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AGRICULTURAL CROP AND FERTILIZER RECOMMENDATIONS BASED ON VARIOUS PARAMETERS

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ABSTRACT-

Agriculture is a vital sector for global food security and economic sustainability. This research introduces an integrated system for crop and fertilizer recommendation using deep learning models, specifically Multilayer Perceptron (MLPs) and Convolutional Neural Networks (CNNs). The system analyse soil images and environmental parameters such as temperature, pH, and rainfall to recommend suitable crops and natural fertilizers. By combining image analysis and historical weather data, the system ensures accurate and location-specific predictions. Alerts are also disseminated to farmers via SMS, enhancing the usability of the solution in rural areas.

Keywords—Crop Recommendation, Deep Learning, CNN, MLP, Soil Analysis, Precision Agriculture

1.INTRODUCTION

Machine learning-based crop recommendation systems, especially those using Multilayer Perceptron (MLPs), can model complex relationships between environmental factors and optimal crop choices. By incorporating location-specific data and continuously learning from new inputs, MLPs offer adaptive, accurate, and personalized suggestions that enhance agricultural productivity and sustainability. These systems handle uncertainties in real-world data effectively, making them robust tools in precision farming. Their ability to evolve with changing conditions paves the way for smarter, more resilient agricultural practices.

2.EXISTING SYSTEM

Agriculture plays a vital role in India's economy, but factors like climate change, unpredictable rainfall, water scarcity, and excessive pesticide use have negatively impacted crop production. To understand the current state of agriculture, descriptive analytics is applied to historical crop yield and climatic data. The primary goal of this research is to improve crop yield prediction through a more effective methodology. Although there are studies on agricultural statistics, few focus on predicting crop yields using historical climatic and production data.

Principal Component Regression (PCR) Method:

The existing system uses Principal Component Regression (PCR) for predictive analytics, which involves two steps:

1. **Dimensionality Reduction**: PCR first reduces data dimensions by selecting the most significant variables and extracting the highest variation within the data. This is done by finding factors that maximize dispersion and rotating them perpendicular to each other.
2. **Linear Regression**: After reducing the dimensionality, a linear regression is applied to the transformed data to establish correlations with the factors.

3.PROPOSED SYSTEM

Predicting crop yield using environmental, soil, water, and crop parameters has been a key research area. Deep learning models are commonly used to extract significant crop features, but they have limitations, including:

1. Difficulty in establishing direct non-linear or linear mappings between raw data and yield values.
2. Performance highly dependent on the quality of extracted features.

To address these issues, deep reinforcement learning (DRL) combines reinforcement learning and deep learning, offering a comprehensive framework for crop yield prediction. DRL can map raw data directly to crop yield values.

In this project, deep neural networks (DNNs) are used to predict the yield, yield check, and yield difference of corn hybrids from genotype and environmental data. DNNs, which belong to representation learning models, can automatically learn data features without manual input. With multiple stacked non-linear layers, DNNs transform raw data into more abstract representations, improving prediction accuracy as the network deepens. When properly tuned, DNNs are universal approximators, capable of approximating nearly any function.

4 TECHNOLOGY

HARDWARE REQUIREMENTS • Processor • RAM • Hard disk • Compact Disk • Keyboard • Monitor : Intel core processor 2.6.0 GHZ : 1GB : 160 GB : 650 Mb : Standard keyboard : 15-inchcolor monitor

SOFTWARE REQUIREMENTS • Operating system • Front End • Back End • IDE : Windows OS : PYTHON : MYSQL : PYCHARM

Multi-Layer Perceptron (MLP) Overview:

A **Multi-Layer Perceptron (MLP)** is a type of artificial neural network used in machine learning. It consists of:

- **Input layer**: Receives data.
- **Hidden layers**: Apply non-linear transformations to the data.
- **Output layer**: Produces the final prediction.

During training, MLPs adjust weights and biases to minimize a loss function using **backpropagation**, which calculates the gradient of the loss function to update parameters. After training, the network can make predictions on new data.

MLPs are widely used in **image and speech recognition**, **natural language processing**, and **predictive modelling**.

