

Plant Disease Detection Apps

CMPE 187 AI Test Modeling Report

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Team 1

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1. AI Function Test Requirement Analysis

This section will introduce the AI functional requirements for the apps we are testing. The primary feature of the apps is AI classification of plant diseases. The AI function was tested under various conditions such as picture clarity, zoom level, plant life stage, picture angle, and disease area.



FarmAssistX



Sick Plant Disease Identifier



PlantDiseaseIdentifier



PictureThis

Figure 1.1 Apps to be Tested

The above apps were selected as they all have the same plant disease identification feature.

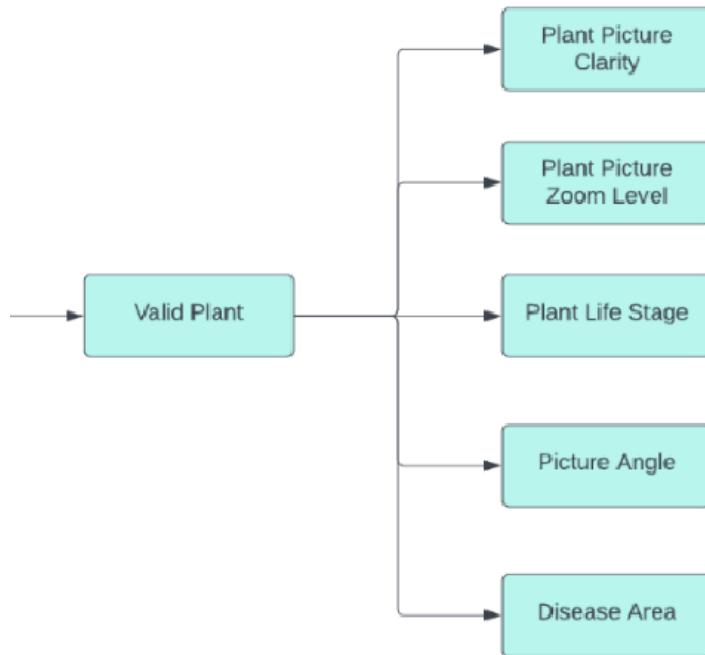


Figure 1.2 AI Plant Disease Identification Features

For our AI testing, our group will conduct various trials testing as to whether our selected applications (FarmAssistX, Sick Plant Disease Identifier, PlantDiseaseIdentifier, and PictureThis) can correctly identify the Potato Blight, Tomato Leaf Mold, Strawberry Leaf Scorch, and Corn Common Rust diseases. We will vary test conditions by testing photos with varying attributes: plant picture clarity, plant picture zoom level, plant life stage, picture angle, and disease area. We believe that testing using these varying attributes will give us a comprehensive understanding of how accurate the selected AI applications are at detecting disease.

Chosen diseases:

- Potato blight
- Tomato leaf mold
- Strawberry leaf scorch
- Corn common rust

2. AI Test Modeling for AI Features

2.1 Context Modeling for AI Features

The Context Classification Spanning Tree is a crucial part of our Test Model because it illustrates how our testing criteria will be systematically organized. The four main categories for our testing are Plant Type, Disease Effect Area, Plant Life Stage, and Occurrence. The Plant Type category can be broken down into the

Potato, Strawberry, Corn, and Tomato categories. The Disease Effect Area will be divided into either one spot of the disease or multiple. The plant life stage category was divided into an early and a late life category. The last category for our testing criteria is the Occurrence category, which is divided into the one leaf, one plant, and multiple plants subsections.

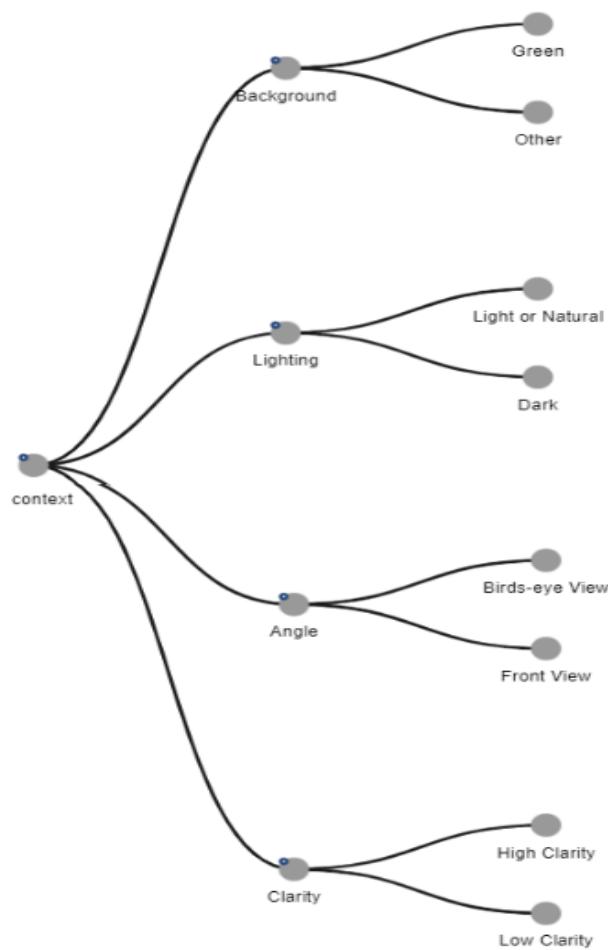


Figure 2.1 Context Classification Spanning Tree

2.2 AI-powered Function Input Classifications

This classification tree is used to encapsulate all the plant-specific information for our test cases. Plants can vary by type, disease effect area, life stage, and occurrence (how many plants in the test case are affected by a disease).

