AgriSage: An AI-Powered & IoT-Enabled Centralized Platform for Sustainable Farming

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Problem Statement

Farmers today face a multitude of challenges:

- Inefficient fertilizer usage leading to soil degradation.
- Market access instability causing income fluctuations.
- Inaccurate price forecasting.
- Environmental stress due to pollution and climate change.
- Presence of middlemen in seed procurement.
- Lack of centralized tools for daily farming challenges.

AgriSage aims to solve these issues with a unified, AI-driven, IoT-integrated, and blockchain-supported platform for sustainable and intelligent agriculture.

Project Description

AgriSage is an integrated decision support system that uses Artificial Intelligence, Remote Sensing, Blockchain, and Robotics to support farmers in every phase of agriculture. It provides smart recommendations, automates tasks, offers environmental insights, and ensures transparency in market dealings.

Core Modules and Technologies

1. Smart Fertilizer Recommendation Engine

- **Inputs**: Soil health parameters, crop type, and weather data.
- **Technologies**: Python, TensorFlow, REST APIs, OpenCV (soil image analysis).
- **Features**:
    - Custom fertilizer recommendations.
    - Sustainability scoring.
    - Carbon footprint estimation.

2. Price Prediction Module

- **Inputs**: Historical price trends, seasonal data, buffer stocks, rainfall patterns.
- **Technologies**: ARIMA + LSTM + XGBoost.
- **Features**:
    - Accurate price forecasts.
    - Model retraining based on recent data.

3. AgriMarket: Contract Farming Platform

- **Technologies**: MERN Stack / Django + React, Blockchain-lite ledger.
- **Features**:
    - Secure digital contracts.
    - Escrow-based payments.
    - Buyer & farmer Trust Index.

4. Remote Sensing for Environmental Monitoring

- **Technologies**: Google Earth Engine, Sentinel-2, Landsat, NDVI, thermal bands.
- **Features**:
    - Detection of thermal stress and pollution.
    - Mapping of environmental impact on crops.

5. Crop Yield Prediction & Harvest Monitoring

- **Technologies**: Deep Learning (CNN, LSTM), weather APIs.
- **Features**:
    - Yield prediction based on pollution, weather, and soil.
    - Smart harvest planning.

6. Water Pollution Detection Robot

- **Hardware**: Arduino/Raspberry Pi, GPS, pH, TDS sensors, camera module.
- **Software**: Python, OpenCV.
- **Features**:
    - Autonomous navigation near water bodies.
    - Waste and pollutant detection.
    - Suggestive remediation techniques.

7. Weather-Based Crop Recommendation System

- **Technologies**: Time Series Forecasting, ML models.
- **Features**:
    - Crop suggestions based on microclimate.
    - Adaptation suggestions for changing weather and pollution levels.

8. Blockchain Smart Contracts for Seed Procurement

- **Technologies**: Ethereum/Polygon, Web3.js, IPFS.
- **Features**:
  - Eliminates middlemen.
  - Ensures quality and transparency in seed purchasing.

9. Cost Optimization & Resource Management

- **Features**:
  - Cost-effective input alternatives.
  - Government scheme integration.
  - ROI estimation per crop.

10. High-Demand Crop Analytics

- **Features**:
  - Data-driven analysis of most profitable crops in the area.
  - Inter-cropping and seasonal recommendations.

Innovative Additions

- Voice-based assistant for regional language support.
- **Multilingual Interface for Farmers**: Application supports multiple Indian languages to cater to farmers across diverse linguistic backgrounds, enhancing accessibility and usability.
- Mobile app with offline capability.
- AI chatbot for 24/7 Q&A.
- Augmented Reality-based crop health visualization.
- Carbon credit reward system for sustainable practices.

