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Crop Prediction System, Crop Disease Identificationand Its Solution Using Machine Learning

Prof. Hrushikesh Joshi
SCTR'S Pune Institute of Computer Technology, Pune, Maharashtra, India

Rani Holambe
SCTR'S Pune Institute of Computer Technology, Pune, Maharashtra, India

Pooja Patil
SCTR'S Pune Institute of Computer Technology, Pune, Maharashtra, India

Padmaja Pawar
SCTR'S Pune Institute of Computer Technology, Pune, Maharashtra, India

Saurabh Salunkhe
SCTR'S Pune Institute of Computer Technology, Maharashtra, India

Abstract: - India is agricultural land and farming is that the major source of economy. 70% of the Indian population directly relies on agriculture. The common problem existing among the Indian farmers is to settle on the proper crop supported by the soil and atmospheric requirements. thanks to this, they face a significant setback in productivity. Our work proposes to assist farmers to determine the soil quality by analyzing its various parameters and suggesting crops supported by the results obtained using a machine learning approach. The system uses the Classification algorithm of K nearest neighbor to enhance the efficiency of the Crop Recommendation System. The system maps the soil and crop data to predict the list of suitable crops for the soil and it also provides knowledge about nutrients that are deficient in soil for the actual crop. Hence it leaves upon the user to make a decision on the crop to be sown. Thus, the system helps to supply knowledge to the dilettante farmers.

Index terms: Precision Agriculture, Crop Recommendation System, Crop Disease Prediction, Internet of Things, Machine Learning.

I. INTRODUCTION

India is one of the oldest countries which remains practicing agriculture. But in recent times the trends in agriculture have drastically evolved thanks to globalization. Various factors have affected the health of agriculture in India. As a neighbourhood of evolution, we've come up with Crop Recommendation System to assist farmers to recommend appropriate crop supported the soil and atmospheric conditions.

In agriculture, the farmer must choose the appropriate crop to urge good yield which can generate good revenue. Predictions made using the Crop Recommendation System are accurate and precise because just in case of errors it's going to cause heavy material and financial loss. Among these various techniques that are getting used during this field, this paper proposes a system that uses machine learning algorithms to recommend the acceptable crop concerning the input parameters. Also, our project focuses on crop disease prediction, where the system is in a position to detect the disease present on the crop by analyzing the crop leaf. The condition also plays a key role in disease. Soil quality, temperature, wind, nutrition, sunlight influence plant growth. The spreading of disease is additionally influenced by environmental factors. By using image processing techniques and analyzing it with the predefined dataset, the system is in a position to work outcrops disease accurately.

II. RELATED WORK

In Paper [1], Low-cost IoT+ML design for smart farming with multiple application paper authors Fahad Kamraan Syed, Agniswar Paul, Ajay Kumar, Jaideep Cherukuri in paper [1] proposed system for water management systems and improve current irrigation methods. An IoT and ML-based farming system always keeps farmers aware of the upcoming weather possibilities and gives them the best suggestions about irrigation methods and crops thereby helping in better yield. The system provides Crop suggestion using

parameter-type of soil and the weather condition of the current season. It also provides Smart irrigation - checks for the chances of rainfall in next 24 hours using the smart weather detection system and if there is more than 70% then our system sends an alert message to the user and does not irritate the field. It also provides Smart weather using real-time data from the nearest weather station from our location. Depending on the next 24 hours precipitation probability an SMS will be sent to the user and the device will analyse about irrigation

In Paper [2] authors proposed Crop Disease Detection Using Deep Learning. In this analysis, they used some of the common data mining techniques in the field of agriculture. Using this technique, they are identifying the type of crop. It performs the different steps like 1. Collecting the dataset 2. Pre-processing the dataset 3. Training the Convolutional Neural Network (CNN) 4.CNN model to identify the type of crop5.Training CNN model 6. Validation of model through obtained results

In Paper [3] authors proposed Crop Disease Detection Using Deep Learning. In this analysis, they used the techniques like Neural Network, SVM, CNN in the field of agriculture. Using this technique, they developed the Recommendation
System based on Rules for which crop should be yield. To develop a system, they perform the different steps like 1. Dataset Collection 2. Feature Extraction using training data 3. Prepare Ensemble model using CHAID, Random Tree, K-Nearest Neighbor, Naïve Bayes 4. Recommendation System based on Rules 5. Crop to be yield.