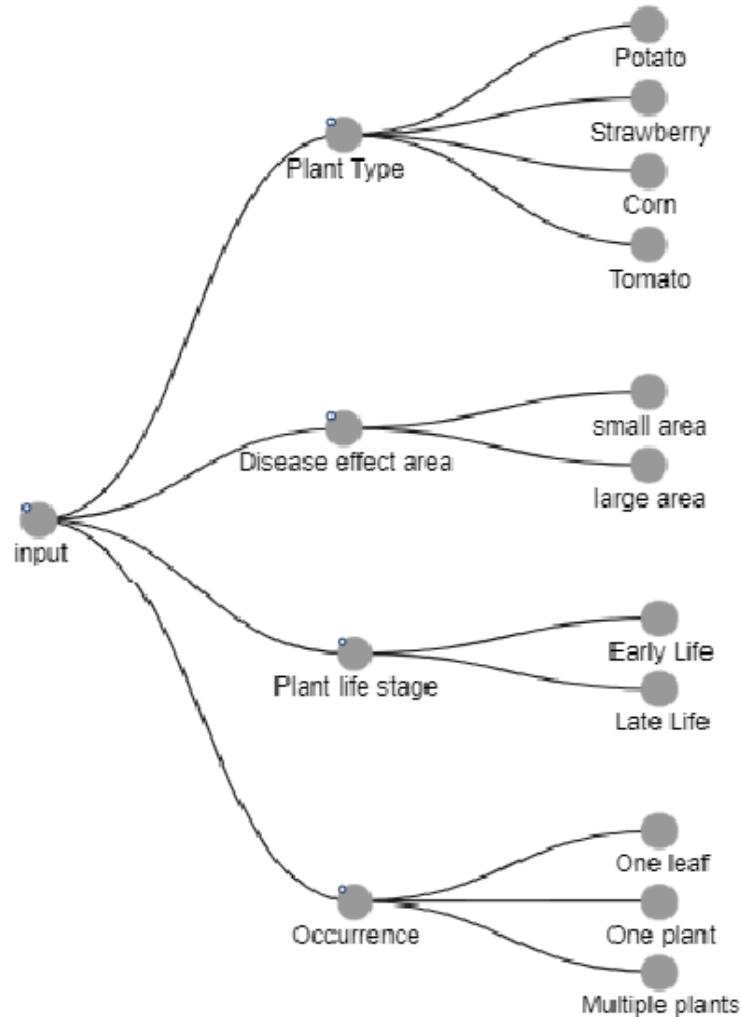


Figure 2.2 Input Classification Spanning Tree

2.3 AI-powered Function Output Classifications

A visual representation of all the possible outputs for our testing process is detailed in our Output Classification Spanning Tree. This ensures that our testing process yields results that are quantitative and free from ambiguity.

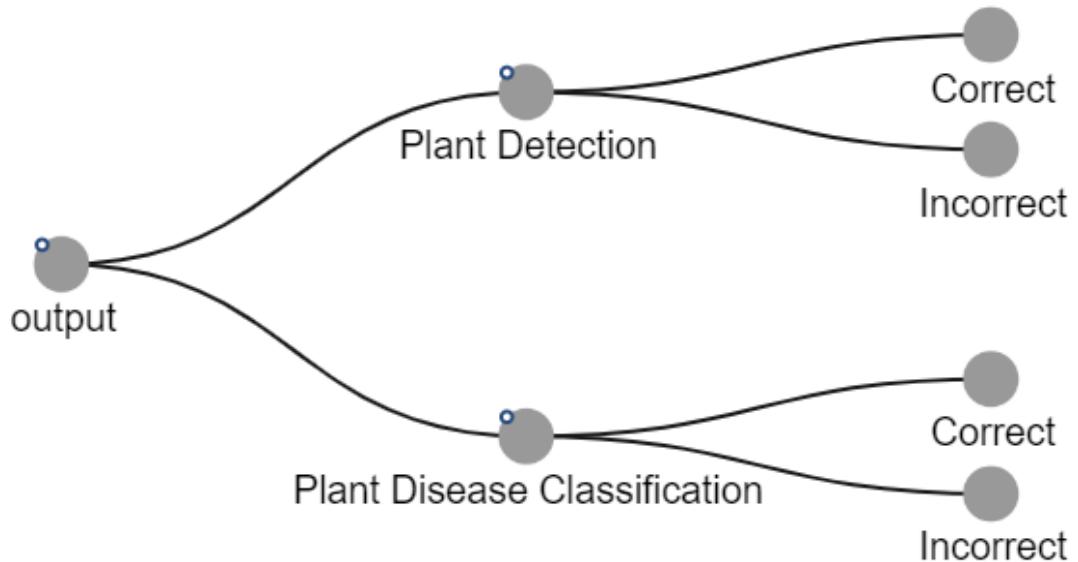


Figure 2.3 Output Classification Spanning Tree

2.4 AI-powered Functions Classification Decision Tables

Our 3D classification decision table provides a reference for every test case used in our testing process. Each row in this table is an individual attribute of a test case, and the rows represent a single test case. Below is our 3D classification decision table for our Plant Disease identifier applications.

ID	Angle	Background	Clarity	Lighting	
				Front View	Side View
1	Front View	Green	High Clarity	Light or Natural	Dark
2	Front View	Green	Low Clarity	Light or Natural	Dark
3	Front View	Other	High Clarity	Light or Natural	Dark
4	Front View	Other	Low Clarity	Light or Natural	Dark
5	Side View	Green	High Clarity	Light or Natural	Dark
6	Side View	Green	Low Clarity	Light or Natural	Dark
7	Side View	Other	High Clarity	Light or Natural	Dark
8	Side View	Other	Low Clarity	Light or Natural	Dark
9	Birds-Eye View	Green	High Clarity	Light or Natural	Dark
10	Birds-Eye View	Other	Low Clarity	Light or Natural	Dark

Plant	Disease	Plant Disease Classification			Disease effect area	Jitter
		Small Area	Large Area	Whole Plant		
Potato	Potato Blight	Small Area	Large Area	Whole Plant	Small Area	Medium
Potato	Potato Blight	Small Area	Large Area	Whole Plant	Medium	Medium
Potato	Potato Blight	Small Area	Large Area	Whole Plant	Medium	Medium
Potato	Potato Blight	Small Area	Large Area	Whole Plant	Medium	Medium
Strawberry	Strawberry Leaf Scorch	Small Area	Large Area	Whole Plant	Medium	Medium
Strawberry	Strawberry Leaf Scorch	Small Area	Large Area	Whole Plant	Medium	Medium
Strawberry	Strawberry Leaf Scorch	Small Area	Large Area	Whole Plant	Medium	Medium
Strawberry	Strawberry Leaf Scorch	Small Area	Large Area	Whole Plant	Medium	Medium

Figure 2.4 3D Classification Decision Table

2.4.1 Context Spanning Table

ID	Angle	Background	Clarity	Lighting
C1	Birds-Eye View	Green	High	Light
C2	Birds-Eye View	Other	High	Light
C3	Front View	Green	High	Light
C4	Front View	Other	High	Light
C5	Front View	Other	High	Dark

C6	Front View	Other	Low	Light
C7	Front View	Other	Low	Dark

2.4.2 Input Spanning Table

ID	Plant Type	Disease effect area	Occurrence	Life Stage
I1	-	-	No Plant	-
I2			One plant	Early Life
I3	Potato	One Spot	One leaf	Late Life
I4	Tomato	One Spot	One plant	Late Life
I5	Potato	Multiple Spots	One leaf	Late Life
I6	Potato	Multiple Spots	One plant	Late Life
I7	Strawberry	Multiple Spots	One leaf	Late Life
I8	Strawberry	Multiple Spots	One plant	Late Life
I9	Corn	Multiple Spots	One leaf	Late Life
I10	Corn	Multiple Spots	One plant	Late Life
I11	Tomato	Multiple Spots	One leaf	Late Life
I12	Tomato	Multiple Spots	One plant	Late Life

2.4.3 Output Spanning Table

ID	Plant Detection	Plant Disease Classification
O1	Correct	Correct
O2	Correct	Wrong
O3	Wrong	Wrong

