

# **Plant Disease Detection Apps**

CMPE 187 Conventional Test Report

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Team 1

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# **CMPE 187 Group 1 Conventional Test Report**

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# 1. Introduction

## 1.1 Application Introduction

With the recent strides to revolutionize the agricultural field, several apps were developed that helped identify plant diseases using artificial intelligence. These apps take an image of the plant as an input, and display the predicted disease. The following apps are used for our testing,



FarmAssistX



Sick Plant Disease Identifier



PlantDiseaseIdentifier



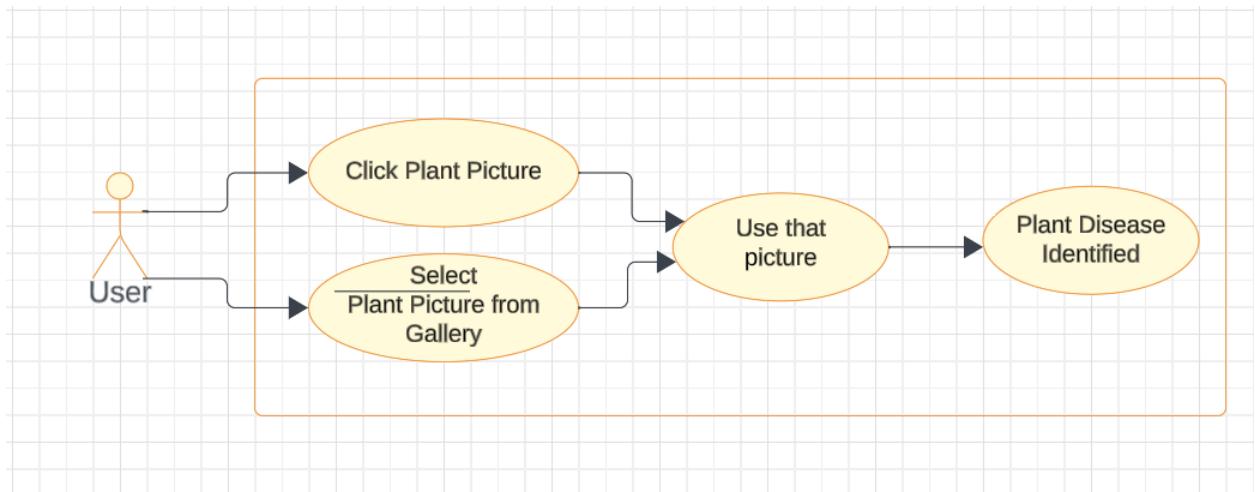
PictureThis

## 1.2 Testing Introduction

The four apps are each tested and compared. Additionally, the following four plant types have been chosen as an experimental group: Corn, Potato, Tomato, and Strawberry. Several black-box testing methodologies are used.

Non-plant related item, Fake plant item,diseased plant: (corn w/ rust, corn w/ gray leaf spot)

## 1.3 Test Function Scope: Test Plant Disease



## 1.4 Testing Methods Selection

For this deliverable, we will only conduct black-box testing. We will conduct our complete testing through 4 conventional black-box testing methods:

- Boundary Value Testing
- Category Partition Testing
- Equivalence Partition Testing
- Scenario Testing