In Paper [4] authors proposed Intelligent Decision Support System for Smart Agriculture. In this analysis, they used the various components like Temperature, Soil Moisture, Humidity, soil PH. They developed the System which is smart enough to start and stop irrigation automatically considering human expert opinion learning. They develop System which is smart enough to start and stop irrigation automatically considering human expert opinion learning.

In Paper [5] authors proposed Review of image processing approaches for detecting plant diseases. In this analysis, they used the various techniques like CNN, Fuzzy-Logic. They developed the System Using the extracted features and techniques for identification of the area of interest, region of interest. The system extracted the features and techniques for identification of the area of interest, region of interest.

In Paper [6] authors proposed Crop hand-an android based crop and fertilizer advisor. In this analysis, they used the various techniques like Random Forest Algorithm, Clustering application, Association Rule Mining, Apriori Algorithm. They observed the Crop Recommendation using soil type, the system provides for Users can open their accounts to view recommended crops and fertilizers and also purchase them. Crop Recommendation using soil type. The system provide for Users can open their accounts to view recommended crops and fertilizers and also purchase them.

III. CROP PREDICTION SYSTEM

DataSet: -The data used in existing system is made up of by combining the parameters like Nitrogen, Phosphorous, Potassium and pH values of the soil. It also contains the temperature, humidity and rainfall required for a particular crop. This data is predefined data and using those data system will recommend the crop but it work on only predefined data value. Now, Current System takes the real time data contains temperature, humidity, pH and moisture of soil using DTH11 sensor and soil moisture sensor. After taking those data values then store it on firebase. System will work on real time data values so that it will beneficial to farmers to choose correct crop.

Proposed System Of Crop Prediction System:-

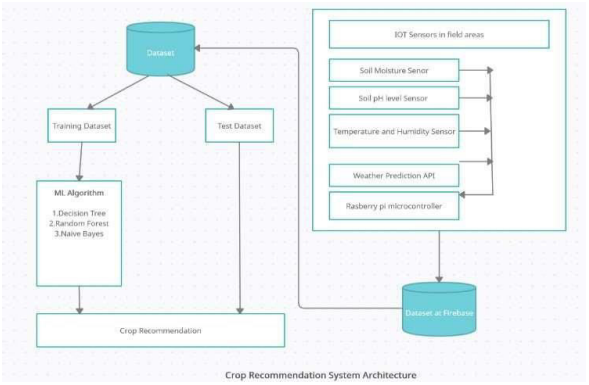

Figure 1. Proposed System Of Crop Prediction System

Above architecture depicts crop recommendation system using machine learning algorithms. This proposed system worked on real time data which is fetch via IOT sensors. All soil moisture real values are taken through soil moisture sensor, soil pH values via Soil pH level sensor, temperature and humidity are taken via DTH11 sensor. After getting all values that store on firebase in real database. Then, those data will divide into two datasets one is training dataset and another testing dataset. Next step is applied the machine learning algorithm decision tree classifier to recommend the best crop based on real data values.

Algorithm Used Crop Prediction System: -

The goal of this algorithm is to predicts the value of a target variable, for which the decision tree

uses the tree representation to solve the problem. In which the leaf node corresponds to a category label and attributes are represented on the interior node of the tree. In a decision tree, for predicting the class of the given dataset, the algorithm starts from the root node of the tree. This algorithm compares the values of root attribute with the real dataset values and, based on the comparison, follows the branch and jumps to the next node.

