

# Tomato Care App: Nurturing Healthy Tomato Crops

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## *Abstract*

The Tomato Disease Detection App is a revolutionary mobile solution aimed at transforming tomato crop management in agriculture. Leveraging sophisticated image recognition algorithms, the app enables farmers to detect and address diseases at an early stage, fostering improved yields and economic stability. Collaborations with agricultural experts and government agencies ensure the app's accuracy and relevance. With a user-centric approach, multilingual support, and a freemium model, the app is designed for accessibility and impact. Environmental considerations and legal compliance underscore its commitment to sustainable and responsible development. The Tomato Disease Detection App stands as a technological beacon, driving positive change in crop health, agricultural practices, and food security.

## **1. Problem Statement**

Tomato is a widely cultivated and economically significant crop, recognized for its versatility and nutritional value, standing as the second most important vegetable crop globally after potatoes. The current worldwide production exceeds 100 million tons, with India ranking as the third-largest exporter of tomatoes. A staple in various cuisines, tomatoes are consumed globally in diverse forms, be it fresh, cooked, or processed into sauces and pastes.

However, tomato plants are susceptible to various diseases that can significantly impact yield and quality. Common diseases include Early Blight, manifesting as dark lesions on lower leaves; Late Blight, causing rapid foliage decay; and Septoria Leaf Spot, resulting in distinctive spots on leaves, among others. These diseases weaken the plant, reduce fruit production, and, if left unmanaged, lead to substantial crop losses.

To address this challenge, we propose the development of an early tomato disease detection app for farmers. Timely diagnosis and appropriate treatments are crucial for sustaining tomato crop health and ensuring a robust harvest. This app aims to empower farmers with a user-friendly tool for early disease detection, providing a proactive approach to crop management.

## **2. Market/Customer/Business Need Assessment**

### **2.1 Market Analysis**

#### **2.1.1 Target Market**

The major tomato-producing states in India, including Maharashtra, Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Madhya Pradesh, and Assam, represent the primary target market.

### **2.1.2 Market Size and Potential**

In 2023, India produced approximately 20 million metric tons of tomatoes. The prevalence of diseases causing 10-50% yield loss indicates a significant market potential for a disease detection solution.

### **2.1.3 Market Trends**

Rising tomato prices in 2023, driven by plant diseases and resulting in substantial yield losses, highlight the need for preventive solutions. Early disease detection aligns with the market trend towards sustainable and efficient agriculture.

## **2.2 Customer Analysis**

### **2.2.1 Farmers**

Farmers in the said states are the primary customers. They seek solutions to mitigate yield losses caused by diseases and aim to secure a consistent and high-quality tomato harvest.

### **2.2.2 Consumers**

End consumers benefit from early disease detection as it helps maintain stable tomato prices and ensures the availability of good quality tomatoes at affordable rates.

### **2.2.3 Economic Impact**

Given the potential for 10-20% annual production loss and price fluctuations, both farmers and consumers stand to gain economically from a reliable disease detection solution.

## **2.3 Business Analysis**

### **2.3.1 Problem Statement**

Plant diseases in tomatoes lead to significant yield losses (10-50%) and contribute to annual production loss (10-20%), impacting prices and supply chain stability.

### **2.3.2 Value Proposition**

The development of a disease detection app offers a proactive solution, enabling farmers to detect and manage diseases early, thereby minimizing yield losses and stabilizing prices for both farmers and consumers.

### **2.3.3 Economic Impact**

A successful disease detection app addresses the economic impact of production losses, ensuring a more stable supply chain, lower prices for consumers, and increased profitability for farmers.

### **3. Target Specification & Characterization**

#### **3.1 Geographic Target**

##### **3.1.1 Primary Focus**

Targeting major tomato-producing states in India, with a focus on Maharashtra, Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Madhya Pradesh, and Assam.

##### **3.1.2 Expansion Potential**

Consideration for scalability to other regions with significant tomato cultivation.

#### **3.2 User Profile**

Primarily for small to medium-scale farmers.

#### **3.3 App Specifications**

##### **3.3.1 User Interface**

Simple and user-friendly interface suitable for users with varying levels of technological expertise.

##### **3.3.2 Multilingual and voice Support**

Incorporate regional languages and text-to-speech to enhance accessibility.

