroundings, ways, and societies. Also, the involvement of modern technology or information technology in several decisions by farmer in work help them in gaining better results. For the process of decision making, data mining ways related to husbandry are used. "Data Mining" is the process of finding the patterns and extracting that pattern from large datasets or we can say that to find useful information from given orexisting data. There are mainly three steps involved in the process of "data mining", which is data pre-processing (in data pre-processingcleaning of data, integration, selection, and transformation take place), extracting data (useful data is extracted in this step), evaluation of data and its presentation (data analyzing and result presentation take place). Applying the data mining ways on literal climate and crop product data several prognostications can be made grounded on knowledge gathered which can help farmer in gaining better crop productivity.

Keywords – Agriculture; Content-Base; Crop Recommendation System; Fertilizer Recommendation System; Machine Learning; Recommendation Algorithms.

I. INTRODUCTION

As we know since the humans have started practicing or doing agriculture activities "Agriculture" has become the most important activity for humans. In today's era or world agriculture is not only for surviving it's also play huge part or role in economy of any country. Agriculture plays vital role in India's economy and in human future too. In India it also provides large portion of employment for Indians. As a result, with passage of time the need for production has been accumulated exponentially. Thus, on manufacture in mass amount individuals are exploitation technology in associate degree extremely wrong method.

With the improvement of the technologies dayby day there is creation of hybrid varieties day by day. In comparison with naturally created crop these hybrid varieties don't offer or provide essential contents. Depending more on unnatural techniques may lead to soil acidification and

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crust. These types of activities all lead up to environmental pollution. These types of activities (unnatural activities) are for avoiding or reducing losses. However, once the farmer or producer get or grasp the correct data on the crop yield, it will help the farmer in avoiding or reducing the loss

Around the globe India is the second largest country in terms of population. Many people are dependent on agriculture, but the sector lacks efficiency and technology especially in our country. By bridging the gap between traditional agriculture and data science, effective crop cultivation can be achieved. It is important to have a good production of crops. The crop yield is directly influenced by the factors such as soil type, composition of soil, seed quality, lack of technical facilities etc.

II. PROBLEM STATEMENT

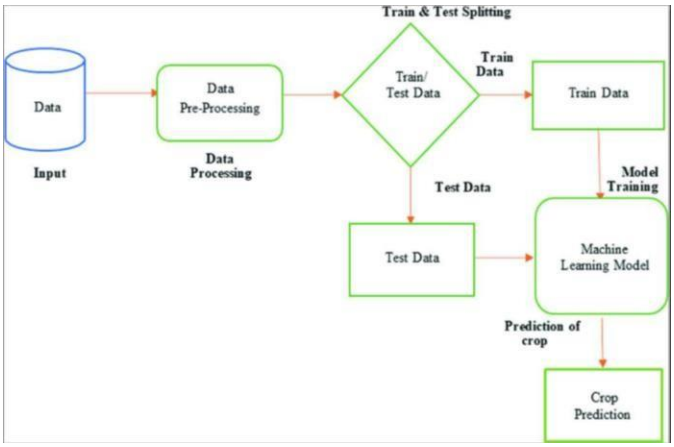
Most of the Indians have farming as their occupation. Farmers plant the same crop over and over again without trying new varieties and randomly fertilize without knowing the amount and content that is missing. Therefore, it directly affects crop yield and acidifies the soil result in reducing soil fertility.

We are designing the system using machine learning to help farmers in crop and fertilizer prediction. Right crop will be recommended for a specific soil and also keeping in mind of climatic boundaries. Also, the system provides information about the required content and the needed amount of fertilizer, the seeds needed for planting

III. PROPOSED SYSTEM

In the system, we propose testing of multiple algorithms and by reading the classification report we compare the algorithms and select the best one. It should find accuracy for the given datasets, test database accuracy, precision and recall by comparing algorithms.

IV. SYSTEM DESIGN:



Architecture Diagram of Proposed Framework.

As a field, the information gadget is closely associated with computer knowledge, so having a mathematical legacy helps you to better see and apply machine management techniques.

