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TITLE PAGE

Problem Statement Title:
AI Crop Disease Detection System

Team Name: **ResQ**

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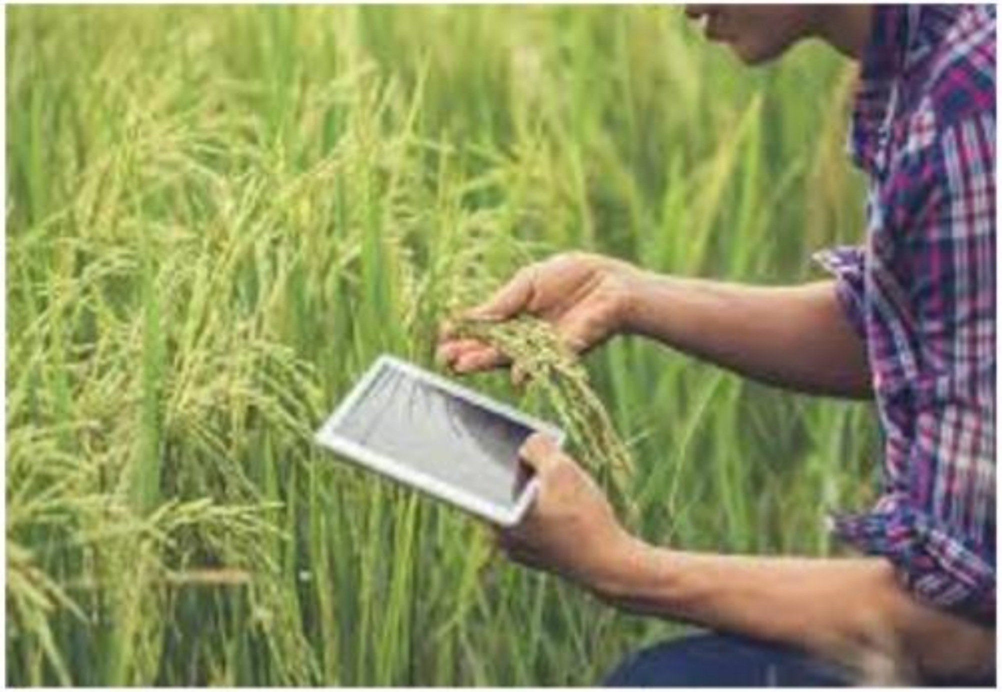

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THE PROBLEM LANDSCAPE

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Problem Statement

Farmers lose **20%–40%** of crops due to plant diseases that are often detected too late, leading to major yield losses and severe economic stress

Target Audience

- Small and medium-scale farmers
- Agricultural extension workers
- Rural farming communities dependent on crop income

Why Now?

- Population will reach **~9.1B by 2050**.
- Food production must grow by **50–70%**.
- Disease diagnosis is still **slow and expert-dependent**.
- Early **AI detection** is crucial for sustainable farming and food security.

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- Users can **upload crop images** showing potential symptoms. The system guides them through the upload process.

  Image Processing Pipeline:
  - **Upload handling:** Uses a secure API endpoint that accepts multipart/form-data
  - **Image validation:** Checks format (PNG/JPEG), size (<10MB), and dimensions
  - **Preprocessing:** Resizes to 224x224px, normalizes to [0,1] range
  - **Augmentation:** Applies random rotations, flips, and brightness adjustments

- A **Convolutional Neural Network** (CNN) processes images, **extracting features** and patterns to identify diseases.

  CNN Model:
  - Three convolutional blocks with increasing filters (32, 64, 128)
  - Each block includes Conv2D, BatchNormalization, ReLU, and MaxPooling
  - Global Average Pooling reduces spatial dimensions
  - Final dense layer produces 256-dimensional feature vector

- The system **collects environmental data** such as temperature and humidity. Through **Regression and time series analysis**, it correlates this data with **historical disease outbreaks**.

  Environmental Data Processing:
  - API client fetches weather data using location/timestamp
  - Normalizes numerical values (temperature, humidity, rainfall)
  - Fully connected network processes these features

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- The **system combines** insights from both **image processing and environmental data. Ex.** If user uploads a **wilting plant image** and **high temperatures** are recorded, the likelihood of **bacterial wilt** is considered.

  Model Fusion:

  - Concatenates CNN features (256-dim) with environmental features (64-dim)
  - Two dense layers (512, 256 units) with dropout for regularization
  - Final layer uses softmax activation for disease probability distribution
  - Confidence threshold of 0.85 for automatic classification

- The system **evaluates the confidence** of its predictions. If **confidence is low**, it **requests additional images** for further analysis. Once a disease is diagnosed, the system **provides personalized recommendations**, including **treatment options** (pesticides or organic solutions).

