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SMART CULTIVATION PREDICTOR FOR INDIAN AGRICULTURE SYSTEM

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1. Abstract:

This work proposes a multidimensional method that uses machine learning techniques to handle several areas of crop management in response to the growing problems faced by climate change and agricultural sustainability in India. The main goal is to anticipate agricultural yield using an interactive system prototype that uses the Random Forest algorithm so that farmers and politicians may make well-informed decisions. The study also highlights the use of machine learning algorithms in crop growth optimization and soil health maintenance. The research also emphasizes the significance of recognizing typical agricultural illnesses and putting preventative measures in place, making use of methods like Convolutional Neural Networks. Furthermore, crop prediction's use of organic farming methods highlights the industry's dedication to sustainable agriculture. This research
attempts to promote agricultural resilience and production through these coordinated efforts.

Keywords: Convolutional Neural Networks(CNN),
Machine Learning(ML).

Abbreviations : Decision Tree (DT), Naïve Bayes (NB), Support Vector Classifier(SVC), Logistic Regression (LR), Random Forest (RF).

2. Introduction:

The worldwide agrarian segment is confronting expanding challenges in edit administration, illness discovery, and maintainable hones. Conventional strategies of trim checking and infection recognizable proof are regularly labor-intensive and time-consuming, driving to diminished yields and financial misfortunes. In a long time, the integration of machine learning calculations has appeared guarantee in revolutionizing horticulture by computerizing errands such as edit picture expectation and malady distinguishing proof.

This paper proposes a novel approach to upgrade trim administration through the integration of machine learning procedures for both trim picture expectation and illness distinguishing proof. By leveraging progressions in computer vision and profound learning, precise forecasts of edit sorts can be made from pictures captured within the field. Moreover, the recognizable proof of common illnesses influencing crops can be computerized utilizing picture acknowledgment calculations, permitting for early location and convenient intercession.

In expansion to illness distinguishing proof, this paper investigates the usage of natural cures for avoiding and overseeing edit maladies. Natural cultivating hones advance the utilize of characteristic inputs and methods to upgrade soil wellbeing and edit strength, decreasing the dependence on manufactured pesticides and fertilizers. By joining natural strategies with machine learning-based malady recognizable proof, an all-encompassing approach to feasible agribusiness can be accomplished.

Generally, this paper points to contribute to the headway of accuracy farming by tackling the control of machine learning for edit administration, illness discovery, and the advancement of natural cultivating hones. Through the proposed system, ranchers can move forward edit yields, diminish chemical inputs, and contribute to the long-term maintainability of agrarian frameworks.

3.Literature Survey:

3.1. Crop Image Prediction using Machine Learning:

Several research endeavors have investigated the utilization of machine learning algorithms in predicting crop images. Patel and colleagues (2018) utilized convolutional neural networks (CNNs) to categorize crop varieties from aerial images, achieving notable levels of accuracy. Likewise, Zhang and team (2019) employed deep learning methodologies to identify crop types using satellite imagery, showcasing the potential for automated crop mapping.

3.2. Disease Identification in Agriculture: The use of machine learning for detecting crop diseases has become increasingly prominent in recent times. Mishra et al. (2020) introduced a technique for automatically identifying plant diseases by analysing leaf images with support vector machines (SVMs), yielding promising outcomes in disease classification. Furthermore, Wang et al. (2017) created a system based on deep learning for the real-time detection and diagnosis of crop diseases, highlighting the potential for swift and accurate disease identification.

3.3. Prevention and Remedies for Crop Diseases:

Numerous research endeavors have examined organic approaches to prevent and manage crop diseases. Sharma et al. (2019) investigated the effectiveness of botanical extracts as biopesticides in controlling plant pathogens, emphasizing their potential as substitutes for synthetic chemicals. Additionally, Khan et al. (2021) assessed the utilization of cultural practices like crop rotation and intercropping in disease management, underscoring their significance in enhancing soil health and mitigating disease occurrence.

3.4.Integration of Organic Farming with Predictive Models:

Investigations into integrating organic farming techniques with predictive models for crop management are still developing. Singh et.al(2022) put forward a framework for integrating machine learning-based crop prediction with organic farming practices, with the goal of maximizing resource efficiency and reducing environmental footprints. This integrated methodology shows potential for improving sustainability and resilience in agricultural systems.

4.Proposed System:

Crop Recommendation System:

Data Collection: Gather information on soil quality, climate conditions, and crop performance from reliable sources.