Workflow Map

1. DATA COLLECTION
   - Soil, weather, satellite imagery, market data, water samples

2. DATA INGESTION & STORAGE
   - Central server (Firebase/MongoDB/PostgreSQL)

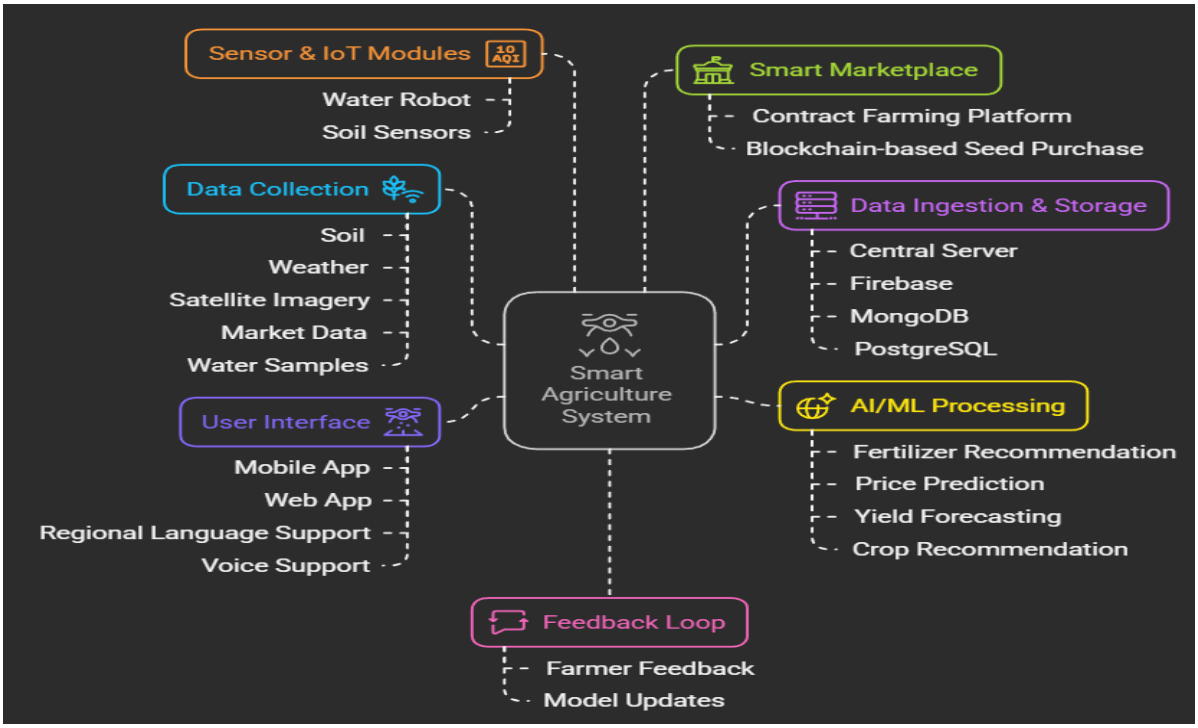
3. AI/ML PROCESSING
   - Fertilizer recommendation
   - Price prediction
   - Yield forecasting
   - Crop recommendation

4. SENSOR & IOT MODULES
   - Water robot collects pollution data
   - Soil sensors send real-time updates

5. USER INTERFACE
   - Mobile/Web App for farmers
   - Regional language and voice support
   - Multilingual text-based support

6. SMART MARKETPLACE
   - Contract farming platform
   - Blockchain-based seed purchase

7. FEEDBACK LOOP
   - Farmers provide usage feedback
   - Continuous model updates and adaptation



Potential Tools & Datasets

- **Datasets**:
  - Soil Health Card
  - IMD Weather Data
  - Agmarknet Pricing
  - Sentinel & Landsat Satellite Data
- **Tools**:
  - TensorFlow, PyTorch, Scikit-learn
  - React, Flutter, Django, Node.js
  - Ethereum, IPFS, Web3
  - Google Earth Engine, OpenCV

Final Vision

AgriSage is designed to be a **one-stop digital solution** that empowers Indian farmers through data-driven insights, sustainability, cost-efficiency, and secure digital markets. It aims to increase profitability, reduce losses, and foster ecological farming practices.
