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**BSc. COMPUTER SCIENCE**

**COMMERCIAL PROGRAMMING**

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# PROJECT PROPOSAL: AI-POWERED TOMATO DISEASE DETECTION APP

## INTRODUCTION

Tomato farming is a crucial pillar of Kenya's agricultural sector, contributing approximately **8% of the country's agricultural GDP** and employing about **7% of the agricultural labor force**. However, tomato farmers face major challenges due to high disease prevalence, which results in **annual losses of KES 4.2 billion (~USD 39 million)**. Farmers, particularly 500,000+ smallholder growers, struggle with late disease identification, leading to **yield losses of up to 100% in severe cases**.

Traditional detection relies on visual symptoms, which often appear too late for effective intervention. Our solution is an AI-powered mobile application that helps farmers detect tomato diseases early by analyzing uploaded images and providing accurate treatment recommendations. Designed to be affordable, scalable, and accessible, the app will help **reduce crop losses by 45-60%** and **increase farmer income by up to KES 35,000 (~USD 325) per season**.

## PROBLEM STATEMENT

Tomatoes are one of the most widely grown and economically important crops, yet they are highly vulnerable to diseases such as **Early Blight, Buckeye Rot, and Fusarium Wilt**. These diseases can cause significant yield losses, threatening the livelihoods of farmers, particularly smallholder growers, who cultivate **less than 2 hectares of land**. These farmers depend on tomato farming for income and food security, yet many of them **lack immediate access to agronomists or reliable diagnostic tools**. This leads to **delayed, incorrect, or ineffective treatments**, resulting in **wasted resources, financial strain, and lower agricultural productivity**.

Currently, most farmers rely on **visual inspection and traditional knowledge** to diagnose plant diseases, which is often **inaccurate**. Without expert guidance, they may **misidentify diseases, overuse or misuse pesticides, or take no action at all until it's too late**.

Additionally, existing agricultural advisory services are often **expensive, slow, or inaccessible**, especially in **rural areas with poor internet connectivity**.

To address this challenge, we propose an **AI-powered mobile application that allows farmers to upload images of infected tomato plants for instant disease detection and receive accurate treatment recommendations**. The app will be user-friendly, and optimized for low-end smartphones, ensuring accessibility for farmers in underserved regions. By providing **fast, reliable, and data-driven disease diagnosis**, this solution will empower farmers to take immediate action, reduce crop losses, and improve overall food security.

## JUSTIFICATION

The system is justified for the following reasons:

### 1. Rapid and Accurate Disease Diagnosis

- AI-based detection identifies diseases 5-14 days earlier than traditional methods.
- Farmers receive instant feedback with a confidence score and targeted remedies.

### 2. Accessibility for Smallholder Farmers

- Over **500,000 smallholder farmers** rely on tomato farming, many of whom **lack access to agronomists**.
- A mobile application ensures farmers in **remote areas** can access disease detection tools.
- **78% of farming areas have at least 3G connectivity**, making the system viable for a large user base.

### 3. Cost-Effective and Scalable Solution

- Hiring agronomists is **expensive and time-consuming**, making expert consultations unaffordable for many farmers.
- The AI-based system provides a **low-cost, scalable alternative** capable of reaching thousands of farmers.
- The system requires **minimal infrastructure** and can be **updated with new disease data over time**.

### 4. Improved Disease Management and Treatment

- **Disease-related losses** can be **reduced by 45-60%** with early intervention.
- The system provides **organic, chemical, and preventive treatment recommendations**, ensuring **scientifically backed solutions**.
- It helps farmers **make informed decisions on disease management**, increasing **yield quality and productivity**.

### 5. Reduced Pesticide Misuse and Environmental Impact

- **42% of tomato farmers own or have access to smartphones**, allowing easy adoption of the app.
- Without proper diagnosis, **farmers misuse pesticides**, leading to **increased costs and environmental degradation**.
- The AI system **recommends targeted pesticide use or organic treatments**, minimizing unnecessary chemical application.

## 6. Contribution to Food Security and Economic Stability

- The **horticulture industry**, including tomatoes, generated **KES 157 billion (~USD 1.1 billion) in 2022**.
- **Potential additional income per farmer: KES 25,000-35,000 (~USD 230-325) per season**.
- Higher tomato yields contribute to **food security, stable farmer incomes, and stronger agricultural communities**.

This AI-powered tomato disease detection system is **practical, accessible, and a cost-effective solution** to a critical problem affecting farmers worldwide.

## OBJECTIVES

The **primary objective** of this project is to develop an AI-powered mobile application that enables farmers to accurately **diagnose tomato disease and receive treatment recommendations from uploaded images**.

### Specific Objectives

#### 1. Develop an AI Model for Disease Detection

- Train a machine learning model capable of identifying common tomato diseases with high accuracy.
- Optimize the model for mobile deployment to ensure fast, reliable disease identification.

#### 2. Implement a Mobile Application for Farmers

- Create a user-friendly mobile interface that allows farmers to upload images of infected tomato plants.
- Ensure accessibility for farmers with low-end smartphones.

