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CROPMATE: A Mobile Application for Data Driven Crop Recommendation and Personalized Analysis

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Abstract

CropMate is a revolutionary mobile application designed to revolutionize the agricultural landscape by providing data- driven crop recommendations and personalized analysis to farmers.

Through advanced algorithms and machine learning techniques and analyzes various factors such as soil quality, climate conditions, and historical crop performance to suggest the most suitable crops for cultivation.

This innovative tool empowers farmers to make informed decisions, optimize yields, and maximize profitability while minimizing environmental impact and farming becomes smarter, more efficient, and more sustainable, ushering in a new era of precision agriculture.

Introduction

Crop recommendation refers to the process of advising farmers on the most suitable crops to grow based on various factors such as soil type, climate, water availability, market demand, and the farmer's resources and preferences. This practice integrates scientific knowledge, agricultural expertise, and data analysis to optimize agricultural productivity and sustainability.

The introduction of crop recommendation systems has been driven by the need to improve agricultural efficiency and address challenges such as food security, climate change, and resource constraints. By providing personalized guidance to farmers, these systems aim to enhance yields, reduce input costs, minimize environmental impact, and maximize profitability.

Modern crop recommendation systems utilize advanced technologies such as geographic information systems (GIS), remote sensing, machine learning, and big data analytics to analyze vast amounts of data and generate customized recommendations. These systems take into account factors such as soil fertility, moisture levels, temperature, precipitation patterns, pest and disease prevalence, and historical crop performance to determine the most suitable crops for a particular location and farming situation.

Crop recommendation services may be provided by government agricultural extension agencies, research institutions, agribusiness companies, or technology startups. They often include interactive platforms, mobile apps, or web-based tools that allow farmers to input their specific conditions and receive tailored advice in real-time.

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Overall, crop mate plays a crucial role in promoting sustainable agriculture, increasing farmers' incomes, and ensuring food security for growing populations. By harnessing the power of data and technology, these systems contribute to more informed decision-making in farming practices, ultimately leading to more resilient and productive agricultural systems.

Literature Survey

Survey : "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms.

Author : Zeel Doshi, Subhash Nadkarni, Rashi Agrawal, Prof. Neepa Shah.

Methodlogy : The paper proposes AgroConsultant, an intelligent crop recommendation system utilizing machine learning. It incorporates two subsystems: Crop Suitability Predictor and Rainfall Predictor. accuracy:- Crop Suitability Predictor achieved high accuracies: Decision Tree (90.20%), K-NN (89.78%), Random Forest (90.43%), and Neural Network (91.00%). Rainfall Predictor achieved an accuracy of 71%.

Drawback: The system does not consider socio-economic factors such as market demand or economic viability, which could significantly impact a farmer's decision-making process.

Proposed Work

Cropmate proposes to revolutionize agriculture by offering a comprehensive platform that combines cutting-edge technologies such as data analytics and soil analysis to enable farmers to recommend crops with precision. By providing actionable insights and recommendations, Cropmate empowers farmers to optimize crop yields, minimize inputs, and enhance sustainability practices. With a focus on precision agriculture, user-friendly farm management software, Cropmate aims to drive efficiency and profitability across the entire agricultural value chain, ultimately contributing to food security and environmental stewardship.

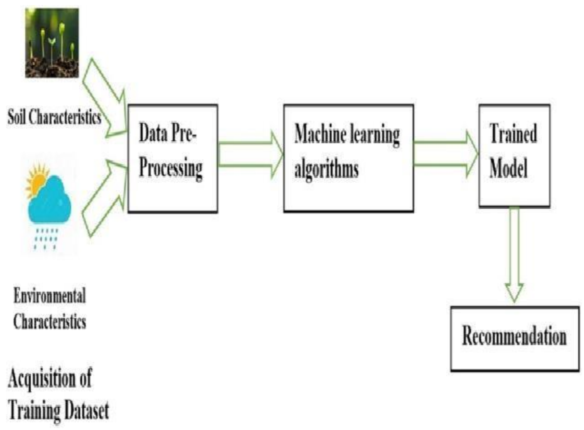

Fig 1: Proposed Model For Crop Recommendation

Dataset Description

Dataset Name: Crop Recommendation Dataset (CRD) Description: The Crop Recommendation Dataset (CRD) is designed to assist farmers in making informed decisions about suitable crop selection based on various environmental and soil conditions. This dataset encompasses information on soil properties, and season and geo-graphical location collected from diverse agricultural regions. CRD leverages machine learning algorithms and agronomic expertise to generate crop recommendations tailored to specific locations and farming contexts. CRD provides personalized recommendations to optimize crop yields, minimize risks, and enhance agricultural sustainability. This dataset serves as a valuable tool for farmers, agronomists, and agricultural extension services seeking to improve crop selection practices and maximize productivity.

Format: CSV Variables:

Location (string): Geographic location (e.g., latitude, longitude) of the farm or agricultural area Soil Type (string): Classification of soil type based on texture, structure, and composition Crop Options (list of strings): List of recommended crops suitable for the given environmental and soil conditions CRD serves as a valuable decision support tool for farmers, enabling them to optimize crop selection and management practices to achieve sustainable and profitable agricultural outcomes. Additionally, CRD can be integrated into agricultural advisory services and digital farming platforms to provide real-time recommendations and guidance to farmers across different regions and cropping seasons.