Pseudocode:

1. **Initialize** weights and biases randomly.
2. **Set** learning rate and epochs.
3. **For each epoch**:
    - Shuffle training data.
    - For each example:
        - Feed input through the network and compute output.
        - Calculate the error (predicted vs. actual).
        - Backpropagate error to update weights and biases.
    - Calculate average error for the epoch.
    - Test on validation set.
4. Repeat until satisfactory validation performance.
5. Test final network on the test set.

5 MODULE SPECIFICATION

A. Dataset Acquisition

Crop yield and soil datasets are uploaded in CSV and image formats, respectively. These datasets include parameters such as temperature, rainfall, pH, nitrogen, phosphorus, and potassium. Data is sourced primarily from Kaggle and stored in a database for future processing.

B. Preprocessing

This module handles data cleaning by removing irrelevant values and estimating missing entries. For soil images, noise is reduced using the Median Filtering algorithm, which is effective for removing salt-and-pepper noise while preserving image details.

C. Feature Extraction

Key features such as soil color, shape, and texture are extracted from images. Datasets are labeled and trained for multiple crops (e.g., rice, maize). A Convolutional Neural Network (CNN) is employed to extract and process image features for classification.

D. Model Training

Two models are used:

- **MLP (Multilayer Perceptron):** Trained on numerical environmental data for crop yield prediction. The dataset is split into training and validation sets to optimize model performance.
- **CNN:** Trained on soil images. The dataset is divided into training, validation, and testing sets. Backpropagation and gradient descent are used to fine-tune the model.

Model evaluation is based on accuracy, precision, recall, and F1 score to ensure optimal performance.

E. Crop Prediction

Using trained MLP and CNN models, the system predicts suitable crops and associated yield metrics. User inputs are processed, and the output includes recommended crops and fertilizer information. Predictions are validated using standard evaluation metrics and can be deployed for practical use in crop management systems.

6.LITERATURE SURVEY

Various studies have shown the effectiveness of ML algorithms in predicting suitable crops based on environmental parameters:

Patil & Thorat (2016) proposed a decision support system using the Naïve Bayes classifier to recommend crops based on soil type, temperature, and rainfall. The model demonstrated decent accuracy and served as a foundational approach for crop prediction.

Uddin et al. (2021) developed a deep learning-based system using Convolutional Neural Networks (CNNs) to analyze satellite imagery for large-scale crop recommendation across regions, proving the scalability of AI in agriculture.

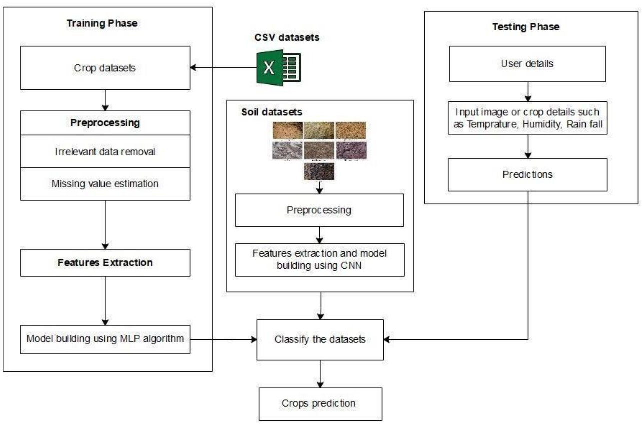
Chatterjee et al. (2017) introduced an expert system using fuzzy logic and rule-based reasoning to provide fertilizer suggestions. It considered parameters like crop type, soil moisture, and nutrient deficiency levels.

Anjana et al. (2020) proposed a hybrid ML model combining Logistic Regression and Gradient Boosting to simultaneously suggest suitable crops and optimal fertilizer dosages. Their system achieved an accuracy of over 90% on test data.