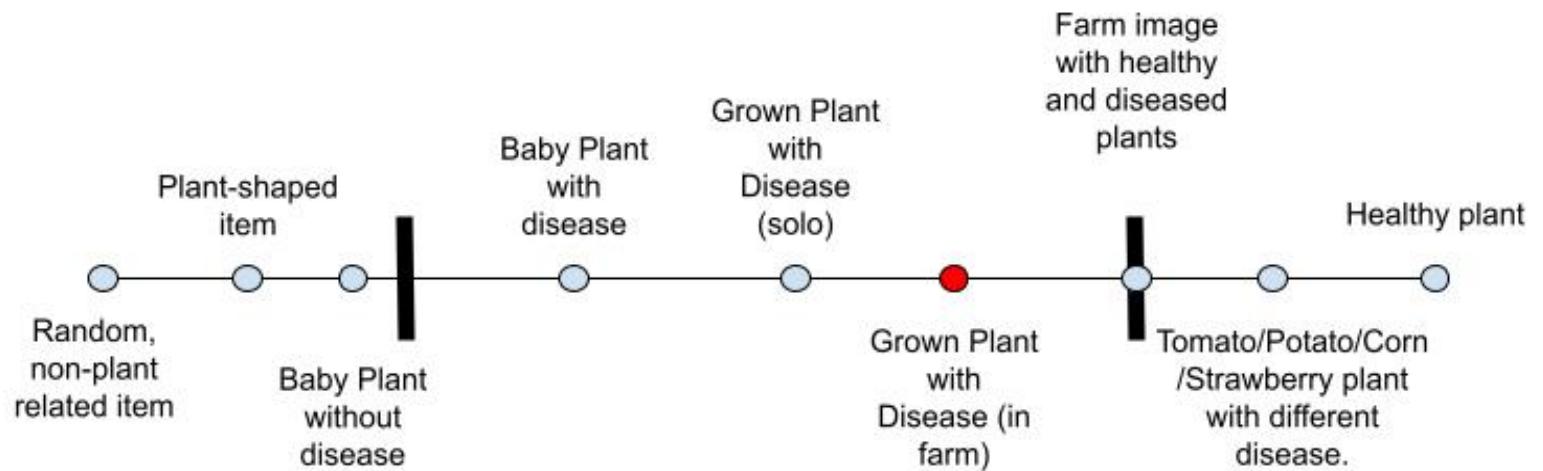
Each of these testing methods serve different purposes and comprehensively test all the apps under various different conditions.

## 2. Conventional Test Design

### 2.1 Boundary Value Testing

#### 2.1.1 Method Design for AI feature

All plant testing within the boundary are for either Tomato, Potato, Corn, or Strawberry plants.



The lower bound consists of a baby plant with a disease. This is due to baby plants often dying early into the disease cycle therefore the chances of determining a disease with little area of effect are slim. In the bounds we also have a grown plant with a disease by itself, and a grown plant with disease in a farm environment (or with multiple other plants). The farm environment is ideal since it tests the epitome of most apps mentioned. Finally, in the higher bound, we have a farm environment with both healthy as well as diseased plants. The figure shown above depicts our boundary testing values.

### 2.1.2 Test Cases

Test Case ID	1			
Test Case Description	Random, non-plant related item			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	No Detection/ Not a plant	No Detection/ Not a plant	No Detection/ Not a plant	No Detection/ Not a plant
Actual Result	Healthy	Diagnosis: Colocasia esculenta	Not A Plant	Your plant looks healthy!
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	2			
Test Case Description	Plant shaped item			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh

Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	No Detection/ Not a plant	No Detection/ Not a plant	No Detection/ Not a plant	No Detection/ Not a plant
Actual Result	Healthy	Great Job! Your plant looks healthy!	Not A Plant	Your plant looks healthy!
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	3			
Test Case Description	Baby plant without disease			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy	Healthy	Healthy
Actual Result	Healthy	Great Job! Your plant looks healthy!	Healthy Tomato Plant	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	4			
Test Case Description	Baby plant with disease (solo) - Corn Common Rust			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn Common Rust	Corn Common Rust
Actual Result	Healthy	Your plant looks un-healthy -rust (most likely) -fungi (87%) -daylily rust (12%)	Puccinia - Rust	Your corn plant seems to have Corn Common Rust
Test Case Result	Fail	Pass	Fail	Pass

Test Case ID	5			
Test Case Description	Grown plant with disease (solo) - Corn Gray Leaf Spot			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn Gray Leaf Spot	Corn Gray Leaf Spot	Corn Gray Leaf Spot	Corn Gray Leaf Spot
Actual Result	Corn Gray Leaf Spot (50% confidence)	Great Job! Your plant looks healthy!	Corn - Fungi	Your plant looks healthy!
Test Case Result	Pass	Fail	Pass	Fail

Test Case ID	6			
Test Case Description	Grown plant with disease (solo) - Potato Early Blight			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution	09/29/2023	09/29/2023	09/29/2023	09/29/2023

Date				
Expected Result	Potato Early Blight	Potato Early Blight	Potato Early Blight	Potato Early Blight
Actual Result	Potato Early Blight (83.14% confidence)	Late Blight (Phytophthora infestans) (most likely) - water mold pathogen	Physalis - Bacterial infection	Your plant has mottling on its leaf
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	7			
Test Case Description	Grown plant with disease (solo) - Tomato Leaf Mold			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Healthy	Your plant looks un-healthy Powdery Mildew Gray Mold (Botrytis cinerea)	Tomato Plant - Nutrient Deficiency	Your plant may have Botrytis Blight.
Test Case	Fail	Fail	Fail	Fail

