FARMGENIE

Cultivating Success

Summary

FarmGenie aims to tackle the significant problem of crop losses due to pests, diseases, and improper crop selection. By leveraging AI technologies, it seeks to develop a comprehensive system that predicts crop diseases and provides recommendations for optimized crop selection, mitigating losses and enhancing agricultural productivity.

Devankit Sarkar & Prameya Mohanty
Delhi Public School, Rourkela

Problem Statement

Crop losses caused by pests, diseases, and improper crop selection continue to present a major challenge in agriculture. According to the Associated Chambers of Commerce and Industry of India, the annual economic impact of these losses exceeds ₹50,000 crore (approximately $500 billion). This is especially alarming in a country where millions struggle with food insecurity.

Furthermore, global agricultural land is shrinking by about three million hectares annually due to soil degradation and erosion. These issues demand intelligent, technology-driven solutions that can reduce losses, optimize productivity, and ensure sustainable cultivation practices to meet the growing food demands of the population.

Solution Statement

FarmGenie is an AI-integrated platform offering a Crop Disease Prediction and Crop Recommendation System to empower farmers with real-time, scientific decision-making.

It predicts diseases, recommends suitable crops based on soil and climate conditions, and integrates live weather, soil detection, and dial-in AI assistance for accessibility — ensuring that precision agriculture reaches every farmer, even those with basic keypad phones.

Features of the project

- **Crop Disease Prediction:** Detects plant diseases early using AI and provides preventive and remedial suggestions.
- **Crop Recommendation System:** Suggests the most profitable and sustainable crops by analysing soil and weather data.
- **User Dashboard:** Offers multi-farm management tools, AI-generated reports, and weather forecasts for large-scale farmers.
- **Expert Support:** Connects farmers directly to agricultural experts for instant disease-related assistance.
- **Dial-in AI Assistant (Upcoming):** Enables farmers with keypad phones to call, share soil data, and receive crop recommendations via voice.
- **Real-time Alerts:** Sends automated updates via WhatsApp and email about rainfall, diseases, or other urgent information.

Technologies Used

1. **Crop Recommendation System**

   - Algorithm: LightGBM (Light Gradient Boosting Machine) — an efficient gradient boosting model that builds sequential decision trees to minimize prediction errors, ideal for structured agricultural datasets.

   - Libraries & Tools: Pandas, NumPy (data handling), Scikit-learn (training & evaluation), Plotly and Seaborn (data visualization).

   - Model Deployment: Serialized using Pickle for lightweight, scalable deployment.

2. **Disease Prediction System**

   - Algorithm: Convolutional Neural Network (CNN) — deep learning model trained to recognize disease symptoms through leaf images, textures, and patterns.

- Framework: PyTorch, leveraging GPU acceleration for efficient training. Uses CrossEntropyLoss and Adam Optimizer for accurate multi-class classification.

3. API & Integration Layer

- Google Earth Engine: Soil pH and composition analysis.

- OpenWeather & Open-Meteo APIs: Real-time temperature, humidity, and rainfall data.

- GPS & Postal APIs: Location mapping and geotagging.

- Exotel + Google Gemini API: Telephonic connectivity and conversational AI for the dial-in assistant.

Application of AI Components in FarmGenie

1. Predictive Analytics for Crop Recommendation: AI models analyze soil nutrients (N, P, K), pH, temperature, humidity, and rainfall data to predict the most suitable crop for specific regions. The LightGBM algorithm learns from historical agricultural data, providing accurate, data-driven, and region-specific recommendations to optimize yield and resource utilization.

2. Computer Vision for Disease Detection: Deep Learning through CNNs enables image-based detection of plant diseases. The model identifies patterns and early signs of infection, allowing timely interventions and reducing crop loss.

3. Integrated AI Ecosystem: By combining predictive analytics, computer vision, and NLP-powered conversational AI, FarmGenie builds a holistic support system — guiding farmers on both what to grow and how to protect it, driving the shift towards smart, sustainable, and inclusive agriculture.

SDGs Impacted

- SDG 1 – No Poverty: Improves farmer income through reduced crop loss and optimized cultivation.

- SDG 2 – Zero Hunger: Enhances yield and food security through intelligent farming practices.

Future Scope and Scalability

- Satellite-Based Crop Health Monitoring: Real-time disease mapping and predictive alerts.

- IoT Integration: Soil sensors for continuous monitoring of moisture and nutrient levels.

- Multilingual Voice Support: Expanding the Dial-in AI Assistant to regional languages for broader accessibility.

- Collaboration with Agricultural Bodies: Partnering with government departments and NGOs for deployment in rural regions.

- AI-Powered Mobile App: A unified platform for dashboard access, expert consultation, and personalized analytics.