##### **3.3.3 Functionality**

Robust image recognition algorithms for accurate disease detection. and provide real-time disease diagnosis.

#### **3.4 User Engagement**

##### **3.4.1 Educational Resources**

Integration of educational content on disease prevention and sustainable farming practices and providing links to websites to gain further information and help to talk with govt. agents or personalized agro experts for help.

##### **3.4.2 Feedback Mechanism**

In-app feedback form to gather user insights and improve app functionality.

##### **3.4.3 Customer Support**

Responsive customer support channels for query resolution.

### **4. External Search**

- <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5519495/>
- <https://vikaspedia.in/agriculture/crop-production/package-of-practices/vegetables-1/tomato-1>
- <https://www.drishtiias.com/daily-updates/daily-news-analysis/tomatoes-price-volatility>
- <https://www.ikisan.com/tg-tomato-disease-management.html>

## 5. Benchmarking

S.No.	Services	Observation	Implication
1	Simplicity	Many existing apps are deemed too simple	There's an opportunity to create a more comprehensive and user-friendly interface.
2	Language Support	Most apps are primarily in English	Incorporating multilingual support can enhance accessibility for a wider range of users, especially farmers in non-English-speaking regions
3	Detection Capabilities	Existing apps are proficient in detecting diseases	Our focus will be on maintaining or exceeding current detection capabilities while introducing additional features
4	Recommendations	Some apps lack recommendation features	Integrating personalized recommendations for disease management could significantly enhance the utility of the app for farmers
5	Educational Content	Limited availability or no educational content in many of the apps	Incorporating a robust repository of educational materials on disease prevention, sustainable farming, and weather insights can position the app as a holistic resource.

## 6. Applicable Patents

Not found any of such app patents.

## 7. Applicable Regulations

- Data Privacy Regulations
- Accessibility Standards
- Ethical Guidelines
- Copyright & Intellectual Property Laws

## 8. Applicable Constraints

- Technological Constraints: Device Compatibility, Internet Connectivity, Image Processing Resources.
- Economic Constraints: Affordability, Cost of Internet data.
- User Literacy and Awareness: Technological Literacy, Awareness Programs.
- Regulatory and Legal Constraints: Data Protection Laws.
- Cultural and Linguistic Diversity: Multilingual Support, Cultural Sensitivity.
- Environmental Considerations: Energy Efficiency, E-Waste Management.

## 9. Business Models

The Tomato Disease Detection App adopts a dynamic business model that balances user accessibility with sustainable revenue streams. The primary monetization idea revolves around a freemium model, ensuring basic features are available for free while offering premium services through subscription plans. Additionally, potential collaborations with government agencies present an avenue for subsidies, reducing barriers to entry for farmers. The key elements of the monetization strategy are as follows:

### 9.1 Freemium Model

- Provide fundamental disease detection and educational content at no cost, ensuring widespread adoption among farmers.
- Introduce subscription plans offering advanced features such as personalized agro-advisory services, enhanced disease detection algorithms, and exclusive content.

### 9.2 Government Subsidies

- Explore partnerships with government agricultural agencies to secure subsidies for farmers.
- Government-backed initiatives can significantly lower the cost of premium features, making them more accessible to a broader user base.

### 9.3 In-App Promotions

- Partner with agricultural input suppliers for in-app promotions, connecting farmers with relevant products and services.
- Generate additional revenue through partnerships while providing farmers with access to valuable resources.

We can further add more revenue models like we can share anonymized data for agricultural research purpose with institutes or we can add subscription tier plans etc.