Result				
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Test Case ID	8			
Test Case Description	Grown plant with disease (solo) - Tomato Mosaic Virus			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Tomato Mosaic Virus	Tomato Mosaic Virus	Tomato Mosaic Virus	Tomato Mosaic Virus
Actual Result	Healthy	Tomato Mosaic Virus tobamovirus	Garaden Lettuce - Healthy	Your plant looks healthy!
Test Case Result	Fail	Pass	Fail	Fail

Test Case ID	9			
Test Case Description	Grown plant with disease (solo) - Strawberry leaf scorch			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Strawberry leaf scorch	Strawberry leaf scorch	Strawberry leaf scorch	Strawberry leaf scorch
Actual Result	Strawberry Leaf Scorch (81.8% confidence)	Strawberry Scorch Diplocarpon earlianum (65%) Animalia (35%)	Strawberry - Leaf Scorch	Your strawberry plant has Leaf Scorch
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	10			
Test Case Description	Grown plant with disease (multiple plants to replicate farm environment) - Potato Early Blight			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				

Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Potato Early Blight	Potato Early Blight	Potato Early Blight	Potato Early Blight
Actual Result	Strawberry Leaf Scorch (56.08% confidence)	Your plant looks un-healthy Elderberry Leaf Spot (Aureobasidium microstictum) (most likely)	Elderberry - Healthy	Your Rose Bush has Black Spot!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	11			
Test Case Description	Farm image with both healthy and diseased plants			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				

Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch (67% confidence)	Strawberry Scorch Diplocarpon earlianum (most likely)	Strawberry Leaf Scorch	Your strawberry plant has Leaf Scorch
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	12			
Test Case Description	Strawberry plant with different disease (strawberry leaf blight)			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected	Strawberry Leaf Blight	Strawberry Leaf	Strawberry Leaf Blight	Strawberry

Result		Blight		Leaf Blight
Actual Result	Strawberry Leaf Scorch (56% confidence)	Your plant looks un-healthy Clover Leaf Spot (Mycosphaerella trifolii)	Strawberry Leaf - Fungi	Your Strawberry Plant has Leaf Blight
Test Case Result	Fail	Fail	Fail	Pass

Test Case ID	13			
Test Case Description	Healthy plant (Corn)			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy Corn	Healthy	Healthy
Actual Result	Healthy	Zea Mays (corn) Great Job! Your plant looks healthy!	Corn - Healthy	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Pass

### 2.1.3 Test Result Analysis and Summary

The following table gives a rundown of how each of the apps performed. Overall, PlantDiseaseIdentifier had the highest success rate at 54%. The general low score is indicative of failures within the initial test cases of non-plant items. Most apps defaulted to saying ‘Healthy’ even though there was no real plant.

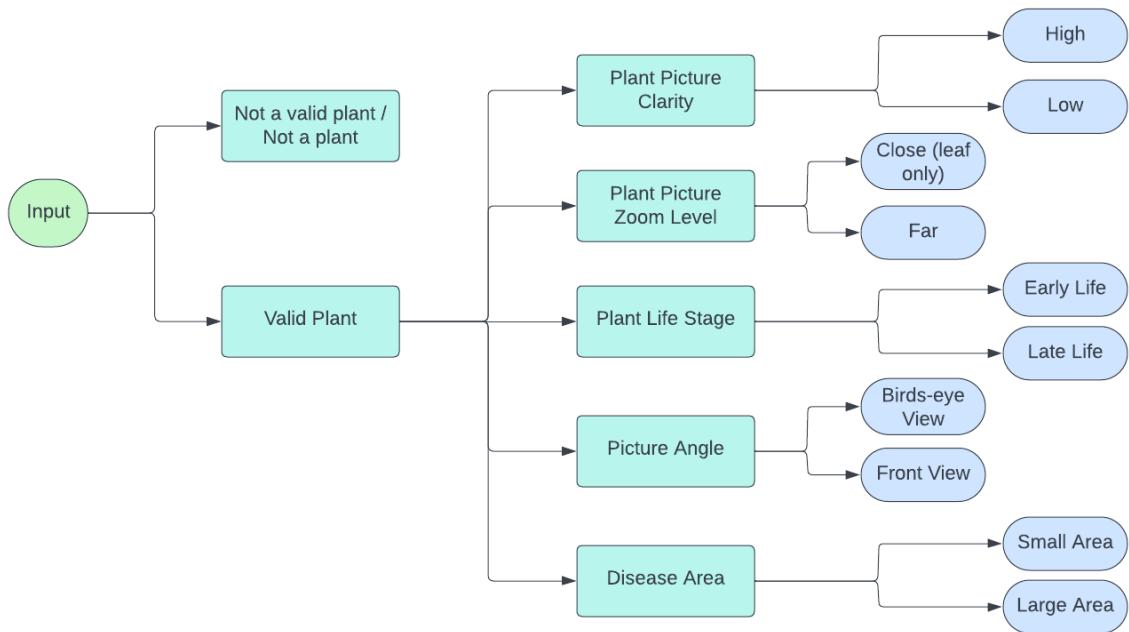
Test Results Summary				
	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Pass Rate	6/13	6/13	7/13	6/13
Pass Percentage	46.15%	46.15	54.8%	46.15%

