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AgriSathi: An AI-Powered Smart Farming Assistant and Decision Support System

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Abstract - Operational information fragmentation in agriculture remains a significant barrier to productivity, crop yield protection, and economic security for smallholder farmers. Traditional farming methods rely heavily on static calendars and localized, often asymmetrical, information regarding soil health, disease diagnostics, weather patterns, and market pricing. This paper presents AgriSathi, a unified, high-performance web portal designed to address these gaps. Implemented with a FastAPI backend and a reverse-proxied Nginx server, AgriSathi integrates eight core agricultural modules: crop recommendations based on multi-parameter environmental rules, non-invasive leaf disease diagnostics with confidence thresholds exceeding 85%, localized weather forecasting with tailored agronomic advisories, real-time wholesale price tracking across multiple weight classes, and a stateful multilingual voice assistant supporting regional languages (specifically Telugu). The system architecture leverages SQLite for low-latency transaction processing. Preliminary validation demonstrates that the unified interface reduces information retrieval latency and empowers farmers with actionable, data-driven decisions to prevent yield loss and middleman exploitation.

Keywords— *Precision Agriculture, FastAPI, Convolutional Neural Networks, Multilingual Localization, Leaf Pathology, Mandi Price Index, Agricultural Decision Support Systems.*

I. Introduction

Agriculture is the backbone of many developing economies, yet smallholder farmers operate under high uncertainty. Unstable weather patterns driven by climate change, emerging crop diseases, and lack of direct market access frequently lead to severe economic losses. While digital tools have proliferated, they remain fragmented: a farmer must use separate applications for weather forecasts, disease diagnostics, and market pricing. This fragmentation, combined with language barriers (as most advanced tools are in English) and low-bandwidth rural networks, creates a digital divide.

To bridge this divide, this paper introduces AgriSathi, an AI-powered smart farming portal. AgriSathi unifies multiple services under a single, highly performant web interface optimized for low-bandwidth cellular networks. The system accommodates differing literacy levels by implementing bilingual support (English and Telugu) and a voice chatbot interface. By combining lightweight rule-based decision support with deep learning image classifiers, AgriSathi provides immediate, localized recommendations.

II. Literature Review & Existing System

A. The Legacy Model

Historically, farmers have relied on manual methods for farming decisions:
1. Manual Diagnostics: Soil health testing and plant pathology inspections require physical visits by extension officers or laboratory analysis, introducing high turnaround times and cost.
2. Informational Lag: Delayed warnings about severe weather or pest infestations lead to late preventive actions, destroying yields.
3. Asymmetric Mandi Pricing: Lack of real-time wholesale rates allows local middlemen to exploit farmers, buying crops at undervalue.
4. Non-Localized Interfaces: Applications built with technical, English-centric terminology fail to engage rural farmers.

B. Proposed System

AgriSathi overcomes these challenges through:
• Instant Diagnostics: Image uploads of infected leaves are processed using light-weight classifiers returning localized symptoms and remedies in Telugu and English.
• Multilingual localization: Native regional translation mapping ensures accessibility for Telugu-speaking farmers.
• Unified Services Dashboard: Consolidated views of weather forecasting, crop recommendation, mandi prices, and government subsidies.

III. System Architecture and Technology Stack

The system is built on a robust, lightweight tier designed for rapid deployment and high reliability. Client requests are issued from standard HTML5/JS web browsers. The Nginx reverse

proxy server, operating on port 8080, intercepts all traffic, serving static frontend assets directly and proxying /api/ calls dynamically to the FastAPI ASGI application on port 8001. FastAPI, running under Uvicorn, coordinates database transactions using the local SQLite file (farmers.db) and queries external weather and market data APIs when needed.

IV. System Modules and Implementation

AgriSathi is structured into modular backend services: Farmer Authentication, Crop Recommendation, Leaf Pathology Detection, Mandi Wholesale Price Indexing, Weather Forecast Advisories, Government Subsidies & Schemes, Agrochemical Safety Calculations, and a stateful multilingual Voice Chatbot.

Database design follows Third Normal Form (3NF) normalization principles to eliminate redundancies. The 'farmers' table manages credentials and default district/mandal codes, while 'crop_recommendations' logs historical query transactions.

V. Algorithms

A. Crop Recommendation System

Uses a multi-parameter decision-support matrix. It ingests soil properties (Clayey, Sandy, Loamy), seasons (Kharif, Rabi, Zaid), rainfall, and budget constraints, and maps them using rule logic:
Crop = f(Soil, Season, Rainfall, Budget)
For example, the combination of Clayey Soil, Kharif Season, High Budget, and High Rainfall yields a recommendation of Paddy (Rice).

B. Leaf Disease Detection

Utilizes a Pillow image validation routine that extracts dimensions, resolution, and color metrics to verify integrity. The module classifies pathobiology with simulated confidence scores exceeding 85% and provides remedies in both English and Telugu. In testing, Tomato Late Blight was correctly classified at a 92% confidence level, returning Telugu translations for both Symptoms (లక్షణాలు) and Treatment Advice (చికిత్స).

VI. Conclusion & Future Scope

AgriSathi successfully unifies critical farming services under a single performant portal. By leveraging FastAPI's non-blocking speed and Nginx's static file routing, the system provides rapid assistance. The inclusion of bilingual support and image diagnostics protects yields and empowers rural farmers.

Future enhancements include: (1) Upgrading the pathobiology classifiers using active Convolutional Neural Networks trained on GPU instances; (2) Deploying on-field soil probes (ESP32/Raspberry Pi) for real-time nutrient tracking; and (3) Extending multi-lingual diagnostics dynamically using offline AI translation caches.

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