## 10. Concept Generation

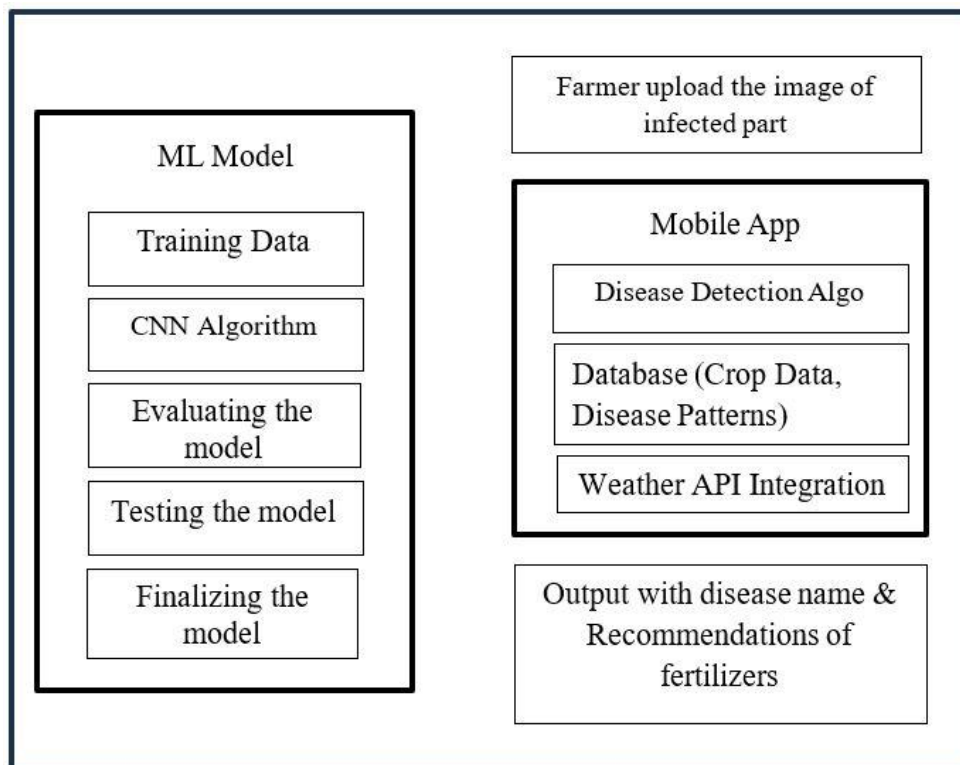
- Problem Identification: In 2023, tomato prices surged due to poor crop yield caused by viruses and adverse climatic conditions.

- Insight: The need for a proactive solution to detect diseases early and prevent yield losses became apparent.
- Idea: Develop a Tomato Disease Detection App to address the challenges faced by farmers in timely identifying and mitigating crop diseases.
- Objective: Enable farmers to safeguard their tomato crops by providing early disease detection, preventive measures, and agricultural insights.

## 11. Concept Development

- The Tomato Disease Detection App leverages advanced image recognition algorithms to empower farmers in the early identification and management of diseases affecting tomato crops.
- Providing real-time analysis and personalized recommendations, the app aims to improve crop health, boost yields, and foster economic stability in agriculture.
- With a user-friendly interface, multilingual support, and collaborations with agricultural experts and government agencies, the app is designed for accessibility and impact.
- The revenue model includes a freemium structure for basic detection & recommendation of fertilizers, & a revenue model for personalized advisory with educational content in different language, & potential government subsidies.

## 12. Final Product Prototype with Schematic Diagram



## **13. Product Details**

### **13.1 How Does It Work**

The Tomato Disease Detection App employs a straightforward and user-friendly process:

- **Image Capture:** Users capture images of tomato crops using the app's camera feature.
- **Image Upload:** Captured images are uploaded to the app's server for analysis.
- **Disease Detection Algorithm:** The app utilizes advanced image recognition algorithms to analyze uploaded images. Algorithms identify patterns, symptoms, and characteristics associated with various tomato diseases.
- **Real-time Analysis:** Disease detection results are generated in real-time, providing instant feedback to the user.
- **Recommendations and Educational Content:** Based on the disease detected, the app provides recommendations for preventive measures and treatments. Educational content, sourced from agricultural experts, offers additional insights on crop management.
- **Push Notifications:** Users receive push notifications for timely alerts, weather updates, and recommended actions.

### **13.2 Data Sources**

- **User-Provided Images:** Primary data source is the images of tomato crops uploaded by users for disease detection.
- **Weather APIs:** External weather APIs are utilized to integrate real-time weather data, enhancing disease prediction accuracy.