## 2.2 Category Partition Test Method

### 2.2.1 Method Design for AI Feature

The goal of the category partition test method is to evaluate application performance for various image characteristics. We chose to evaluate how picture clarity, zoom level, plant age, picture angle, and affected disease area affected model performance.

**Graph:**



## Categories:

- Type
  - Valid Plant
  - Not Valid Plant
- Plant Picture Clarity
  - High Clarity
  - Low Clarity
- Plant Picture Zoom Level
  - Close zoom (leaf only)
  - Far zoom
- Plant Life Stage
  - Early life
  - Late life (fruit bearing)
- Picture Angle
  - Birds-eye View
  - Front View
- Disease Area
  - Small Area
  - Large Area

- Birds-eye View
- Front View
- Disease Area
  - Small Area
  - Large Area

### 2.2.2 Test Cases

Test Case ID	1			
Test Case Description	Not a Plant / Not a Valid Plant			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	No Plant Found	No Plant Found	No Plant Found	No Plant Found
Actual Result	Healthy	Great Job! Your plant looks healthy!	Calliarthron tuberculosum	Your plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	2			
Test Case Description	Valid Plant			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy Plant - Corn	Healthy Plant - Corn	Healthy Plant - Corn	Healthy Plant - Corn
Actual Result	Healthy	Great Job! Your plant looks healthy!	Healthy Plant - Corn	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	3			
Test Case Description	High Picture Clarity			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn - Rust Disease	Corn - Rust Disease	Corn - Rust Disease	Corn - Rust Disease
Actual Result	Corn Common Rust (73.8% confidence)	Uromyces Your plant looks un-healthy -common rust	Corn - Rust Disease	Your plant seems to have Corn Common Rust.
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	4			
Test Case Description	Low Picture Clarity			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh

Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn - Rust Disease	Corn - Rust Disease	Corn - Rust Disease	Corn - Rust Disease
Actual Result	Corn Common Rust (70.2% confidence)	Uromyces Your plant looks un-healthy -common rust	Sorghum Bicolor - Rust Disease	Your plant seems to have Corn Common Rust.
Test Case Result	Pass	Pass	Fail	Pass

Test Case ID	5			
Test Case Description	Close Zoom (Leaf Only)			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot
Actual Result	Corn Gray Leaf Spot (55% confidence)	Dracaena (Dragon trees) -water excess or uneven watering	Pucciniaceae - Rust	Your plant seems to have Gray Leaf Spot.

Test Case Result	Pass	Fail	Fail	Pass
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Test Case ID	6			
Test Case Description	Far Zoom			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot	Corn - Gray Leaf Spot
Actual Result	Healthy	Great Job! Your plant looks healthy!	Corn - Gray Leaf	Your plant seems to have Mosaic Virus.
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	7
Test Case Description	Early Stage

App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn (Zea mays)	Corn (Zea mays)	Corn (Zea mays)	Corn (Zea mays)
Actual Result	Healthy	Your plant looks un-healthy -Herbicide Damage -Rhizoctonia spp	Zea mays	Your plant looks healthy!
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	8			
Test Case Description	Late Stage			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn (Zea mays)	Corn (Zea mays)	Corn (Zea mays)	Corn (Zea mays)
Actual Result	Healthy	Your plant looks un-healthy -Herbicide Damage -Rhizoctonia spp	Zea Mays - Healty	Your plant looks healthy!
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	9			
Test Case Description	Birds-eye View			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Mycosphaerella Leaf Spot - Strawberry	Mycosphaerella Leaf Spot - Strawberry	Mycosphaerella Leaf Spot - Strawberry	Mycosphaerella Leaf Spot - Strawberry
Actual Result	Strawberry Leaf Scorch	Your plant looks un-healthy -Cercospora Leaf Spot	Mycosphaerella Leaf Spot - Strawberry	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Fail