#### 3. Provide Accurate and Reliable Treatment Recommendations

- Integrate a treatment recommendation system based on scientific agricultural best practices.
- Offer both organic and chemical treatment options for different tomato disease types.

#### 4. Ensure Scalability and Future Expansion

- Design the system to easily integrate additional crops in the future.

- Establish a feedback mechanism to improve the model with real-world data.

### **5. Reduce Crop Losses and Improve Farmer Decision-Making**

- Empower farmers with timely, data-driven insights to take preventive and corrective measures.
- Minimize pesticide misuse by promoting targeted, disease-specific treatments.

By achieving these objectives, the system will provide farmers with an accessible, affordable, and reliable tool for managing tomato diseases, ultimately improving yields, incomes, and food security.

## **SYSTEM REQUIREMENTS**

### **FUNCTIONAL REQUIREMENTS**

#### **1. Image-Based Disease Detection**

- The system must allow users to upload images of tomato plants via a mobile application.
- AI should analyze the image and classify the detected disease with a confidence score.

#### **2. Treatment Recommendations**

- The system should provide accurate treatment options based on the diagnosed disease.
- Recommendations should include organic, chemical, and preventive measures.
- Users should receive step-by-step guidance on applying treatments.

#### **3. Multilingual Support**

- The app should support multiple languages to accommodate different farming communities.
- Users should be able to switch languages easily within the settings.

#### **4. Offline Mode**

- The app must allow disease detection without an internet connection by running the AI model on-device.
- Treatment recommendations should be accessible offline, with updates syncing when the internet is available.

#### **5. User-Friendly Interface**

- The app should have a simple and intuitive UI for farmers, with clear icons and instructions.

#### **6. Farmer Profile & History Tracking**

- Users should be able to create an account to track their past diagnoses and treatments.
- The system should store previous disease detections for reference and learning.

## **NON-FUNCTIONAL REQUIREMENTS**

### **1. Accuracy & Performance**

- AI disease detection should achieve at least 85% accuracy before deployment.
- The app should process images and return results within 5 seconds.

### **2. Scalability & Future Expansion**

- The system should be designed in a way that allows easy expansion to other crops in the future.
- It should support increasing users without compromising performance.

### **3. Security & Data Privacy**

- User data, including uploaded images, should be securely stored and encrypted.
- The system should follow data privacy regulations and not share user data without consent.

### **4. Lightweight & Low Resource Consumption**

- The app should be optimized to run on low-end smartphones ( $\leq 2$ GB RAM).
- AI models should be compressed using TensorFlow Lite or ONNX to reduce memory usage.

### **5. Device Compatibility**

- The app should be developed for Android first, with a future plan for iOS support.
- The UI should be responsive to different screen sizes.

### **6. Error Handling & User Feedback**

- The system should handle blurry or unclear images gracefully, prompting users to upload better images.
- Users should be able to report issues or incorrect diagnoses to improve the model over time.

# SCOPE

## MVP

### 1. AI-Powered Image-Based Disease Detection

- The system will allow farmers to upload images of tomato plants.
- AI will analyze the image and identify common tomato diseases with a confidence score.

### 2. Treatment Recommendations

- The app will provide disease-specific treatment options, including:
  - Organic solutions (e.g., neem oil, crop rotation).
  - Chemical treatments (e.g., fungicides, pesticides).
  - Preventive measures (e.g., irrigation control, resistant seed varieties).

### 3. User-Friendly Mobile Interface

- Simple UI/UX designed for farmers with minimal technical knowledge.
- Basic navigation with image upload button and results display.

## FUTURE ENHANCEMENTS

1. Disease detection for other crops.
2. Advanced Farmer Profiles & Disease History Tracking.
3. Real-time agronomist consultations.
4. Integration with e-commerce platforms for pesticide purchases.
5. Voice Input & Chatbot Support.

## SYSTEM ARCHITECTURE

### 1. User Interface Layer(Mobile Application)

**Technology:** Flutter

- Provides an easy-to-use mobile UI for farmers.
- Allows image uploads from camera or gallery.
- Displays diagnosis results and treatment recommendations.
- Offers language selection and offline mode.

### 2. AI Model Layer(Disease Detection Engine)

**Technology:** Google Gemini AI

- Uses computer vision to analyze uploaded tomato plant images.
- Identifies common tomato diseases with a confidence score.

### **3. Backend Layer**

#### **Technology: Django**

- Handles user authentication and profile management
- Interaction with APIs

### **Conclusion**

Tomato diseases pose a major challenge to farmers, leading to reduced yields and financial losses. The AI-powered Tomato Disease Detection App provides a fast, accessible, and cost-effective solution, enabling farmers to upload images, receive instant diagnoses, and get reliable treatment recommendations.

With multilingual support and a user-friendly interface, the app ensures widespread accessibility, even in remote areas. The system is scalable, with potential future enhancements like support for other crops, real-time expert consultations, and marketplace integration.

By empowering farmers with AI-driven insights, this app will help reduce crop losses, improve yields, and promote sustainable farming practices, ultimately contributing to food security and economic stability.