For those who have never studied mathematics before, the definition of reliability and regression, the two most commonly used methods of assessing the correlation between quantitative statistics, is a good place to start.The relationship of degree of communication between unstructured or independent variables to each other. Reversal is used to look for the correlation between a single supported variable and a neutral one at its basic level. Because they can be used for fixed variable predictions while neutral variables are understood, retrospective facts provide predictive capabilities.

Dataset for crop recommendation

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As we all know that good crop production or good yield of crop depends on various factor, in this dataset we are provided with various factors that is involved in production of crop. With the help of this data set crop recommendation modelcan be created.

Dataset for crop recommendation have following data fields

a) N: tells about the ratio of nitrogen
b) P: tells about the ratio of Phosphorous
c) K: tells about the ratio of Potassium
d) Temperature: in Celsius
e) Humidity: relative humidity in %
f) Ph: tells either soil is acidic or basic
g) Rainfall: in mm

	A	B	C	D	E	F	G	H
1	N	P	K	temperat	humidity	ph	rainfall	label
2	90	42	43	20.87974	82.00274	6.502985	202.9355	rice
3	85	58	41	21.77046	80.31964	7.038096	226.6555	rice
4	60	55	44	23.00446	82.32076	7.840207	263.9642	rice
5	74	35	40	26.4911	80.15836	6.980401	242.864	rice
6	78	42	42	20.13017	81.60487	7.628473	262.7173	rice
7	69	37	42	23.05805	83.37012	7.073454	251.055	rice
8	69	55	38	22.70884	82.63941	5.700806	271.3249	rice
9	94	53	40	20.27774	82.89409	5.718627	241.9742	rice
10	89	54	38	24.51588	83.53522	6.685346	230.4462	rice
11	68	58	38	23.22397	83.03323	6.336254	221.2092	rice
12	91	53	40	26.52724	81.41754	5.386168	264.6149	rice
13	90	46	42	23.97898	81.45062	7.502834	250.0832	rice
14	78	58	44	26.8008	80.88685	5.108682	284.4365	rice
15	93	56	36	24.01498	82.05687	6.984354	185.2773	rice
16	94	50	37	25.66585	80.66385	6.94802	209.587	rice
17	60	48	39	24.28209	80.30026	7.042299	231.0863	rice
18	85	38	41	21.58712	82.78837	6.249051	276.6552	rice
19	91	35	39	23.79392	80.41818	6.97086	206.2612	rice
20	77	38	36	21.86525	80.1923	5.953933	224.555	rice
21	88	35	40	23.57944	83.5876	5.853932	291.2987	rice

crop_recommendation

V. RESULTS

On applying it on dataset it gives accuracy of 95.22%.

Logistic Regression

```
In [28]:
from sklearn.linear_model import LogisticRegression

LogReg = LogisticRegression(random_state=2)

LogReg.fit(Xtrain,Ytrain)

predicted_values = LogReg.predict(Xtest)

x = metrics.accuracy_score(Ytest, predicted_values)
acc.append(x)
model.append('Logistic Regression')
print("Logistic Regression's Accuracy is: ", x)

print(classification_report(Ytest,predicted_values))
```

```
Logistic Regression's Accuracy is:  0.9522727272727273
              precision    recall  f1-score   support

       apple       1.00      1.00      1.00        13
      banana       1.00      1.00      1.00        17
   blackgram       0.86      0.75      0.80        16
    chickpea       1.00      1.00      1.00        21
     coconut       1.00      1.00      1.00        21
      coffee       1.00      1.00      1.00        22
      cotton       0.86      0.90      0.88        20
```

Figure: accuracy in logistic regression

On applying it on dataset it gives accuracy of 99.09%.

