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Intelligent Crop Recommendation System Using Machine Learning and IoT Authors

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Abstract: A large portion of India's population depends on agriculture as their main occupation. However, improper use of fertilizers often results in poor crop production. This paper presents a system that combines Internet of Things (IoT) and Machine Learning (ML) technologies for soil testing and intelligent crop recommendation. Sensors are used to measure parameters such as soil temperature, moisture, pH, and nutrient levels (NPK). The data collected is processed using ML algorithms, particularly Random Forest, to recommend suitable crops. Additionally, Convolutional Neural Networks (CNNs) are applied to detect plant diseases. This system minimizes soil degradation and supports farmers in making data-driven agricultural decisions.

Keywords: Soil nutrient identification, Crop suggestion, Plant pathology, NPK, IoT, Machine Learning, CNN, K-Nearest Neighbour (KNN).

I. INTRODUCTION

India's economy and food security heavily rely on agriculture. Due to changing climates, resource mismanagement, and financial risks, many farmers face severe challenges. AI and ML offer a promising way to reduce uncertainties by recommending suitable crops based on real-time and historical data.

II. MACHINE LEARNING IN AGRICULTURE

Machine Learning (ML) is a subset of AI where systems learn from data and improve over time without being explicitly programmed. It helps discover patterns and make predictions or decisions by training models on historical data.

2.1 Types of ML

Supervised Learning
Unsupervised Learning
Semi-Supervised Learning
Reinforcement Learning

2.2 Benefits in Crop Recommendation

Improved crop selection accuracy
Real-time data analysis
Early pest/disease detection
Reduction in human error
Informed decision-making

III. LITERATURE SURVEY

Research has focused on integrating economic data, weather forecasting, and mobile-friendly systems. The models evaluated include Random Forest, Decision Trees, KNN, and XGBoost.

IV. PROPOSED WORK

Objectives:

- Recommend suitable crops
- Minimize resource wastage
- Enhance profitability
- Provide real-time, personalized suggestions

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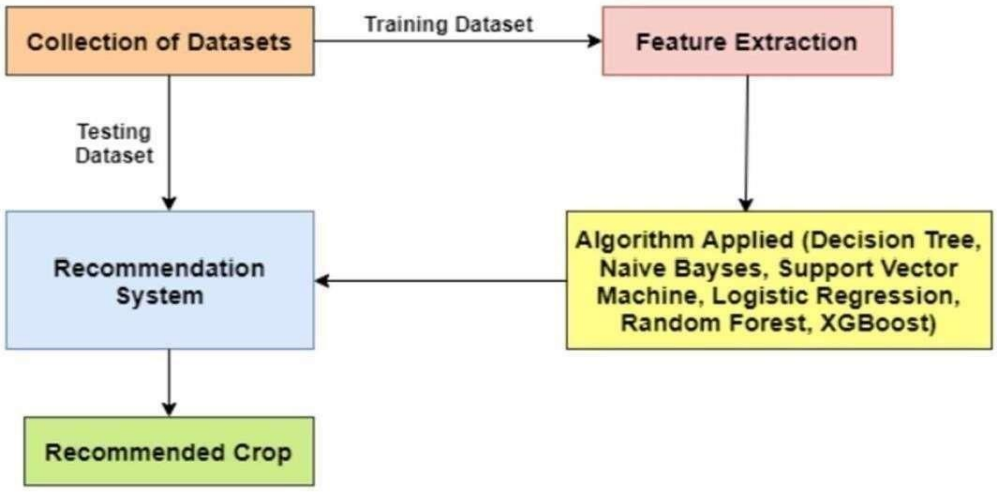
Problem Statement:
Develop a machine learning-based crop recommendation system that uses IoT data to support accurate crop choices.

Architecture:
- Data Collection
- Preprocessing
- Feature Extraction - Model Training

V. METHODOLOGY

The system is built using several ML algorithms:
Decision Tree
Naïve Bayes
Support Vector Machine
Logistic Regression
Random Forest
XGBoost



VI. HARDWARE AND SOFTWARE REQUIREMENTS

Software:
- Windows/Linux
- Python (Pandas, Sklearn, TensorFlow)
- MySQL

Hardware:
- 8GB RAM
- 1TB HDD
- i5 CPU

VII. DESIGN AND IMPLEMENTATION

Includes use case, sequence, and activity diagrams. Interface includes Admin and Home pages. System is backed by Python code and a ML model.

VIII. CONCLUSION AND FUTURE WORK

Conclusion:
This system demonstrates a scalable and effective way to support Indian farmers using IoT and ML.
Future Work:
- Real-time IoT integration

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- Offline mobile app - Climate adaptation
- Market trend prediction
- Indigenous knowledge
- Deep learning for disease detection

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