We have applied Decision tree approach in our model as:

(i) Importing library DecisionTreeClassifier from sklearn. tree Class

(ii) Now we create DecisionTreeClassifier object

(iii)In the last we fit our data

```
#Importing Decision Tree classifier
from sklearn. tree import DecisionTreeRegressor
clf=DecisionTreeRegressor ()
#Fitting the classifier into training set
clf.fit(X_train,y_train)
pred=clf.predict(X_test)
```

IV. CROP DISEASE IDENTIFICATION AND ITS SOLUTION

Dataset: - We have used the plant Village dataset. This dataset includes the healthy and infected leaves of various plants. The dataset consist the various plants like tomato, potato, Pepper_Bell etc. We have spilt dataset into training dataset, testing dataset and validation dataset. There is total 38 classes, 54,305 images belong from training set, 43444images belongs from test set, 10861 images belong from validation set. The images cover 14 species of crops, including: apple, blueberry, cherry, grape, orange, peach, pepper, potato, raspberry, soy, squash, strawberry and tomato. It contains images of 17 basic diseases, 4 bacterial diseases, 2 diseases caused by mold (oomycete), 2 viral diseases and 1 disease caused by a mite. 12 crop species also have healthy leaf images that are not visibly affected by disease

Architecture:-

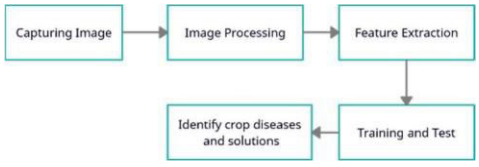

Figure 2. Proposed System Of Crop Disease Identification

Take the picture or choose it from mobile gallery of an infected leaf. Then that user input get to convolutional neural network for doing the processing like image processing, feature extraction. After that it will divides the dataset into test and train set. And then it will gives us a predicted crop disease.

Algorithm Used In Crop Identification:-

There are steps to followed to perform CNN model

1. we flatten the input image dimensions to 1D using width pixels * height pixels.
2. Normalize the image pixels values(divide by 255)
3. One-Hot Encode the categorical column
4. Build a sequential model architecture using dense layers
5. Train the model and make the predictions.

We have applied CNN algorithm in our model as:

(i)Importing library from keras. preprocessing.image from keras Class

(ii)In the last we fit our data

```
# Model building to get trained with parameters
BATCH_SIZE = 64
# Model building to get trained with parameters
opt=keras.optimizers.Adam(lr=0.001)
model.compile(optimizer=opt,loss='categorical_cross entropy',metrics=['accuracy'])
train=model.fit(train_generator, epochs=20,steps_per _epoch=train_generator.samples,validation_data=val _generator,validation_steps= val_generor.samples,ver bose=1,callbacks = early_stopping).
```

V. EXPERIMENTAL RESULTS

i. Firstly, the input image is subjected to two convolution layers having 32 filters each and filter size of 2 2. The ReLU activation function is applied internally in the convolution layer. Parallelly, we apply the batch normalization to the convolution layer to reduce the training size. After that, we use a max-pooling layer of size 2 2 to reduce the size of the convo-lutino matrix further. Again, we used two convolution layers with 64 filters and size 2 2 along with ReLU activation function and batch normalization. This is followed by one more max-pooling layer with size 2 × 2., we applied two more convolution layer with 128 filters and filter size 2-2 with ReLU and batch normalization. This is followed by two more convolution layers with 256 filters and filter size 2 2 with ReLU and batch normalization. After all this, a flattening layer is used to get a vector of neurons which uses ReLU function. Then two dense layers are used: one uses ReLU, while the other uses the SoftMax function and depicts the output class.