Test Case ID	10			
Test Case Description	Front View			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Tomato Leaf Mold	Your plant looks un-healthy Tomato Early Blight ( <i>Alternaria solani</i> ) (most likely) -Late Blight ( <i>Phytophthora infestans</i> )	Unable to identify plant	Your plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	11			
Test Case Description	Small Disease Area			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn Gray Leaf Spot	Corn Gray Leaf Spot	Corn Gray Leaf Spot	Corn Gray Leaf Spot
Actual Result	Healthy	Your plant looks un-healthy! Corn Gray Leaf Spot	Corn - Fungi	Your plant seems to have Corn Gray Leaf Spot.
Test Case Result	Fail	Pass	Pass	Pass

Test Case ID	12			
Test Case Description	Large Disease Area			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn - Common Rust	Corn - Common Rust	Corn - Common Rust	Corn - Common Rust
Actual Result	Corn Common Rust	Your plant looks un-healthy -common rust	Puccinia - Fungi	Your plant looks healthy!
Test Case Result	Pass	Pass	Fail	Fail

### **2.2.3 Test Result Analysis and Summary**

The following table summarizes the performance of each disease identification app on various images for the category partition testing. Many of the apps had an accuracy of 50-60%, but FarmAssistX performed best with an accuracy of 75%. FarmAssistX performed better when the images were at a further zoom level, and not just of individual leaves. All of the other models failed to identify diseases from afar.

### **Test Results Summary**

	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Pass Rate	9/12	6/12	7/12	7/12
Pass Percentage	75%	50%	58%	58%

## 2.3 Equivalence Partition Test Method

### 2.3.1 Method Design for AI Feature

Equivalence Partition Table	
Non-Plant	P1: Non-plant object
	P2: Cartoon Plant
	P3: Plastic Plant
Healthy Plant	P4: Healthy Corn
	P5: Healthy Tomato
	P6: Healthy Potato
	P7: Healthy Strawberry
Diseased Plant	P8: Corn Common Rust
	P9: Corn Gray Leaf Spot
	P10: Potato Early Blight
	P11: Tomato Leaf Mold
	P12: Tomato Mosaic Virus
	P13: Strawberry Leaf Scorch

### 2.3.2 Test Cases

Test Case ID	1			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P1: Non-plant Object			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	No Detection/ Not a plant	Not a Plant (Invalid Input)	Not A Plant	Not a Plant
Actual Result	Healthy	Diagnosis: Xerocomellus	Not A Plant	Your plant looks healthy!
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	2			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P2: Cartoon plant			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023

Expected Result	No Detection/ Not a plant	Not a Plant (Invalid Input)	Not A Plant	Not a Plant
Actual Result	Healthy	Great Job! Your plant looks healthy!	Not a Plant	Your plant looks healthy!
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	3			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P3: Plastic Plant			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	No Detection/ Not a plant	Not a Plant (Invalid Input)	Not A Plant	Not a Plant
Actual Result	Healthy	Great Job! Your plant looks healthy!	Chinese Banyan - Healthy	Your plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	4			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Condition	P4: Healthy Corn			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy Corn (Valid Input)	Healthy Corn	Healthy
Actual Result	Healthy	Zea Mays (corn) Great Job! Your plant looks healthy!	Zea Mays (Corn) - Healthy	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	5			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P5: Healthy Tomato			
Test Case Input				

Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy Tomato (Valid Input)	Healthy Tomato	Healthy
Actual Result	Healthy	Solanum lycopersicum (tomato) Your plant looks un-healthy -Viruses (Most Likely) -mosaic virus (35%) -Animalia (35%)	Tomato Plant - Healthy	Your plant looks healthy!
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	6			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P6: Healthy Potato			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy Potato (Valid Input)	Healthy Potato	Healthy
Actual Result	Healthy	Solanum tuberosum (potato) Your plant looks	Potato Plant - Healthy	Your plant looks healthy!