2.4.4 Test Case Design

ID	Context Spanning Tree	Input Spanning Tree	Output Spanning Tree
T1	C1	I6	O1
T2	C7	I6	O1
T3	C4	I6	O1
T4	C5	I6	O1
T5	C4	I8	O1
T6	C6	I8	O1
T7	C3	I9	O1
T8	C4	I9	O1
T9	C2	I12	O1
T10	C4	I12	O1
T11	C4	I1	O1
T12	C4	I2	O1
T13	C4	I3	O1

T14	C4	I4	O1
T15	C4	I5	O1
T16	C4	I6	O1
T17	C4	I7	O1
T18	C4	I8	O1
T19	C4	I9	O1
T20	C4	I10	O1
T21	C4	I11	O1
T22	C4	I12	O1
T23	C2	I5	O1
T24	C2	I6	O1
T25	C2	I7	O1
T26	C2	I8	O1
T27	C2	I9	O1
T28	C2	I10	O1
T29	C2	I11	O1
T30	C2	I12	O1

3. AI Function Test Cases with Inputs/Outputs

3.1 Test Data Model

All our test data types are broken down into eight types: Disease effect areas (single, multiple), Input Size (one leaf, multiple leaves, entire plant, multiple plants), Occurrence (one plant, many plants), Life Stage (early life, late life), Angle (birds-eye view, front view), Background (green, color), Clarity (low, high), and Light (Bright, Dark).

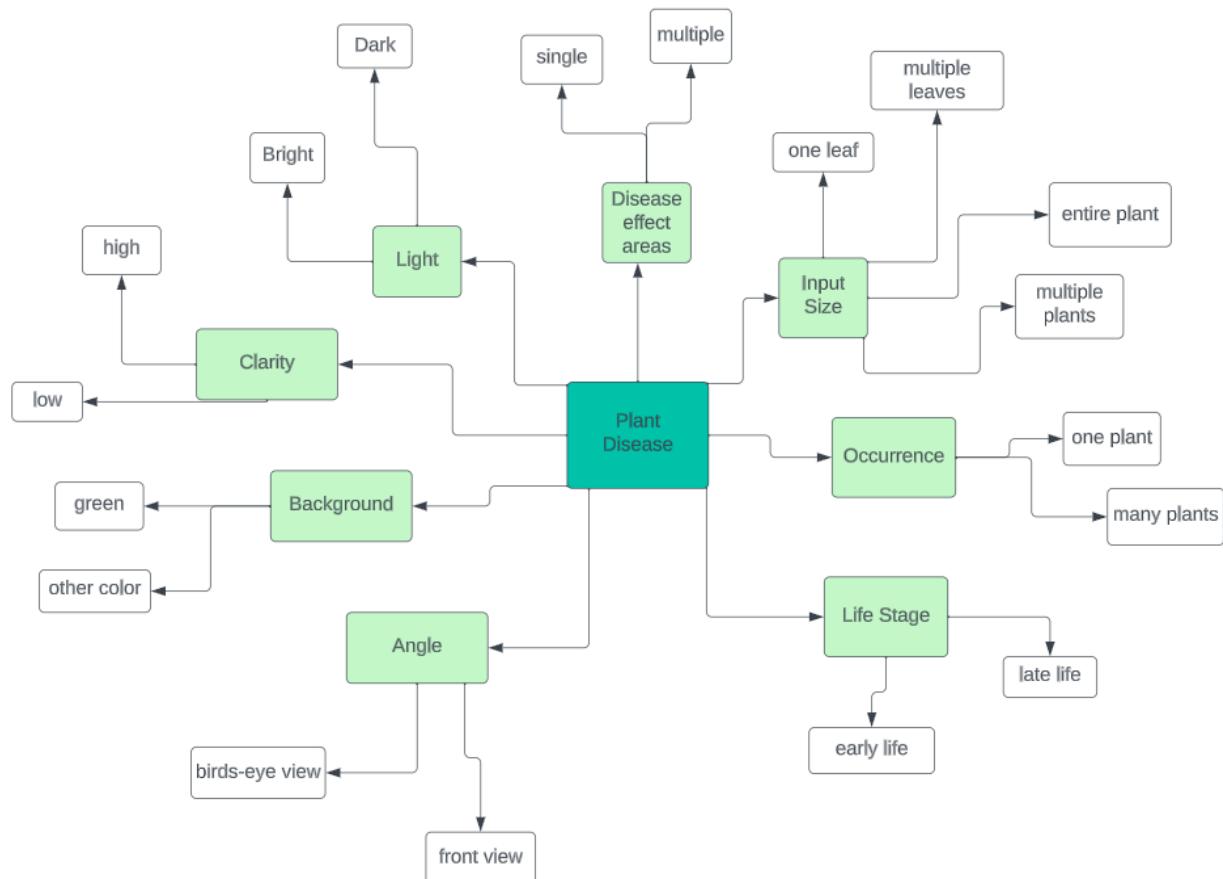


Figure 3.1 Test Data Model

3.2 Test Case

3.2.1 Context Test Cases

3.2.1.1 Outlier Test Cases

Test Case ID	T1 - T2
Test Classification	Context: Outliers
	-Birds eye view and green background -Dark lighting and low clarity

Test Case ID	T1			
Test Case Description	Birds-eye view, multiple spots, potato blight, green background			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023

Expected Result	Potato Early Blight	Potato Early Blight (Fungi)	Potato Plant - Blight	Potato Blight
Actual Result	Potato Early Blight	Potato Fungi (Most likely)	Potato Plant - Virus	This plant looks healthy!
Test Case Result	Pass	Pass	Fail	Fail

Test Case ID	T2			
Test Case Description	Low clarity, dark lighting, front view potato plant - 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Early Blight	Potato Early blight (Fungi)	Potato Plant - Blight	Potato Blight
Actual Result	Potato Early Blight	Kalanchoe	Groundcherry - Fungi	This plant

		(widow's thrill) Fungi (Most likely)		looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

3.2.1.2 Light Test Cases

Test Case ID	T3 - T4
Test Classification	Context: Lighting Front view, potato blight, high clarity

Test Case ID	T3			
Test Case Description	Potato blight, 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Early Blight	Potato Early Blight (Fungi)	Potato Plant - Blight	Potato Blight
Actual Result	Potato Early Blight	Uromyces viciae-fabae Fungi (Most Likely)	Elderflower - Fungus	This plant has Potato Blight!
Test Case Result	Pass	Fail	Fail	Pass

Test Case ID	T4			
Test Case Description	Potato plant blight, dark setting			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023

Expected Result	Potato Early Blight	Potato Early Blight (Fungi)	Potato Plant - Blight	Potato Blight
Actual Result	Potato Early Blight	Uromyces viciae-fabae Fungi (Most Likely)	Elderberry - Fungi	This plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