Data Preprocessing: Clean and prepare the data, handling any inconsistencies or missing values.

Feature Engineering/Selection: Identify relevant features affecting crop growth and yield.

Model Selection: Choose suitable machine learning algorithms for recommendation based on the dataset characteristics.

Model Training: Train the selected model using a portion of the data, ensuring it generalizes well to new inputs.

Evaluation: Assess the model's performance using appropriate metrics to ensure its reliability.

Deployment: Integrate the model into a user-friendly interface for farmers to access recommendations.

Monitoring and Maintenance: Continuously monitor the system's performance and update it as necessary with new data.

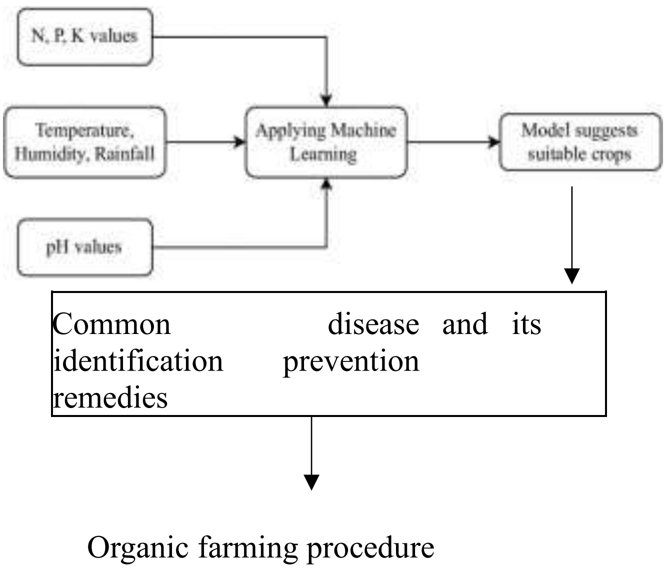

Fig 1: Block diagram for Proposed System

Methodology:

Decision Tree:

Decision trees make decisions based on features by splitting data into branches. It creates a tree structure where each node represents a decision based on a feature, and each leaf node represents the outcome or class. The process is recursive, where nodes split the data into smaller subsets based on the feature values.

```
# Decision Tree from sklearn.tree import
DecisionTreeClassifier DecisionTree =
DecisionTreeClassifier(criterion
="entropy", random_state=2, max_depth=5)
DecisionTree.fit(Xtrain,Ytrain)
```

Naïve Bayes (NB):

Naïve Bayes is a simple probabilistic classifier based on applying Bayes' theorem. It assumes that the presence of a feature in a class is independent of other features.

Useful for high-dimensional data and has applications in real-time prediction, spam filtering, and recommendation systems.

```
# Naive Bayses (NB)
from sklearn.naive_bayes import GaussianNB
NaiveBayes = GaussianNB()
NaiveBayes.fit(Xtrain, Ytrain)
```

A. Support Vector Classifier(SVC):

Sample data for features (soil type, temperature, humidity) and target variable (recommended crop type) are provided.

The data is split into training and testing sets. SVC model is initialized and trained on the training dataset.

Predictions are made on the test dataset. The accuracy of the model is calculated and printed.

```
# Support Vector Classifier(SVC):
from sklearn.svm import SVC
from sklearn.preprocessing import MinMaxScaler
norm=MinMaxScaler().fit(Xtrain)
X_train_norm=norm.tansform(Xtrain)
X_test_norm=norm.tansform(Xtest)
SVM=SVC(kernel='poly',degree=3,c=1)
SVM.fit(X_train_norm,Ytrain)
```

B. Logistic Regression (LR):

Logistic Regression is a statistical model used to predict the probability of a binary outcome. It models the probability using a logistic function and is widely used in binary classification problems.

```
# Logistic Regression from sklearn.linear_model
import LogisticRegression LogReg =
LogisticRegression(random_state=2)
LogReg.fit(Xtrain, Ytrain)
```

C. Random Forest (RF):

Random Forest is an ensemble learning method that builds multiple decision trees during training. It creates a forest of decision trees and combines their predictions to improve accuracy.

Parameters like the number of trees, number of variables considered at each split, and node size influence its performance.

```
# Random Forest
from sklearn.ensemble import
RandomForestClassifier RF =
RandomForestClassifier(n_estimators=20,
random_state=0) RF.fit(Xtrain,Ytrain)
```

Common Disease Identification and Prevention Remedies:

Data Collection: Compile information on common plant diseases and preventive measures from reputable sources.