		un-healthy -Herbicide Damage (Most Likely) -Bacteria (24%) -Animalia (21%)		
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	7			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P7: Healthy Strawberry			
Test Case Input	 A photograph showing several ripe, red strawberries hanging from green stems in a garden setting.			
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Healthy	Healthy Strawberry (Valid Input)	Healthy Strawberry	Healthy
Actual Result	Healthy	Fragaria ananassa Your plant looks un-healthy -Fungi (Most likely) -gray mold -Bacteria	Strawberry Plant - Healthy	Your plant may have Strawberry Anthracnose.
Test Case Result	Pass	Fail	Pass	Fail

Test Case ID	8			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P8: Corn Common Rust			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn Common Rust	Un-healthy Corn -Common Rust (Most likely)	Corn Common Rust	Corn Common Rust
Actual Result	Corn Gray Leaf Spot (52.55% confidence)	Uromyces Your plant looks un-healthy -rust (most likely) -fungi (87%) -daylily rust (12%)	Corn - Common Rust	Your plant seems to have Corn Common Rust.
Test Case Result	Fail	Pass	Pass	Pass

Test Case ID	9			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P9: Corn Gray Leaf Spot			

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Corn Gray Leaf Spot	Un-healthy Corn -Gray Leaf Spot	Corn Gray Leaf Spot	Corn Gray Leaf Spot
Actual Result	Corn Gray Leaf Spot (50.59% confidence)	Dracaena (Dragon trees) -water excess or uneven watering (Most likely)	Corn - Fungi	Your Corn plant seems to have 'Gray Leaf Spot'
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	10			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P10: Potato Early Blight			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Potato Early Blight	Un-healthy Potato -Early Blight	Potato Early Blight	Potato Early Blight

Actual Result	Healthy	Russula (mushroom) Your plant looks un-healthy -Fungi (Most likely) -Bacteria (37%) -Rhizoctonia Damping (36%)	Dark Bitter Bolete - Healthy	Your plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	11			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P11: Tomato Leaf Mold			
Test Case Input	 <small>5487925</small>			
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Tomato Leaf Mold	Un-healthy Tomato -Tomato Leaf Mold	Tomato Leaf - Mold	Tomato Leaf Mold
Actual Result	Healthy	Puccinia arenariae Your plant looks un-healthy -Fungi (Most likely) -Alternaria (36%) -nutrient deficiencies (27%)	Puccinia - Fungi	Your Tomato Plant seems to be having Tomato Leaf Mold
Test Case Result	Fail	Pass	Fail	Pass

Test Case ID	12			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P12: Tomato Mosaic Virus			
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Tomato Mosaic Virus	Un-healthy Tomato -Tomato Mosaic Virus	Tomato Mosaic Virus	Tomato Mosaic Virus
Actual Result	Healthy	Rosa micrantha Your plant looks un-healthly -Animalia (Most Likely) -Insecta (46%) -feeding damage by insects (37%)	Not a Plant	Healthy
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	13			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Condition	P13: Strawberry Leaf Scorch			

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Strawberry Leaf Scorch	Un-healthy Strawberry -Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch (77.25% confidence)	Phragmidium Your plant looks un-healthy -Fungi (Most likely) -rust (26%) -Cercospora Leaf Spot (22%)	Strawberry - Leaf Scorch	Your strawberry plant may have Strawberry Leaf Scorch.
Test Case Result	Pass	Pass	Pass	Pass

### 2.3.3 Test Result Analysis and Summary

*Test Coverage:* The testing coverage of the Equivalence Partition Testing phase covered a total of 13 test cases. These 13 test cases tested how the various AI-applications would respond/diagnose a non-plant, healthy plant, and a diseased plant.

Overall, Sick Plant Disease Identifier and PlantDiseaseIdentifier had similar results. They both were successful in identifying the diseases correctly on multiple occasions. However Sick Plant Disease Identifier failed to correctly identify when

a plant was healthy. Another general analysis showed that the majority of apps failed to pronounce that a non-plant item was actually not a plant. They gave disease identification even for non-plant items. Both of these points are further elaborated in the conclusion.

Test Results Summary				
	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Pass Rate	6/13	9/13	9/13	7/13
Pass Percentage	46.15%	69.23%	69.23%	53.84%

## 2.4 Scenario Testing Method

### 2.4.1 Method Design for AI Feature

Each app has two primary methods of using the plant disease detection AI feature. First, the user can open their camera and take a photo. And secondly, the user can view photos in their photo library and select one to use for detection.

The following tables show detailed scenario steps for each of the apps.