3.2.1.3 Clarity Test Cases

Test Case ID	T5 - T6
Test Classification	Context: Clarity Strawberry leaf scorch, high clarity and low clarity

Test Case ID	T5			
Test Case Description	Strawberry leaf scorch, high 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Plant - Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch	Phragmidium Fungi (Most Likely)	Strawberry Plant - Scorch	This plant has Leaf Scorch!
Test Case Result	Pass	Fail	Pass	Pass

Test Case ID	T6			
Test Case Description	Strawberry leaf scorch, low 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Plant - Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch	Phragmidium Fungi (Most Likely)	Strawberry Plant - Scorch	This plant looks healthy!
Test Case Result	Pass	Fail	Pass	Fail

3.2.1.4 Background Test Cases

Test Case ID	T7 - T8
Test Classification	Context: Background Corn common rust, green background, and different color background

Test Case ID	T7
Test Case	Corn common rust, one leaf, green background

Description				
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn - Rust	Corn Common Rust
Actual Result	Corn Common Rust	Puccinia allii Fungi (Most Likely)	Puccina - Rust	This plant has Common Rust!
Test Case Result	Pass	Fail	Fail	Pass

Test Case ID	T8			
Test Case Description	Corn common rust, one leaf			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn - Rust	Corn Common Rust
Actual Result	Corn Common Rust	Garden Croton Fungi (Most Likely)	Elkhorn Fern - Fungi	This plant has Common Rust!
Test Case Result	Pass	Fail	Fail	Pass

3.2.1.5 Angle Test Cases

Test Case ID	T9 - T10
Test Classification	Context: Angle
	Tomato leaf mold, birds eye view and regular

Test Case ID	T9			
Test Case Description	Birds eye view, 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Healthy	Garden Tomato Fungi (Most Likely)	Tomato Leaf Mold	This plant has Leaf Mold!
Test Case Result	Fail	Pass	Pass	Pass

Test Case ID	T10			
Test Case Description	Tomato leaf mold, 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Healthy	Garden Tomato Viruses (Most Likely)	Nutrient Deficiency	This plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

3.2.2 Input Test Cases

3.2.2.1 Outlier Test Cases

Test Case ID	T11 - T12
Test Classification	Context: Outliers Not a plant, baby plant

Test Case ID	T11			
Test Case Description	Not a 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Not a plant	Not a Plant	Not A Plant	Not a plant
Actual Result	Healthy	Plain earthtongue Your plant looks healthy!	Not A Plant	This plant looks healthy!
Test Case Result	Fail	Fail	Pass	Fail

Test Case ID	T12			
Test Case Description	Baby plant, 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	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Tomato Leaf Mold	Phragmidium Fungi (Most Likely)	Fungi	This plant has Leaf Scorch!
Test Case Result	Fail	Fail	Fail	Pass

3.2.2.2 Disease Effect Area Test Cases

Test Case ID	T13 - T14
Test Classification	Context: Disease Effect Area (One spot, or many spots) Potato blight/Tomato Leaf mold. Both with a singular disease spot High clarity and light

Test Case ID	T13			
Test Case Description	Potato blight, one singular spot on leaf, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Blight	Potato Early Blight (Fungi)	Potato Leaf - Blight	Potato Blight
Actual Result	Healthy	Groundcherry Fungi (Most Likely)	Potato - Blight	This plant has Potato Blight!
Test Case Result	Fail	Pass	Pass	Pass

Test Case ID	T14
Test Case Description	Tomato Leaf Mold, one singular spot on plant, front view, high clarity and light

App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Tomato Leaf Mold	Garden Tomato Fungi (Most Likely)	Tomato Leaf - Mold	This plant looks healthy!
Test Case Result	Pass	Pass	Pass	Fail

3.2.2.3 Plant type Test Cases (front view)

Test Case ID	T15 - T22
Test Classification	Context: Plant type (front view)
	Plant type varies, two test cases for each alternating between one leaf and entire plant. High clarity, light, and front view constant

Test Case ID	T15			
Test Case Description	Potato blight, multiple spots, one leaf, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Blight	Potato Blight	Potato Blight	Potato Blight
Actual Result	Potato Blight	Fissidens moss Fungi (Most Likely)	Tobacco - Fungi	This plant has Potato Blight!
Test Case Result	Pass	Fail	Fail	Pass

Test Case ID	T16
Test Case Description	Potato blight, multiple spots, one plant, front view, high clarity and light

App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Blight	Potato Blight	Potato Blight	Potato Blight
Actual Result	Healthy	Potato Fungi (Most Likely)	Potato Plant - Viruses	This plant looks healthy!
Test Case Result	Fail	Pass	Fail	Fail

Test Case ID	T17			
Test Case Description	Strawberry leaf scorch, multiple spots, one leaf, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Healthy	Phragmidium Fungi (Most Likely)	Fungi	This plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	T18			
Test Case Description	Strawberry leaf scorch, multiple spots, one plant, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch	Strawberry Fungi (Most Likely)	Strawberry Leaf - Scorch	This plant has Leaf Scorch!
Test Case Result	Pass	Pass	Pass	Pass

Test Case ID	T19			
Test Case Description	Corn common rust, multiple spots, one leaf, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
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Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn Common Rust	Corn Common Rust
Actual Result	Corn Common Rust	Dragon trees Fungi (Most Likely)	Sorghum - Fungi	This plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	T20			
Test Case Description	Corn common rush, multiple spots, one plant, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn Common Rust	Corn Common Rust
Actual Result	Healthy	Corn Your plant looks healthy!	Zea Mays - Healthy	This plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	T21			
Test Case Description	Tomato leaf mold, multiple spots, one leaf, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Tomato Leaf Mold	Intermediate polypody Nutrient Deficiency (Most Likely)	Puccina - Nutrient Deficiency	This plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	T22			
Test Case Description	Tomato leaf mold, multiple spots, one plant, front view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Potato Blight	Orange-Yellow Rusts Fungi (Most Likely)	Bindweed - Fungi	This plant has Leaf Mold!
Test Case Result	Fail	Fail	Fail	Pass

3.2.2.4 Plant Type Test Cases (Birds-eye view)

Test Case ID	T23 - T30
Test Classification	<p>Context: Plant type (birds-eye view)</p> <p>Plant type varies, two test cases for each alternating between one leaf and the entire plant. High clarity, light, and birds eye view constant</p>

Test Case ID	T23			
Test Case Description	Potato blight, multiple spots, one leaf, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input	 <i>GardenFocused.co.uk</i>			
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Blight	Potato Blight	Potato Blight	Potato Blight
Actual Result	Potato Blight	Garden Lettuce Fungi (Most Likely)	Brassica - Overwatering	This plant has Potato Blight!
Test Case Result	Pass	Fail	Fail	Pass

Test Case ID	T24	
Test Case	Potato blight, multiple spots, one plant, birds-eye view, high clarity and light	