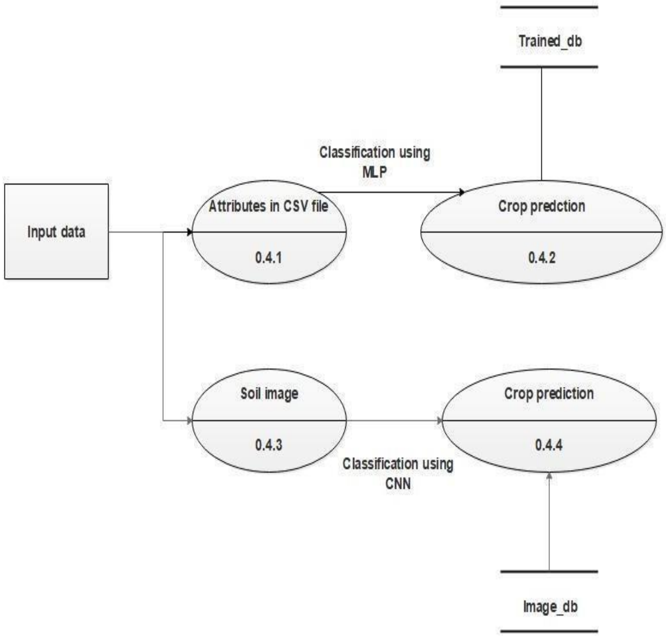
Singh et al. (2021) developed a smartphone-based AI application that utilized weather data APIs, GPS-based soil mapping, and ML predictions to give real-time crop and fertilizer suggestions to farmers in rural India

6.1DESIGN

System architecture is a conceptual framework that outlines the structure, behaviour, and components of a system. It includes the arrangement of hardware, software, and their interactions, providing a foundation for system development and integration. Architecture descriptions often utilize formal languages (ADLs) and may include current system inventories, future upgrade plans, and lifecycle considerations. It defines strategic design decisions, relationships between system elements, and ensures the system meets functional and performance requirements.

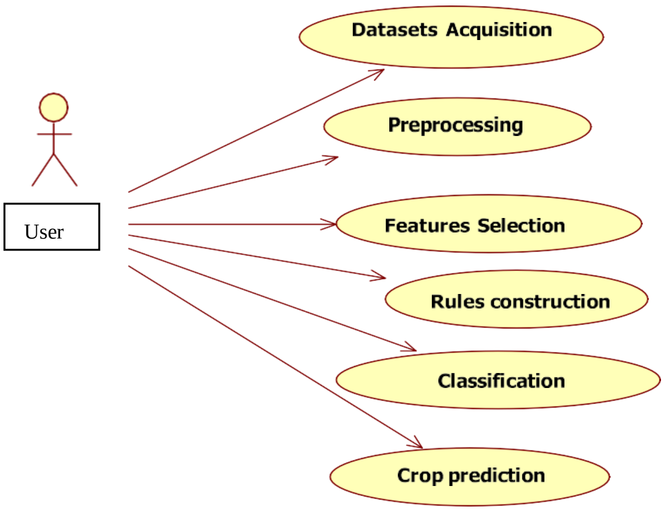


6.2 DATA FLOW DIAGRAM



USECASE DIAGRAM

6.3 USECASE DIAGRAM



7.CONCLUSION

We presented a deep learning approach for crop prediction, which demonstrated superior performance in Crop Challenge using large datasets of products. The approach used deep neural networks to make crop datasets such as soil and textual datasets. In conclusion, deep learning models offer a promising solution for predicting crop yields based on environmental variables such as temperature, pH, rainfall, and soil data. By using neural networks to analyse large and complex datasets, these models can identify patterns and relationships that would be difficult or impossible for humans to discern. By training the model on historical data and then using it to make predictions on new data, farmers and researchers can gain valuable insights into which crops are most likely to thrive under certain environmental conditions. However, there are still some challenges to overcome, such as the need for high-quality and diverse data, the difficulty of interpreting complex neural networks, and the potential for bias and errors in the training data. Overall, deep learning holds great promise for revolutionizing the field of crop prediction and helping to feed a growing global population

8. FUTURE ENHANCEMENT

This project describes crop yield prediction ability of the algorithm. In future we can determine the efficient algorithm based on their accuracy metrics that will helps to choose an efficient algorithm for crop prediction based on soil images.

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