Data Pre-processing

In preprocessing the Crop Recommendation System (CRS), missing values were handled by imputation, replacing them with the mean or mode as appropriate. Numerical features like soil soil type, crops to yield, nearby market were normalized to ensure uniform scale, while categorical variables such as soil type and crop options were encoded using one-hot encoding. Feature engineering was employed to extract additional relevant features, and the dataset was split into training and testing sets for model evaluation. To prevent bias, the training data was shuffled, and dimensionality reduction techniques such as Principal Component Analysis (PCA) were considered for datasets with high dimensionality. These preprocessing steps ensure that the CRS is cleaned, standardized, and ready for analysis and model development to provide accurate crop recommendations.

Feature Selection and Extraction

Feature selection for a crop recommendation system involves identifying the most informative attributes that significantly influence crop selection while minimizing noise and redundancy. This process typically encompasses various techniques, including correlation analysis to detect strong relationships between features and crop choices, feature importance estimation using machine learning algorithms, recursive feature elimination to iteratively prune less relevant attributes, and domain expert consultation to leverage agricultural knowledge. Additionally, statistical tests and regularization methods aid in selecting features with the highest predictive power while reducing overfitting. Integration of principal component analysis can further streamline the feature space, preserving key information while reducing dimensionality. By strategically selecting features through these methods, the crop recommendation system can offer more accurate and actionable insights to farmers, ultimately enhancing agricultural decision-making and productivity.

Results and Discussion

The experimentation evaluations are analyzed with two different CNN model architectures such as VGG-16 and MobileNetV2. The data set has been divided into 80:20 (80% for training and 20% for testing), and experimented for 10 epochs. Once the training data is modelled, the approach uses the confusion matrix as a performance metric to evaluate the performance of the algorithms used. Classification Accuracy is evaluated for each of the architectures in which true labels and false labels are verified for correct classification. The best results were evaluated using VGG-16. The best results are obtained with the VGG-16 CNN model with 10 epochs. The VGG-16 achieved an accuracy of 0.99.

```python
# Set random seeds
tf.random.set_seed(42)

# Building CNN Model
model = Sequential([
    Conv2D(filters=10, kernel_size=3, activation="relu", input_shape=(224, 224, 3)),
    Conv2D(10, 3, activation="relu"),
    MaxPool2D(pool_size=2, padding="valid"),
    Conv2D(10,3, activation="relu"),
    Conv2D(10, 3, activation="relu"),
    MaxPool2D(2),
    Flatten(),
    Dense(4, activation="softmax")
])

# Compile the model
model.compile(loss="categorical_crossentropy",
              optimizer=Adam(),
              metrics=["accuracy"])

# Fit the model
history = model.fit(train_data,
            epochs=10,
            steps_per_epoch=len(train_data),
            validation_data=test_data,
            validation_steps=len(test_data))
```

```python
# Load an example image for testing
input_image_path = '/content/drive/MyDrive/blackSoil.jpeg'  # Replace with the path to your example image
input_image = Image.open(input_image_path).resize((224, 224))  # Resize image to match model input size
input_image = np.array(input_image) / 255.0  # Normalize pixel values
input_image = np.expand_dims(input_image, axis=0)  # Add batch dimension

# Pass input image to the model to get predictions
predictions = model.predict(input_image)

# Interpret the output
predicted_class_index = np.argmax(predictions)  # Get index of class with highest probability
class_names = ['Alluvial soil', 'Black Soil', 'Clay soil', 'Red soil']  # Define class names
predicted_class = class_names[predicted_class_index]  # Get predicted class name
predicted_probability = predictions[0][predicted_class_index]  # Get predicted probability

# Print results
print('Predicted class:', predicted_class)
print('Predicted probability:', predicted_probability)
```

```
1/1 [==============================] - 0s 21ms/step
Predicted class: Black Soil
Predicted probability: 0.9971451
```

Fig 2: System Out put

Conclusion and Future Work

In conclusion, the CropMate Android application project represents an innovative solution to aid farmers in making informed decisions regarding crop cultivation. By leveraging technologies such as image recognition, geolocation, and data analytics, the application provides users with personalized crop recommendations based on factors like soil type, geographical location, and seasonal conditions. The user-friendly interface facilitates seamless interaction, allowing users to input relevant data effortlessly. Integration with external data sources further enhances the accuracy and reliability of recommendations. Moreover, the application prioritizes user privacy and data security while ensuring offline functionality for accessibility in remote areas. With a focus on scalability and maintenance, CropMate is poised to empower farmers with actionable insights, ultimately contributing to improved agricultural sustainability.

Future enhancements for the crop recommendation system could focus on integrating real-time data sources such as weather forecasts, satellite imagery, and soil sensors to provide up-to-date insights and recommendations for farmers. Additionally, leveraging advanced machine learning techniques like deep learning models could further improve the accuracy and robustness of crop predictions by capturing complex relationships within the data. Implementing user feedback mechanisms and adaptive learning algorithms would enable the system to continuously refine its recommendations based on the evolving needs and preferences of farmers. Moreover, incorporating socio-economic factors and market trends could enhance the system's capability to offer holistic and tailored recommendations that align with farmers' goals and market demands. By embracing these advancements, the crop recommendation system can better empower farmers to make informed decisions, optimize resource utilization, and achieve sustainable agricultural practices.

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