  Response Generation:

  - **High confidence:** Queries treatment database with disease classification
  - **Low confidence:** Generates specific requests for additional images
  - Recommendations include immediate actions and preventive measures
  - Response formatted with severity level, treatment steps, and expected timeline

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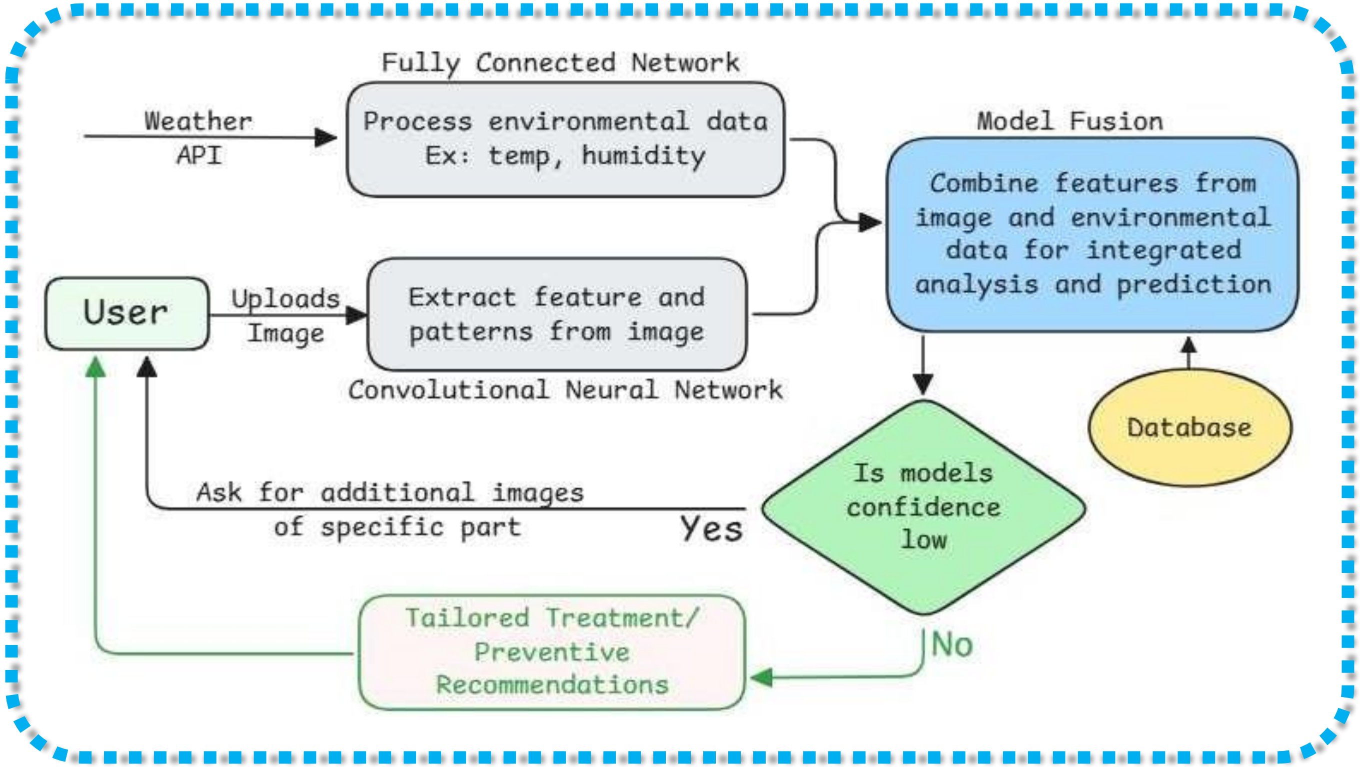
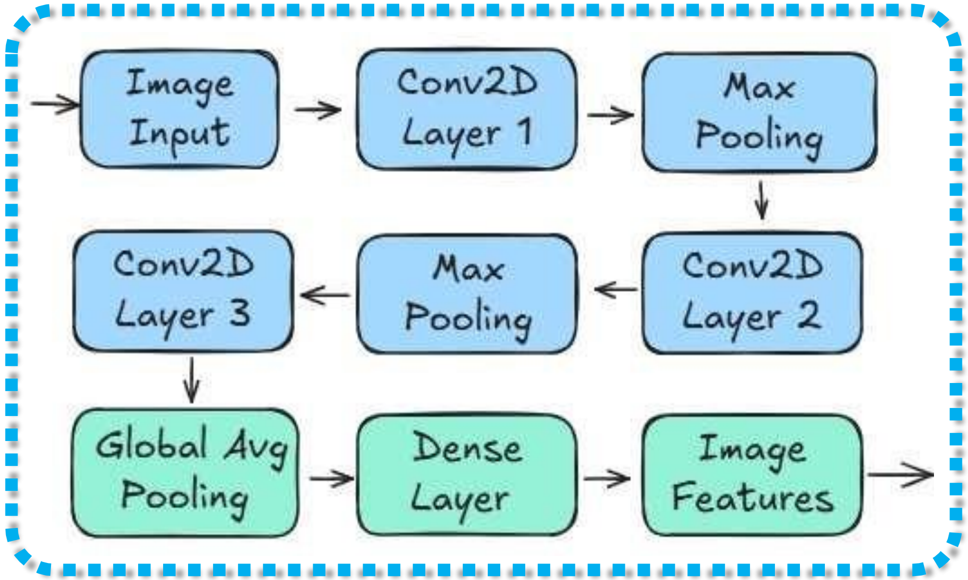
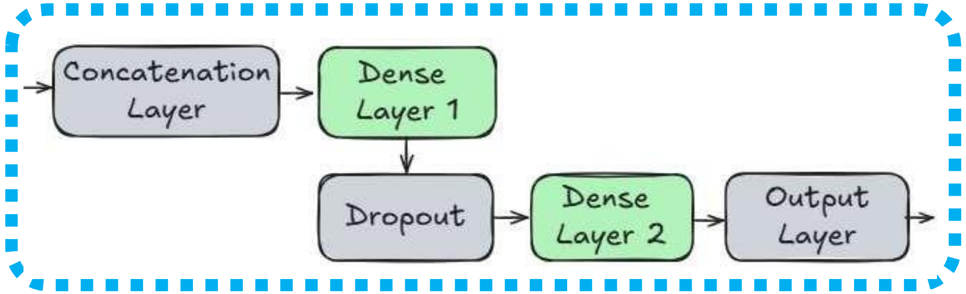
Model Workflow