Description				
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Potato Blight	Potato Blight	Potato Blight	Potato Blight
Actual Result	Healthy	Water Mint Fungi (Most Likely)	Potato Plant - Fungus	This plant has Potato Blight!
Test Case Result	Fail	Fail	Pass	Pass

Test Case ID	T25			
Test Case Description	Strawberry leaf scorch, multiple spots, one leaf, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Healthy	Phragmidium Fungi (Most Likely)	Henbit dead-nettle Fungi	This plant has Leaf Scorch!
Test Case Result	Fail	Fail	Fail	Pass

Test Case ID	T26			
Test Case Description	Strawberry leaf scorch, multiple spots, one plant, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch	Strawberry Leaf Scorch
Actual Result	Strawberry Leaf Scorch	Wild Strawberry Fungi (Most Likely)	Strawberry Plant - Fungi	This plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	T27			
Test Case Description	Corn common rust, multiple spots, one leaf, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn Common Rust	Corn Common Rust
Actual Result	Healthy	Dragon trees Animalia (Most Likely)	Puccina - Sap-sucking pest	This plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

Test Case ID	T28			
Test Case Description	Corn common rush, multiple spots, one plant, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Corn Common Rust	Corn Common Rust	Corn Common Rust	Corn Common Rust
Actual Result	Healthy	Red Pondweed Fungi (Most Likely)	Sorghum - thrips	This plant has Corn Common Rust!
Test Case Result	Fail	Fail	Fail	Pass

Test Case ID	T29			
Test Case Description	Tomato leaf mold, multiple spots, one leaf, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Tomato Leaf Mold	Puccinia arenariae Fungi (Most Likely)	Coleus nutrient - deficiency	This plant looks healthy!
Test Case Result	Pass	Fail	Fail	Fail

Test Case ID	T30			
Test Case Description	Tomato leaf mold, multiple spots, one plant, birds-eye view, high clarity and light			
App Name	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis

Test Case Input				
Performed By	Tejas Kulkarni	Nathan Kim	Mitchell Sayer	Umesh Singh
Execution Date	10/22/2023	10/22/2023	10/22/2023	10/22/2023
Expected Result	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold	Tomato Leaf Mold
Actual Result	Strawberry Leaf Scorch	Groundcherry Fungi (Most Likely)	Physalis - Bacteria	This plant looks healthy!
Test Case Result	Fail	Fail	Fail	Fail

3.3 Test Case Analysis

3.3.1 Overall Test Case Results

Test Results Summary				
Total	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Pass Rate	16/30	6/30	9/30	14/30
Pass Percentage	53.3%	20%	30%	46.6%

Overall Test Case Result

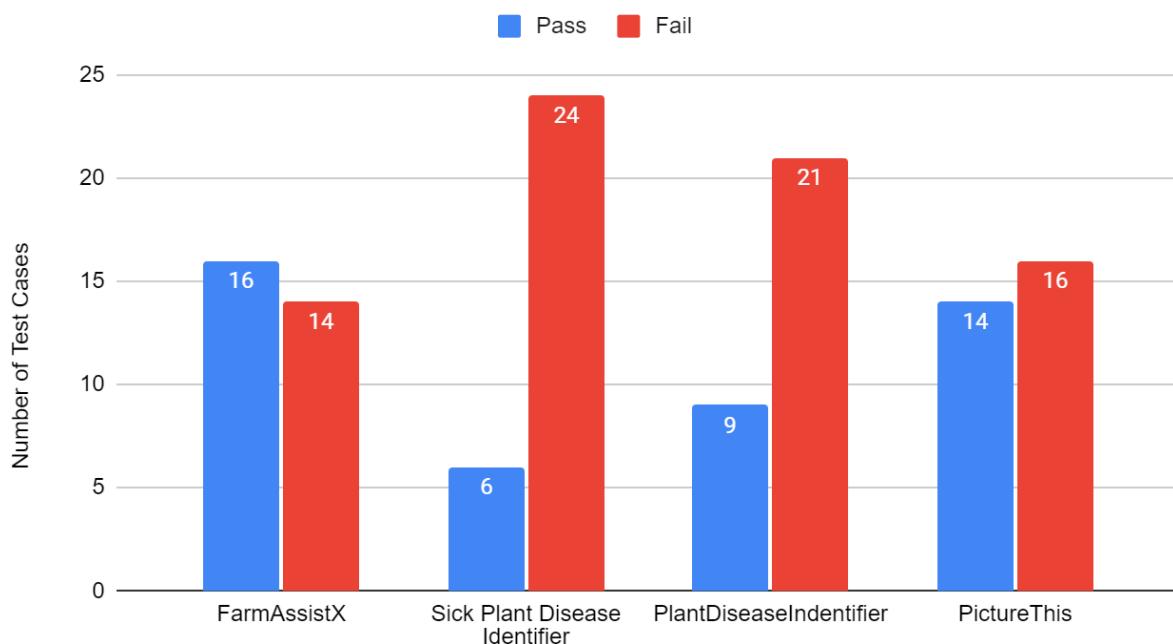


Figure 3.2 Overall Test Cases Results

3.3.2 Context and Input Test Case Results

Total	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Context Pass Percentage	80%	20%	30%	50%
Input Pass Percentage	40%	20%	30%	45%