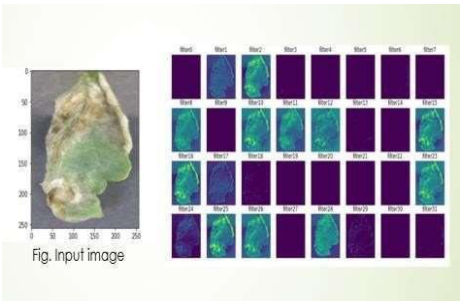

Figure 3:Input given to algorithm

ii. We applied CNN algorithm on crop disease identification and we got 89%accurancy on that model.

```
Epoch 1/20
193/193 [==============================] - 551s 3s/step - loss: 2.2929 -
accuracy: 0.2559 - val_loss: 1.1501 - val_accuracy: 0.6221
Epoch 2/20
193/193 [==============================] - 542s 3s/step - loss: 1.1990 -
accuracy: 0.6123 - val_loss: 0.8882 - val_accuracy: 0.7124
Epoch 3/20
193/193 [==============================] - 537s 3s/step - loss: 0.8545 -
accuracy: 0.7091 - val_loss: 0.7579 - val_accuracy: 0.7485
Epoch 4/20
193/193 [==============================] - 533s 3s/step - loss: 0.7622 -
accuracy: 0.7419 - val_loss: 1.0476 - val_accuracy: 0.6855
Epoch 5/20
193/193 [==============================] - 536s 3s/step - loss: 0.6711 -
accuracy: 0.7756 - val_loss: 0.6989 - val_accuracy: 0.7798
Epoch 6/20
193/193 [==============================] - 536s 3s/step - loss: 0.5765 -
accuracy: 0.8073 - val_loss: 0.5419 - val_accuracy: 0.8184
Epoch 7/20
193/193 [==============================] - 534s 3s/step - loss: 0.4951 -
accuracy: 0.8299 - val_loss: 0.5114 - val_accuracy: 0.8330
Epoch 8/20
193/193 [==============================] - 538s 3s/step - loss: 0.4434 -
accuracy: 0.8512 - val_loss: 0.5789 - val_accuracy: 0.8257
Epoch 9/20
193/193 [==============================] - 529s 3s/step - loss: 0.4170 -
accuracy: 0.8605 - val_loss: 0.4698 - val_accuracy: 0.8555
Epoch 10/20
193/193 [==============================] - 524s 3s/step - loss: 0.3735 -
accuracy: 0.8769 - val_loss: 0.5842 - val_accuracy: 0.8027
Epoch 11/20
193/193 [==============================] - 528s 3s/step - loss: 0.3591 -
accuracy: 0.8759 - val_loss: 0.4462 - val_accuracy: 0.8496
Epoch 12/20
193/193 [==============================] - 524s 3s/step - loss: 0.3401 -
accuracy: 0.8831 - val_loss: 0.3997 - val_accuracy: 0.8643
Epoch 13/20
193/193 [==============================] - 526s 3s/step - loss: 0.3029 -
accuracy: 0.8969 - val_loss: 0.2965 - val_accuracy: 0.9048
Epoch 14/20
193/193 [==============================] - 525s 3s/step - loss: 0.3273 -
accuracy: 0.8865 - val_loss: 0.3969 - val_accuracy: 0.8813
Epoch 15/20
193/193 [==============================] - 524s 3s/step - loss: 0.2944 -
accuracy: 0.9017 - val_loss: 0.4829 - val_accuracy: 0.8496
Epoch 16/20
193/193 [==============================] - 524s 3s/step - loss: 0.2773 -
accuracy: 0.8973 - val_loss: 0.3234 - val_accuracy: 0.8960
Epoch 17/20
193/193 [==============================] - 521s 3s/step - loss: 0.2670 -
accuracy: 0.9071 - val_loss: 0.4942 - val_accuracy: 0.8403
Epoch 18/20
193/193 [==============================] - 524s 3s/step - loss: 0.2426 -
accuracy: 0.9148 - val_loss: 0.3496 - val_accuracy: 0.8823

Test loss: 0.39791545271873474
Test Accuracy: 0.8746660351753235
```

