AI-Driven Smart Agriculture System Using IoT

Objective

Develop a precision agriculture platform that uses real-time sensor data and AI-based analytics to monitor crop health, optimize irrigation/fertilization, and predict crop yields with high accuracy.

1. Required IoT Sensors

Sensor Type	Role in System
Soil Moisture	Determines when irrigation is needed to avoid water stress
Air Temperature	Affects germination, flowering, and ripening
Humidity	Crucial for disease forecasting (fungal outbreaks)
Light Intensity	Ensures optimal photosynthesis, adjusts shading or artificial lighting
pH Sensor	Monitors soil acidity to maintain ideal growth conditions
Rain Sensor	Helps avoid unnecessary irrigation after rainfall
CO_2 Sensor	Measures greenhouse gas levels; useful for greenhouse crop management
Leaf Wetness	Detects conditions for fungal disease like mildew or blight

2. AI Model for Crop Yield Prediction

- **Model Type**: Hybrid Model
    - **Preprocessing**: Scikit-learn pipelines for normalization, imputation
    - **Core AI**: Random Forest Regressor or XGBoost for tabular sensor data
    - **Optional Image Input**: CNN (ResNet or MobileNet) for analyzing aerial/satellite imagery
    - **Alternative (Time-Series)**: LSTM for trend analysis and forecasting
- **Inputs**:
    - Real-time sensor data (daily or hourly)
    - Historical weather data and crop yields
    - Satellite images or drone photos (NDVI/NDRE)
    - Farmer practices (fertilizer use, planting date)
- **Output**:

- Expected crop yield (e.g., tons/hectare)
- Crop stress alerts (e.g., low water, nutrient imbalance)
- Optimal irrigation/fertilization schedule

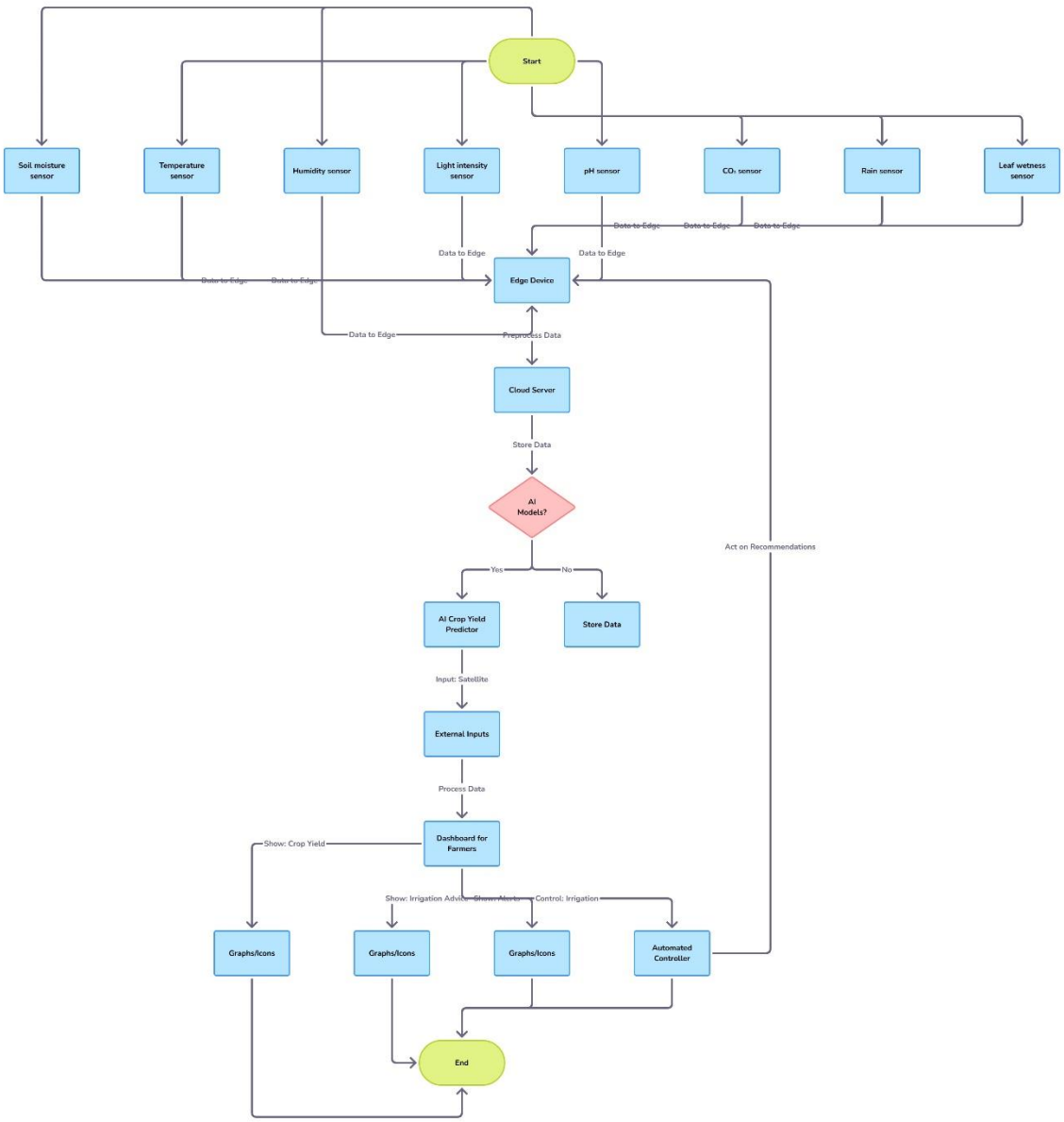
3. System Architecture & Data Flow

1. **Sensor Layer**
   → Soil and environmental sensors placed in field
2. **Edge Gateway (Optional)**
   → Filters and aggregates data locally (e.g., on Raspberry Pi)
3. **Cloud Layer**
   → Stores data in time-series DB (e.g., InfluxDB)
   → Triggers AI model processing (via Python, TensorFlow, or Scikit-learn)
4. **AI Model**
   → Predicts yield and sends results to dashboard
5. **Farmer Dashboard / App**
   → Visualizes insights, sends irrigation or alert messages
6. **Actuator Integration (Optional)**
   → Auto-controls pumps/valves based on AI recommendation

4. Benefits

- **Improved Yield Forecasting**: Farmers can plan harvest and sales more efficiently.
- **Sustainable Resource Use**: Smart irrigation reduces water and fertilizer waste.
- **Disease Prevention**: Early detection of stress or fungal risks.
- **Decision Support**: Data-driven farming practices.

Data Flow Diagram



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