Context and Input Test Case Result

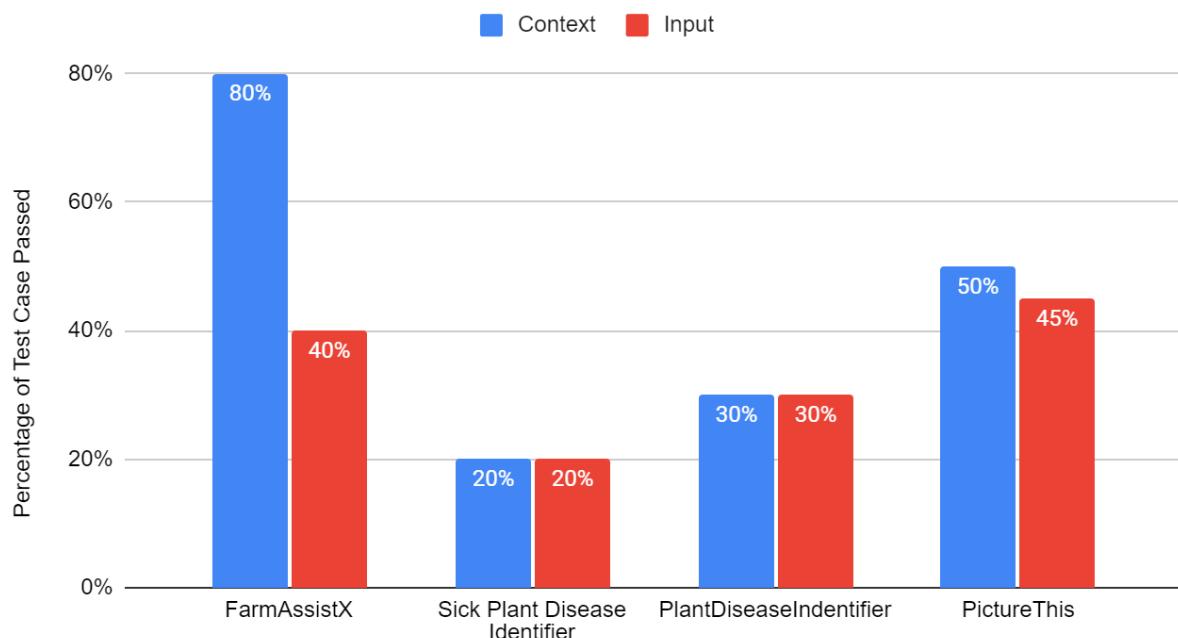


Figure 3.3 Context and Input Test Cases Result

3.3.3 Context Test Case Results

Context	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Background	2/2	0/2	0/2	2/2
Lighting	2/2	0/2	0/2	1/2
Angle	1/3	1/3	1/3	1/3
Clarity	3/3	1/3	2/3	1/3
Pass Percentage	80%	20%	30%	50%

Context Test Case Result

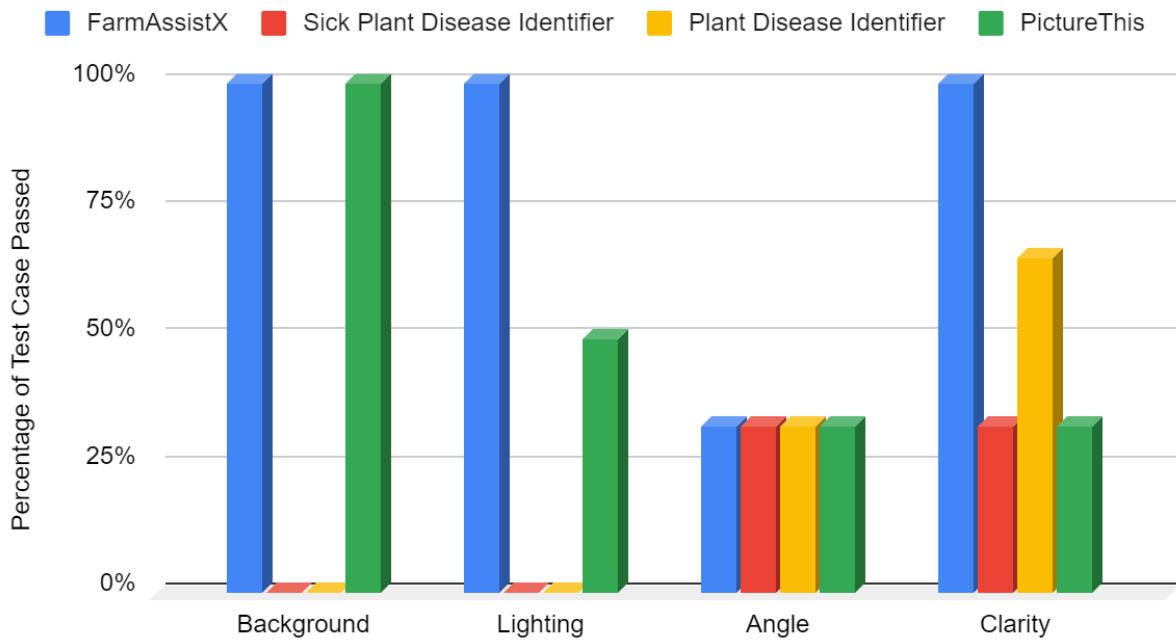


Figure 3.4 Context Test Case Result

3.3.4 Input Test Case Results

Input	FarmAssistX	Sick Plant Disease Identifier	PlantDiseaseIdentifier	PictureThis
Disease Effect Area	1/2	2/2	2/2	1/2
Plant Type	4/9	2/9	1/9	4/9
Occurrence	3/9	0/9	3/9	4/9
Pass Percentage	40%	20%	30%	45%

Input Test Case Result

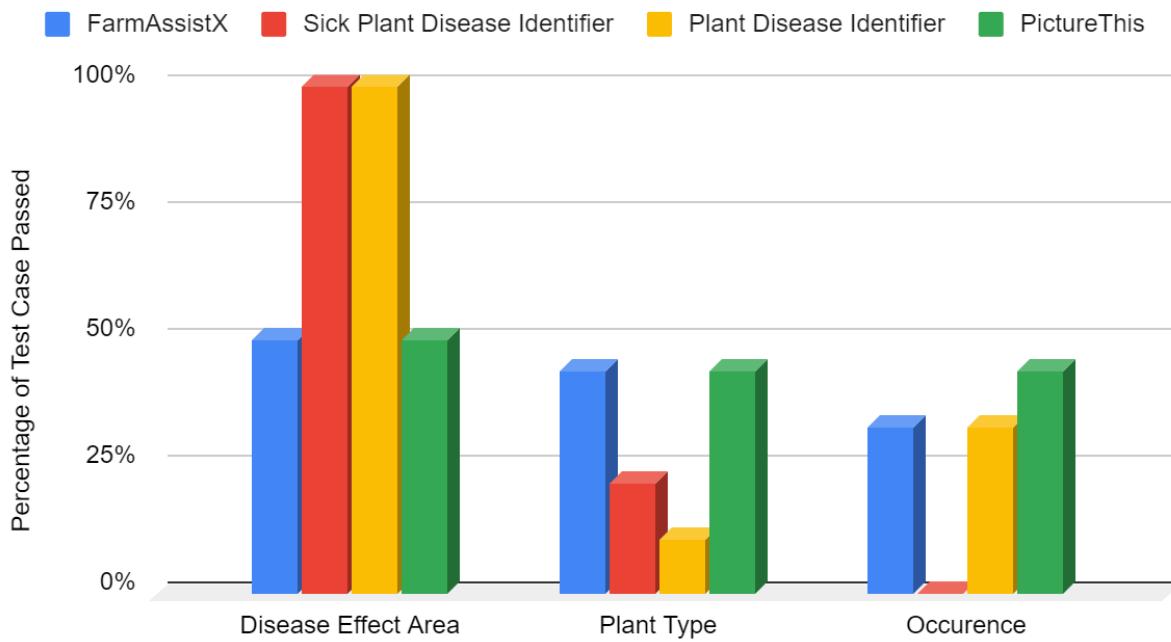


Figure 3.5 Input Test Case Result

Overall, from all the Input testing data collected, the PictureThis application performed the best compared to the other AI applications. It was able to correctly identify 50% (1/2) of the Disease Effect Area test cases and roughly 44% (4/9) of the Plant Type & Occurrence test cases.