Guassian Naive Bayes

```
]:
from sklearn.naive_bayes import GaussianNB

NaiveBayes = GaussianNB()

NaiveBayes.fit(Xtrain,Ytrain)

predicted_values = NaiveBayes.predict(Xtest)
x = metrics.accuracy_score(Ytest, predicted_values)
acc.append(x)
model.append('Naive Bayes')
print("Naive Bayes's Accuracy is: ", x)

print(classification_report(Ytest,predicted_values))
```

```
Naive Bayes's Accuracy is:  0.990909090909091
              precision    recall  f1-score   support

       apple       1.00      1.00      1.00        13
      banana       1.00      1.00      1.00        17
   blackgram       1.00      1.00      1.00        16
    chickpea       1.00      1.00      1.00        21
     coconut       1.00      1.00      1.00        21
      coffee       1.00      1.00      1.00        22
      cotton       1.00      1.00      1.00        20
      grapes       1.00      1.00      1.00        18
        jute       0.88      1.00      0.93        28
 kidneybeans       1.00      1.00      1.00        14
      lentil       1.00      1.00      1.00        23
       maize       1.00      1.00      1.00        21
       mango       1.00      1.00      1.00        26
   mothbeans       1.00      1.00      1.00        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      1.00      1.00        18
 pomegranate       1.00      1.00      1.00        17
        rice       1.00      0.75      0.86        16
  watermelon       1.00      1.00      1.00        15

    accuracy                           0.99       440
   macro avg       0.99      0.99      0.99       440
weighted avg       0.99      0.99      0.99       440
```

Figure: accuracy in gaussian naïve bayes

On applying it on dataset it gives accuracy of 99.09%.

Random Forest

```
In [36]:
from sklearn.ensemble import RandomForestClassifier

RF = RandomForestClassifier(n_estimators=20, random_state=0)
RF.fit(Xtrain,Ytrain)

predicted_values = RF.predict(Xtest)

x = metrics.accuracy_score(Ytest, predicted_values)
acc.append(x)
model.append('RF')
print("RF's Accuracy is: ", x)

print(classification_report(Ytest,predicted_values))
```

Figure accuracy in random forest

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On applying it on dataset it gives accuracy of 90%.

Decision Tree

```
In [15]:
from sklearn.tree import DecisionTreeClassifier

DecisionTree = DecisionTreeClassifier(criterion="entropy",random_state=2,max_depth=5)

DecisionTree.fit(Xtrain,Ytrain)

predicted_values = DecisionTree.predict(Xtest)
x = metrics.accuracy_score(Ytest, predicted_values)
acc.append(x)
model.append('Decision Tree')
print("DecisionTrees's Accuracy is: ", x*100)

print(classification_report(Ytest,predicted_values))
```

```
DecisionTrees's Accuracy is:  90.0
              precision    recall  f1-score   support

       apple       1.00      1.00      1.00        13
      banana       1.00      1.00      1.00        17
   blackgram       0.59      1.00      0.74        16
    chickpea       1.00      1.00      1.00        21
     coconut       0.91      1.00      0.95        21
      coffee       1.00      1.00      1.00        22
      cotton       1.00      1.00      1.00        20
      grapes       1.00      1.00      1.00        18
        jute       0.74      0.93      0.83        28
  kidneybeans      0.00      0.00      0.00        14
     lentil        0.68      1.00      0.81        23
      maize       1.00      1.00      1.00        21
      mango       1.00      1.00      1.00        26
   mothbeans      0.00      0.00      0.00        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      0.84      0.91        19
  pigeonpeas      0.62      1.00      0.77        18
 pomegranate      1.00      1.00      1.00        17
        rice      1.00      0.62      0.77        16
  watermelon      1.00      1.00      1.00        15

    accuracy                           0.90       440
   macro avg      0.84      0.88      0.85       440
weighted avg      0.86      0.90      0.87       440
```

Figure: accuracy in Decision tree

On applying it on dataset it gives accuracy of 97.95%.