Figure 4:accuracy and loss at each epoch

iii. Here we applied Decision tree algorithm on crop prediction system we got 90% accuracy on model and after that get predicted crop for suitable crop.

```
#Sending the predicted crop to database
cp=firebase.put('/croppredicted','crop',c)
```

```
   temperature   humidity       ph    rainfall label
0    20.879744  82.002744  6.502985  202.935536  rice
The data present in one row of the dataset is
   temperature   humidity       ph    rainfall  Black gram  Chickpea  \
0    20.879744  82.002744  6.502985  202.935536         0         0

   Coconut  Coffee  Cotton  Ground Nut  ...  maize  mango  millet  muskmelon  \
0        0       0       0           0  ...      0      0       0          0

   orange  papaya  pomegranate  rice  watermelon  wheat
0       0       0            0     1           0      0

[1 rows x 34 columns]
The accuracy of this model is:  90.43010752688173
The predicted crop is muskmelon
```

Figure5: Accuracy and Output Of Crop Prediction System

VI. SCREENSHOTS OF SYSTEM

Here we upload an image from the android app then the trained crop disease model performs an algorithm on given that input and gives it to the
crop disease name and its solution.

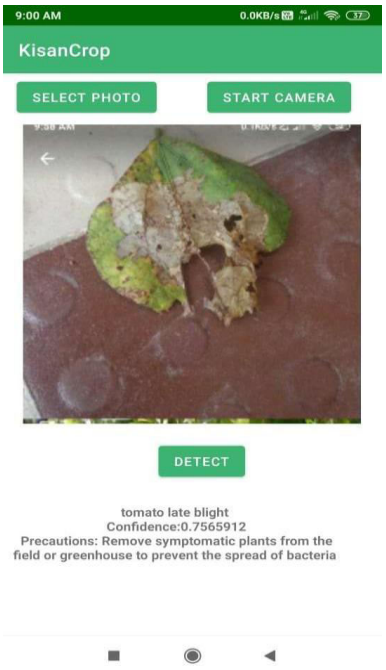

Figure 6.: Predicated Crop Disease

We collected sensor through raspberry pi then stored in firebase database that value given to the trained crop prediction model then performs the necessary operations and gives it to the crop suggestion GUI. The suggestion GUI suggests about the crop that can be chosen for cultivation. Hence precision decision is made by the farmers with the help of the predicted result.

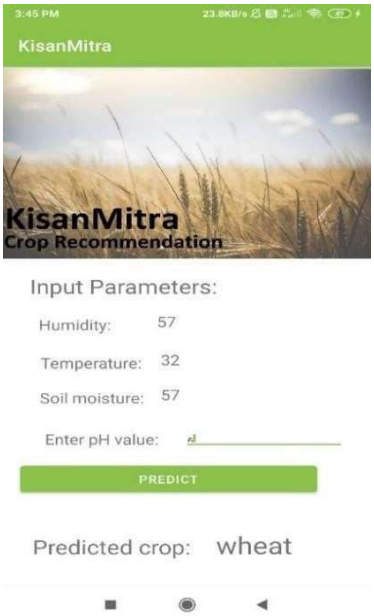

Figure 7. Crop Recommended

Here We show the present weather details of thatuser region in our android app .

Fig8.Weather Shown In Android App

CONCLUSION

Agriculture being an important a neighbourhood of our economy, it's essential to form sure that even the tiniest investment exhausted the agriculture sector should be taken care of when it involves farming and crop seeds are one of them. So, it's essential to ascertain if the proper crop has been chosen for suitable soil that matches its requirements to profit the farmer. this technique would assist the farmers in making an informed decision about which crop to grow relying on a selection of environmental and geographical factors. The IoT and ML based suggestions will help to educate the farmers and help them to minimize the cost for cultivation this enables for a scalable, reliable solution to an important problem affecting many of us. Our future work aims at developing this model with more soil attributes and with a much bigger data set.

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FUTURE SCOPE

Currently, we are worked on the 9 crops and 30 diseases and the system has also provides the solutions for crops based on its causes , in future the system will works on more crops and diseases and also provide the solutions for crops based on its causes. Informing the farmers about the latest news and government schemes related to agriculture sector. System will also provide the regional language support The system will also provide fertilizers and its cost based on recommended crop.

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