### **13.3 Algorithms, Frameworks, Software Needed**

- **Image Recognition Algorithms & Framework:** Deep learning algorithm Convolutional Neural Networks for image analysis and disease detection using TensorFlow.
- **Server Infrastructure:** Robust server infrastructure is required to handle image processing, data storage, and real-time analysis.
- **Mobile App Development:** Development frameworks (e.g., React Native, Flutter) for cross-platform app development.
- **Database Management:** Database management systems (e.g., MySQL, MongoDB) for storing crop data, disease patterns, and user information.
- **Weather APIs:** Integration with external weather APIs for real-time weather data.

### **13.4 Team Required to Develop**

- App Developers
- Data Scientists / Machine Learning Engineers
- Agricultural Experts

- Quality Assurance (QA) Team
- User Support Team

### 13.5 What Does It Cost

- Freemium Model: Provide fundamental disease detection with recommendations and educational content in different languages at no cost, ensuring widespread adoption among farmers.
- Subscription-based model: Offering advanced features such as personalized agro-advisory services, enhanced disease detection algorithms, and exclusive content.
- Government Subsidies: Collaboration with government agencies may result in subsidized or free access to the app for farmers.

## 14. Code Implementation/Validation on Small Scale

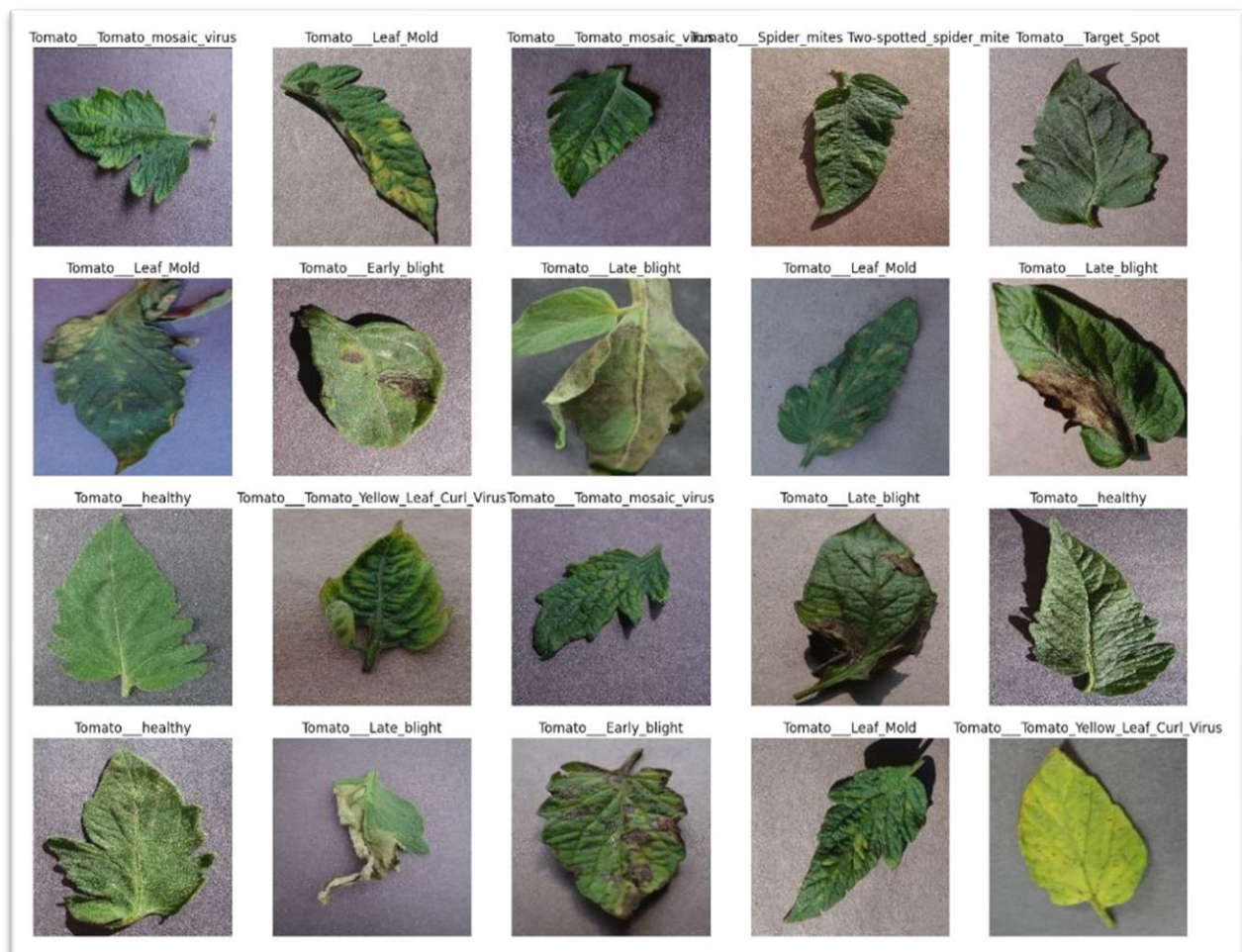
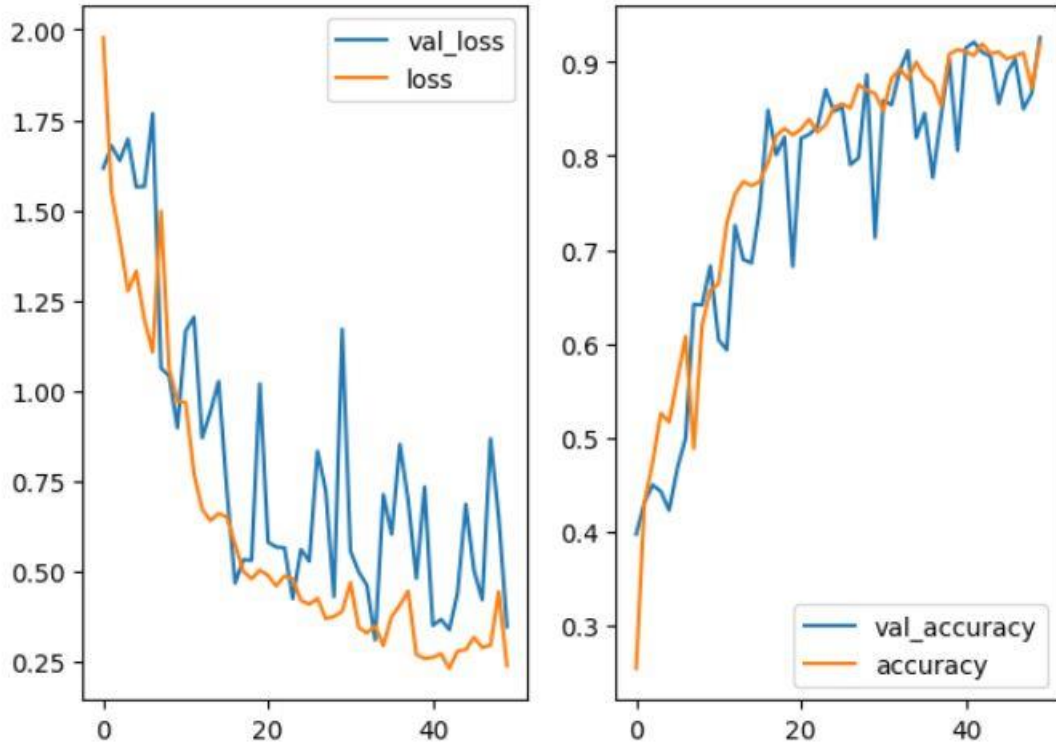


Figure1. Tomato leaves with different types of diseases





**Figure2: loss vs accuracy for Simple CNN**

Accuracy for simple CNN Model for train & validation data came out as 92%. This accuracy can be improved further using transfer learning & further finetuning the models.

## 15. Conclusion

- In conclusion, the Tomato Disease Detection App emerges as a pivotal solution in the agricultural landscape, addressing the critical need for early disease detection in tomato crops.
- By harnessing advanced image recognition algorithms and fostering collaborations with agricultural experts and government agencies, the app is poised to empower farmers, enhance crop health, and contribute to sustainable agriculture.
- The strategic integration of multilingual support, user-friendly design, and a revenue model reflects a commitment to accessibility and widespread impact.
- As the app progresses, continuous innovation, scalability, and adherence to legal compliance will be paramount to ensuring its effectiveness and enduring success in promoting resilient and thriving tomato cultivation practices.