

# FruitSure – Smart Agricultural Fruit Grading and Disease Detection

## 1. Overview

FruitSure is an AI-based web platform that empowers apple farmers to make informed decisions about crop health, fruit quality, and market pricing.

It integrates deep learning, web technologies, and automation to create a unified system for disease detection, quality grading, and market insight generation.

FruitSure reduces the dependency on manual inspection by automating the following tasks:

- Detecting diseases in apple leaves using image recognition.
- Grading apples by quality using image analysis and acoustic features.
- Providing up-to-date apple market prices using real-time web scraping.

## 2. Key Features

### a. Apple Leaf Disease Detection

- Farmers can upload leaf images through the website.
- The backend model analyzes the image to predict whether the leaf is healthy or infected.
- Common diseases detected include Apple Scab, Cedar Apple Rust, and Black Rot.
- The result page shows the disease name, confidence score, and recommended preventive measures.

### b. Apple Quality Grading

- Farmers can upload apple fruit images.
- The system analyzes external features like color, texture, and roundness to determine grade.
- Optionally, it can include acoustic readings (sound waves) to estimate firmness or ripeness.

- Output: Grade A (premium), Grade B (average), or Grade C (low).
- Helps farmers in determining fair selling prices and improving sorting accuracy.

#### **c. Real-Time Apple Market Prices**

- FruitSure automatically scrapes current apple prices from reliable agricultural websites.
- Farmers can view market trends and compare prices across states or mandis.
- This helps them decide the best time and place to sell their produce.

#### **d. AI Chatbot Assistance**

- A Retrieval-Augmented Generation (RAG) chatbot is integrated on the website.
- It allows users to interact naturally by asking questions such as:
  - “How do I upload a leaf image?”
  - “What model do you use for disease detection?”
  - “Show me today’s apple prices in Himachal.”
- The chatbot retrieves relevant knowledge from the FruitSure database and generates human-like responses.

#### **e. User-Friendly Interface**

- Minimal and intuitive design for rural usability.
- Accessible in both English and local languages (future enhancement).
- Mobile-responsive layout for field access.

### **3. Technical Overview**

<b>Component</b>	<b>Description</b>
Frontend	HTML, CSS, JavaScript, Bootstrap (or React if used)
Backend	Flask / Django Framework
Model Integration	REST API endpoints for inference
Machine Learning Models	Vision Transformer (ViT), YOLOv8
Database	SQLite or PostgreSQL

Web Scraping	Python using BeautifulSoup or Selenium
Chatbot Framework	LangChain with LLMs (Mistral, LLaMA, or GPT)
Hosting	Render, Railway, or other cloud hosting services

## 4. Workflow

### 1. User Registration/Login (optional)

Users create an account or proceed as guests.

### 2. Disease Detection Module

- a. User uploads a leaf image.
- b. Image is sent to the backend model.
- c. Model predicts disease class and confidence.
- d. Website displays results and suggestions.

### 3. Quality Grading Module

- a. User uploads an apple image.
- b. Model evaluates external parameters.
- c. Output shows apple grade (A/B/C).

### 4. Price Insights Module

- a. System scrapes the latest apple prices.
- b. Displays dynamic pricing data per region.

### 5. Chatbot Interaction

- a. User can ask questions related to any module.
- b. The RAG pipeline retrieves relevant information and generates an answer.

## 5. Impact and Benefits

- Saves farmers time and cost by automating disease diagnosis.
- Reduces crop loss by enabling early disease detection.
- Improves consistency in apple grading, leading to better pricing.
- Provides real-time price awareness for better selling decisions.
- Encourages technology adoption in agriculture.

## 6. Example Queries and Answers for Chatbot Training

**Query 1:** What is FruitSure?

**Answer:** FruitSure is an AI-based web platform that helps apple farmers detect leaf diseases, grade apple quality, and get real-time market prices through automation and machine learning.

**Query 2:** How do I check if my apple leaf is infected?

**Answer:** Go to the Disease Detection section, upload a clear image of your apple leaf, and click on the “Analyze” button. The model will predict if the leaf is healthy or infected and show the disease name with recommendations.

**Query 3:** Which diseases can FruitSure detect?

**Answer:** FruitSure currently detects major apple leaf diseases like Apple Scab, Cedar Apple Rust, and Black Rot, and can be extended to other types in the future.

**Query 4:** How does the grading system work?

**Answer:** The grading system analyzes the apple’s color, texture, and shape to assign a quality grade (A, B, or C). It may also use acoustic vibration data to assess internal firmness.

**Query 5:** How are apple prices updated?

**Answer:** Prices are automatically updated using a web scraping script that collects data from agricultural market websites. The latest prices are displayed on the Apple Prices page.

**Query 6:** What technology powers FruitSure?

**Answer:** FruitSure uses Flask/Django for backend, deep learning models such as Vision Transformer and YOLOv8 for analysis, and LangChain with a large language model for the chatbot.

**Query 7:** Can I use FruitSure on mobile?

**Answer:** Yes, the website is mobile-friendly and can be accessed through a smartphone browser.

**Query 8:** Does the system require internet access?

**Answer:** Yes, internet access is needed for uploading images, fetching predictions, and viewing live prices.

**Query 9:** How can FruitSure help me as a farmer?

**Answer:** FruitSure helps farmers detect diseases early, assess apple quality for fair pricing, and track current market rates to make better selling decisions.

**Query 10:** What datasets were used to train the models?

**Answer:** The disease detection model was trained on datasets like Plant Pathology 2021 and the Apple Leaf Dataset, containing labeled images of healthy and infected leaves.

## 7. Future Enhancements

- Adding multi-language support for regional farmers.
- Including weather-based disease prediction using real-time data.
- Expanding to other fruits such as mango, orange, and banana.
- Building a mobile app version for offline access.