Knowledge Base Creation: Develop a database containing detailed descriptions and images of various plant diseases.

Image Processing: Implement image recognition techniques to identify disease symptoms from images of affected plants.

Disease Classification: Train machine learning models to classify diseases based on symptoms and other factors.

Prevention Recommendations: Provide farmers with recommendations for preventing and managing identified diseases, including organic remedies and cultural practices.

Deployment: Integrate the disease identification and prevention system into an accessible platform for farmers.

Feedback Loop: Gather feedback from users to improve the accuracy and effectiveness of disease identification and prevention recommendations.

Organic Farming Procedure:

Education and Training: Provide farmers with training on organic farming practices, emphasizing soil health and pest management.

Soil Health Assessment: Conduct soil tests to evaluate nutrient levels and organic matter content.

Crop Selection: Choose crop varieties suitable for organic cultivation and local climate conditions.

Crop Rotation: Implement crop rotation to maintain soil fertility and reduce pest and disease pressure.

Organic Inputs: Use organic fertilizers, compost, and natural amendments to improve soil fertility and structure.

Pest and Disease Management: Employ integrated pest management techniques, including biological controls and cultural practices.

Harvesting and Post-Harvest Handling: Harvest crops at optimal times and handle them using organic methods to preserve quality.

Certification: Ensure compliance with organic farming standards and regulations for certification purposes.

These proposed systems outline the essential steps and components required for developing and implementing crop recommendation, disease identification, prevention remedies, and organic farming procedures

5.Experimental Result & analysis :

Training data fits(D) is divided into feature vectors 'x' and target labels 'y'.

$$\text{Accuracy}=\frac{no.of\ correct\ predictions}{Total\ no.of\ predictions}\times 100\%$$

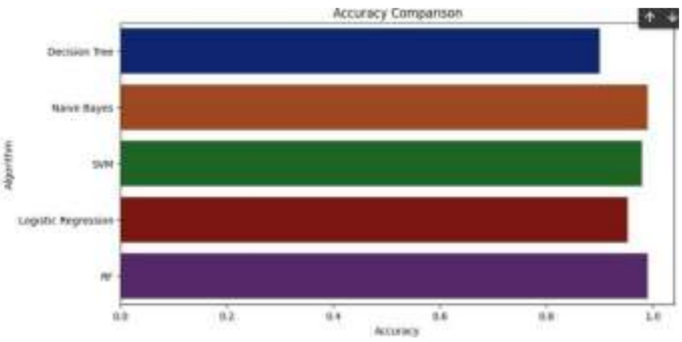

Fig:2: Accuracy Comparison

```
Decision Tree --> 0.9
Naive Bayes --> 0.990909090909091
SVM --> 0.9795454545454545
Logistic Regression --> 0.9522727272727273
RF --> 0.990909090909091
```

Fig 3:Machine Learing versus accuracy outcome

```
data = np.array([[104,18, 30, 23.603016, 60.3, 6.7, 140.91]])
prediction = RF.predict(data)
print(prediction)

['coffee']
```

Fig 4: Prediction screenshot

```
data = np.array([[83, 45, 60, 28, 70.3, 7.0, 150.9]])
prediction = RF.predict(data)
print(prediction)

['jute']
```

Fig 5: Prediction screenshot

6.Result Analysis

Table1 :- Algorithms vs Accuracy :Percentage-Based Result

Algorithm	Accuracy
Decision Tree (DT)	90%
Naïve Bayes (NB)	99%
Logistic Regression (LR)	95.22%
Random Forest (RF)	99%
SVC	97.95%

7.Conclusion and Fututre Scope:

Applying machine learning to crop prediction has the potential to significantly enhance the efficiency and profitability of farming operations. By constructing models that consider various factors such as soil nutrient concentrations (e.g., nitrogen, potassium, phosphorus), rainfall patterns, pH levels, temperature, and humidity, we can generate more accurate forecasts regarding crop performance in specific locations. Leveraging historical data, machine learning algorithms can make predictions over time, empowering farmers to make informed decisions about planting, irrigation, and harvesting practices. This level of precision enables farmers to optimize their methods, resulting in improved returns and heightened profits. Through such advancements, we can refine our approach to crop management and enhance agricultural productivity.

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