Plant Assist X	
Scenario 1	Take new photo

1	User selects ‘Detect’ option at bottom
2	User clicks on camera plus icon
3	User clicks on checkmark icon
4	User crops image as needed and clicks checkmark icon when done
5	App displays plant disease if applicable
<b>Scenario 2</b>	Use existing photo from library
1	User selects ‘Detect’ option at bottom
2	User clicks on library ‘folder’ icon
3	User selects photo from library
4	User crops image as needed and clicks checkmark icon when done
5	App displays plant disease if applicable

Sick Plant Disease Identifier	
<b>Scenario 1</b>	Take new photo
1	User selects ‘Identify Disease’ option at bottom
2	User clicks on camera icon
3	User takes picture of plant (more than one picture option available)
4	User clicks ‘use’
5	App displays plant disease if applicable
<b>Scenario 2</b>	Use existing photo from library
1	User selects ‘Identify Disease’ option at bottom
2	User clicks on library icon

3	User selects photo(s) from library
4	User clicks ‘use’
5	App displays plant disease if applicable

<b>PlantDiseaseIdentifier</b>	
Scenario 1	Take new photo
1	User selects ‘Camera’ from home page
2	User uses camera viewfinder to take up to 5 pictures of subject plant
3	User presses ‘results’ in bottom right corner
4	User selects correct plant from a list of potential plant matches
5	User selects a potential disease to learn more information
6	User selects “finish” to return to home page
Scenario 2	Use existing photo from library
1	User selects ‘Gallery’ option from home page
2	User selects up to 5 photos of the subject from their photo library
3	User selects “add” in upper right
4	User selects correct plant from a list of potential plant matches
5	User selects a potential disease to learn more information
6	User selects “finish” to return to home page

<b>PictureThis</b>	

Scenario 1	Take new photo
1	User clicks 'Diagnose' button at top
2	User takes photo
3	User answers questionnaire about plant location, sunlight amount and watering amount.
4	App displays plant disease if applicable
Scenario 2	Use existing photo from library
1	User clicks 'Diagnose' button at top
2	User clicks on folder icon at button right
3	User selects photo
4	User answers questionnaire about plant location, sunlight amount and watering amount.
5	App displays plant disease if applicable

#### 2.4.2 Test Cases

Test Case ID	1			
Test Case Description	Photo taken using camera			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Plant detected	Plant detected	Plant detected	Plant detected
Actual Result	Healthy	Your plant looks un-healthy Iron Deficiency	Digitalis purpurea - healthy	Your plant looks healthy!
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	2			
Test Case Description	Photo uploaded from library			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh

Execution Date	09/29/2023	09/29/2023	09/29/2023	09/29/2023
Expected Result	Plant is detected (Tomato Mosaic Virus)			
Actual Result	Tomato Mosaic Virus	Your plant looks un-healthy - Fungi	Black Mustard Seed - Healthy	Your plant has signs of the Mosaic Virus
Test Case Result	Pass	Pass	Pass	Pass

#### 2.4.3 Test result analysis and bug summary

All apps passed in overall usability for the given scenarios. Users are able to upload an image from their library, or take a photo with their camera to help identify the plant disease for all four apps.

Test Results Summary				
	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Pass Rate	2/2	2/2	2/2	2/2
Pass Percentage	100%	100%	100%	100%

### 3 Conventional Testing Summary

#### 3.1 Test Complexity

- 4 different applications that use AI to identify plant diseases are compared based on several criteria.
- Plants look different when they are just infected by a disease than what they look like if they have been infected by that disease for a while. So, we had to find images with different time periods of onset.
- We also had to retrieve images for different plant ages because age plays a key role in how a plant looks.

### 3.2 Test Cost

Test Cost	
Activity	Cost
Research and Discussion	5 hours
Determining testing methods	4 hours
Writing test cases	4 hours
Finding test data	3 hours
Analyzing test results	1.5 hours

### 3.3 Test summary

Several conclusions were made after the results of the testing were analyzed.

Overall,

- For most of the apps, when an object other than a plant is detected, the result is defaulted to “healthy”; this led to significantly low success rates for test cases that involved non-plant items.
- Sick Plant Disease Identifier App would always give elaborate potential diseases. These would often be inaccurate.
- FarmAssistX and PlantDiseaseIdentifier provided the overall best results.
- The apps generally work better with better resolution pictures.

## Testing Result Summary