Support Vector Machine (SVM)

```
In [24]:
from sklearn.svm import SVC
# data normalization with sklearn
from sklearn.preprocessing import MinMaxScaler
# fit scaler on training data
norm = MinMaxScaler().fit(Xtrain)
X_train_norm = norm.transform(Xtrain)
# transform testing dataabs
X_test_norm = norm.transform(Xtest)
SVM = SVC(kernel='poly', degree=3, C=1)
SVM.fit(X_train_norm,Ytrain)
predicted_values = SVM.predict(X_test_norm)
x = metrics.accuracy_score(Ytest, predicted_values)
acc.append(x)
model.append('SVM')
print("SVM's Accuracy is: ", x)

print(classification_report(Ytest,predicted_values))
```

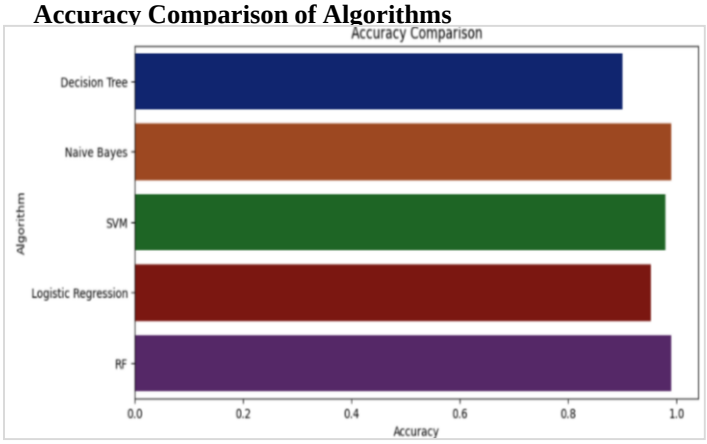
```
SVM's Accuracy is:  0.9795454545454545
              precision    recall  f1-score   support

       apple       1.00      1.00      1.00        13
      banana       1.00      1.00      1.00        17
   blackgram       1.00      1.00      1.00        16
    chickpea       1.00      1.00      1.00        21
     coconut       1.00      1.00      1.00        21
      coffee       1.00      0.95      0.98        22
      cotton       0.95      1.00      0.98        20
      grapes       1.00      1.00      1.00        18
        jute       0.83      0.89      0.86        28
  kidneybeans      1.00      1.00      1.00        14
     lentil        1.00      1.00      1.00        23
      maize       1.00      0.95      0.98        21
      mango       1.00      1.00      1.00        26
   mothbeans      1.00      1.00      1.00        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      1.00      1.00        18
 pomegranate      1.00      1.00      1.00        17
        rice      0.80      0.75      0.77        16
  watermelon      1.00      1.00      1.00        15

    accuracy                           0.98       440
   macro avg      0.98      0.98      0.98       440
```

Figure: accuracy in support vector machine

Accuracy Comparison of Algorithms



VI. CONCLUSION

In this project we try to get best crop and fertilizer recommendation with the help of machine learning. For the calculation of accuracy many machine learning techniques were imposed or used. Numerous algorithms were used on datasets to get the best output which leads to best crop and fertilizer recommendation for particular soil of particular region. This system will help farmers to visualize crop yields based on that climatic and subsistence boundaries. Using this farmer can decide whether to plant that crop or to look for another crop if yield forecasts are incorrect.

This tool can help the farmer to make the best decisions when it comes to growing something harvest. It may also predict the negative effects of the plant. Currently our farmers use outdated technology or not use effectively, so there can be an opportunity of the wrong choice of cultivated crops that will reduce the profit by production. To reduce these types of loss we try to create a farmer-friendly system, which will help in predicting which crop is best for a specific soil and this project will give the recommendation about the fertilizer needed by the soil for cultivation, seeds needed for cultivation, expectations yield and market price. Thus, this

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enables farmers to make the right choice in choosing a crop farming so that the agricultural sector can develop with new ideas.

VII. FUTURE SCOPE

For the upcoming updates in this project we can use deep learning techniques for plant diseases prediction with the help of images and we can also implement IOT techniques for getting contents of soil directly from the fields.

Future Work on this can add many options such as:

- Diagnosis and prevention of plant diseases, predicting plant species.
- Current Market Conditions and analysis for information on crop market rates, production costs, fertilizer.
- Government options for knowing new government programs related to borrowing, fertilizer, and harvesting.
- The mobile app can be developed to assist farmers with uploading farm photos.
- Plant Disease Detection is used to process images where the user finds pesticides based on their pictures of diseases.

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