The worst performer of all the AI applications was definitely the Sick Plant Disease Identifier application. Even though the application was able to identify 100% of the Disease Effect Area test cases (2/2), it was only able to correctly identify 22% (2/9) of the Plant Type test cases, and 0% (0/9) of the Occurrence test cases.

4. AI Function Test Results and Test Criteria

4.1 AI test model-based test results analysis

4.1.1 Test complexity

Initially testing began with conventional test methods, specifically scenario, equivalence partition, boundary value, and category partition tests. Each test was run on each of the 4 plant disease identification apps and the scores were recorded. For AI testing, the category partition method was expanded to include context information such as background, lighting, angle, and clarity as well as partitions for various plant qualities for the input images. Figure 4.1.1 below displays the count of completed test cases for each test method. Note that these test counts are a single test case applied to a single AI application.

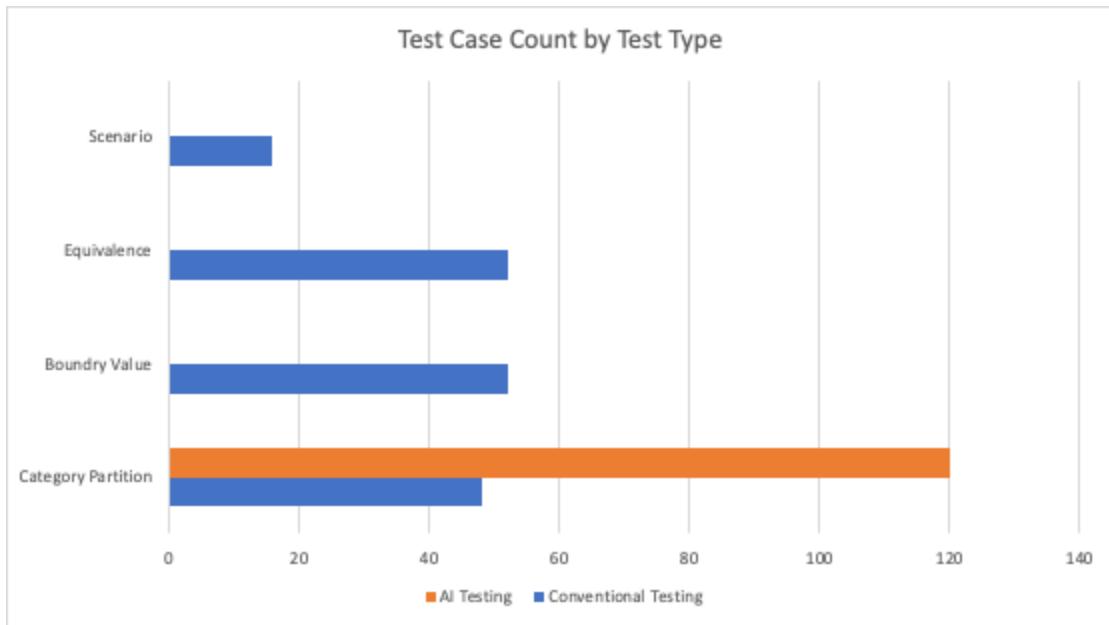


Figure 4.1 Comparison of test case

As can be seen in Figure 4.1, our group used a combination of both conventional and AI Testing techniques. Either of these styles of testing fell within 4 categories: Scenario Testing; Equivalence Testing; Boundary Value Testing; and Category Partition Testing. For the scenario Testing, Equivalence Testing, and the Boundary Value Testing categories only conventional testing was conducted. However, for AI Testing, Category Partitioning was primarily conducted.

Figure 4.2

4.1.2 Test result statistics

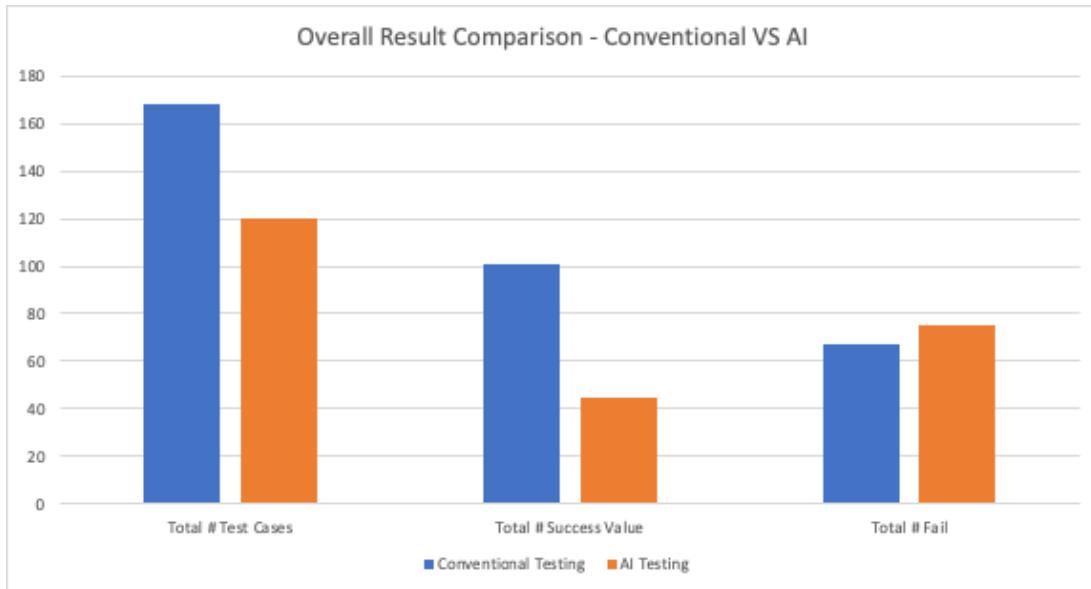


Figure 4.2 Overall Result Comparison - Conventional vs AI

As the figure above shows, our group used more test cases when using a more conventional testing approach as opposed to an AI testing approach. This can be seen in the significant difference between the total number of conventional test cases versus the total number of AI test cases graph above. Along with this, conventional testing yields more success value outputs and fewer failure outputs than AI testing techniques. As for the AI specific testing, which is broken down into the context and input category (in Figure 4.3), input testing was the preferred testing technique (with 80 total test cases). Input testing yielded more passes, as well as more failures than context testing (this is to be expected given only 40 context test cases were used).