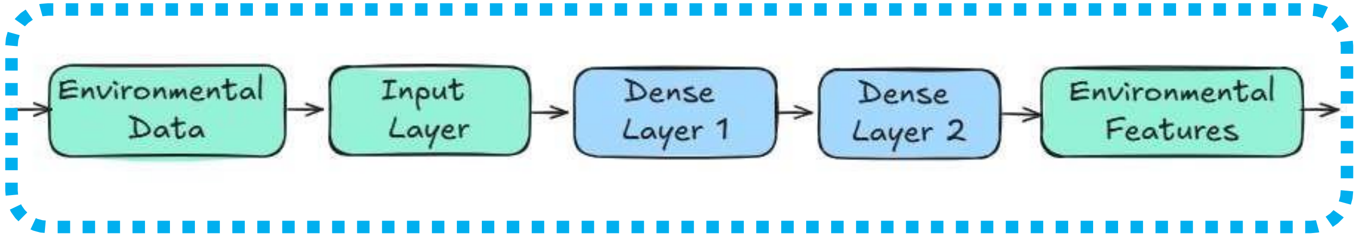
Convolutional Neural Network Architecture



Fusion Model



Fully Connected Network Architecture



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CropGuard AI

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IMPACT & SUSTAINABILITY

- **AI-powered analysis spots diseases** early, preventing major crop losses and **increasing yields**.
- **Offline support** ensures the system works in remote areas with little or no internet access.
- Promotes **smart farming** by providing **instant diagnosis** and simple **treatment recommendations**.
- Reduces excessive **pesticide use**, protecting **soil health** and the **environment**.
- Farmers enjoy **better harvests, lower expenses, and stable income**, making farming more sustainable.

TECHNOLOGY STACK :

pandas
React
node js
OpenCV
Requests
mongo DB
BeautifulSoup
PyTorch
twilio
Express JS
FastAPI
Firebase Cloud Messaging
NumPy
JS
socket.io
matplotlib
TensorFlow
kaggle
AI
Chart.js

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Additional Features & Future Scopes

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Personalized Chatbot for Farming

- The system integrates an AI -powered chatbot tailored for farmers, providing instant responses to agricultural queries.
    - Utilizes **NLP models** to understand user questions and deliver relevant farming advice.
    - **Retrieves real-time data** on weather, soil conditions, and market trends to assist decision-making.
    - **Supports multiple languages** for better accessibility.
    - Continuously improves through **user interactions and feedback**.

Offline Support

- The system is designed to work even in low or no internet connectivity areas, ensuring accessibility for farmers in remote regions
    - Uses lightweight AI models stored on the device for real-time disease detection without internet.
    - **Processes images from mobile cameras** for quick and efficient analysis.
    - Provides instant offline diagnosis and treatment suggestions for quick action without internet..

Live Expert Consultation (Future Scope)

- The system will enable farmers to connect with agriculture experts for real-time guidance and support.
- Provides a platform where users can consult specialists regarding crop diseases, treatments, fertilizers, and farming practices.
- Can be integrated using chat, voice call, or video call features for direct interaction.
- Allows farmers to share crop images and receive personalized recommendations from experts.