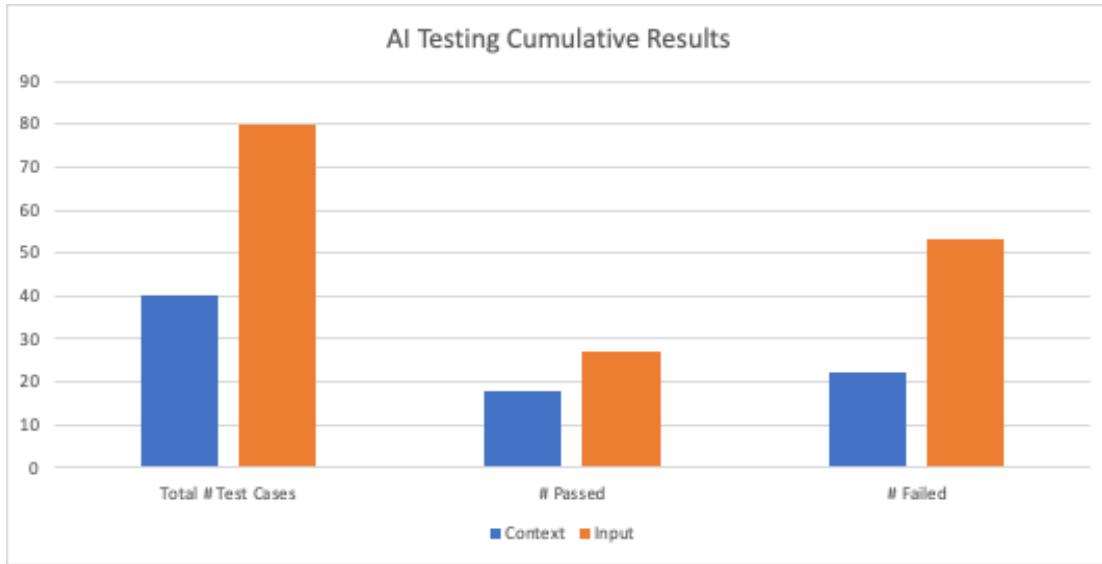


Figure 4.3 AI Test Result Summary

The AI Testing cumulative results graph above shows a similar resemblance in terms of accuracy for both context and input. While Input test cases were more in quantity, they saw a similar rate proportionally for both “Passed” and “Failed”

The findings show that overall the apps that were tested were not particularly effective and accurate. When looking at each of the application’s overall pass percentage (in section 3.3.4 Input Test Case Results) none of the applications scored above a 45% pass rate. Specifically, FarmAssistX has a 40% pass rate, Sick Plant Disease Identifier has a staggering 20% pass rate, PlantDiseaseIdentifier has a 30% pass rate, and PictureThis scored the highest with a 45% pass rate. There are multiple contributing factors as to why these applications performed so low (including poor lighting, angle of the photo, quality, etc.). However, even when presented with adequate photos, these applications still performed poorly.

4.2 AI Function Bug Analysis

4.2.1 Overall Bug Analysis

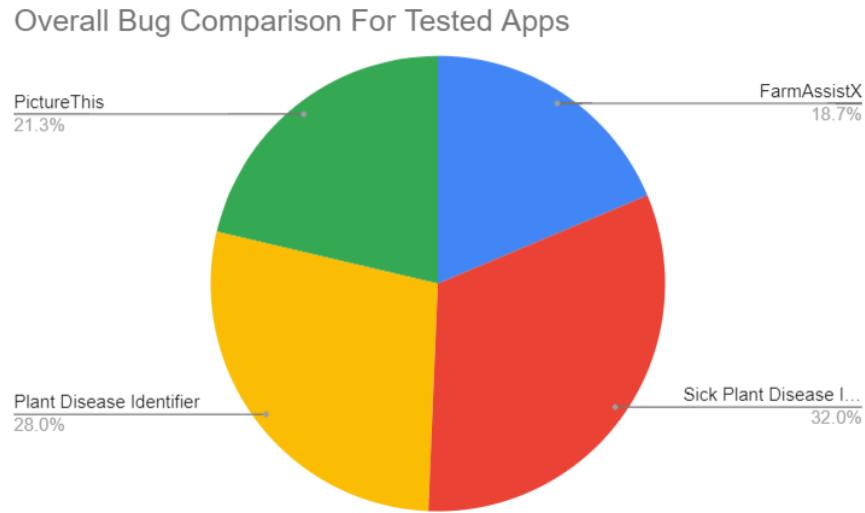


Figure 4.4 Overall Bug Comparison In All Tested Apps

A total of 30 test cases were conducted for each app. In terms of the occurrence of bugs and incorrect responses, the above pie chart highlights these values. Sick Plant Disease Identifier App was the buggiest with around 32% of all detected bugs. Next, we have Plant Disease Identifier at 28%, PictureThis at 21.3%, and FarmAssistX at the lowest bug rate at 18.7%.

4.2.2 Bug Analysis For Each Category



Figure 4.5 Bug Comparison For Each Category in All Tested Apps

4.2.2.1 Background

Sick Plant Disease Identifier and Plant Disease Identifier failed 2 tests in this category.

The app needs to make some changes in regards to how it detects the plant itself. While the disease detection may be fine, having a background that looks similar to the plant (green color) can throw the detection off.

4.2.2.2 Lighting

Both Sick Plant Disease Identifier and Plant Disease Identifier failed 2 test cases in this category once again. The PictureThis app failed 1 test case. Apps need to be able to detect plants and their diseases in various types of lighting situations, both Light and Dark. For the most part, situations where the lighting was dark seemed to give the message that no plant was detected, or that the plant had turned dark due to some disease.

4.2.2.3 Angle

All four apps failed two test cases in this category, this shows an alarming rate of failure in the birds-eye view test cases. Many farm plant detection involves taking aerial shots with a drone, and this may be a large source of error going forward. The apps should train in with multiple angles.

4.2.2.4 Clarity

Sick Plant Disease Identifier and PictureThis app both had 2 failed test cases. Plant Disease Identifier had 1 failed test case. FarmAssistX had no bugs. So, the other apps should improve to the standards of FarmAssistX.

4.2.2.5 Plant Type

As for the input test cases, the Sick Plant Disease Identifier saw 7 failed test cases, the Plant Disease Identifier saw 8 failed test cases, and both FarmAssistX and PictureThis saw 5 failed test cases. Failing the plant type is purely due to lack of training and variety of training.

4.2.2.6 Disease Effect Area

Both FarmAssistX and PictureThis have 1 failed test case. This is extremely good and goes to show that the passing apps have trained for plants with even a small speck of indication of disease.

4.2.2.7 Occurrence

Farm AssistX and Plant Disease Identifier see 6 failed test cases. Sick Plant Disease Identifier had 9 failed test cases, and PictureThis had 5 failed test cases. Occurrence is vital since one of the major use cases of this app is on a large scale such as on a farm. Training in various environments will help with this.

4.3 AI function test quality assessment

Our testing method is category partitioning testing. We conducted this by having several test cases for each app, and for each plant/plant disease. Specifically, the input and context criteria were divided into various partitions. Certain contexts and inputs saw an increased level of rarity such as plant age and birds-eye view. These were placed under the outlier categories.

4.3.1 Test Criteria

Each input and context mix gets tested at least once. There's always at least one test that shows when an input or context isn't right.

4.3.2 Test Coverage

All the input category partitions we classified were covered.

All the context category partitions we classified were covered.

All the output category partitions we classified were covered.