Team B3: Sproutly Final Presentation

Yuna Shin (Presenter),
Jana Armouti, Zara Mansoor

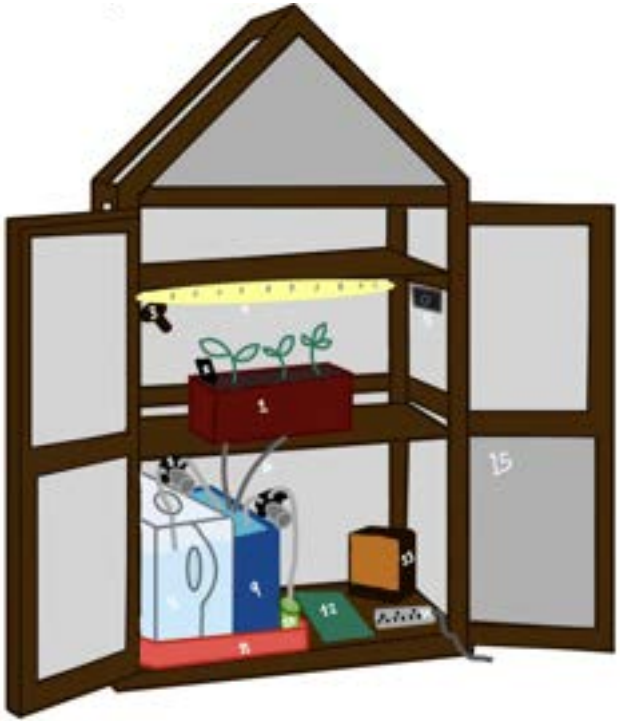
Use Case & Design Requirements

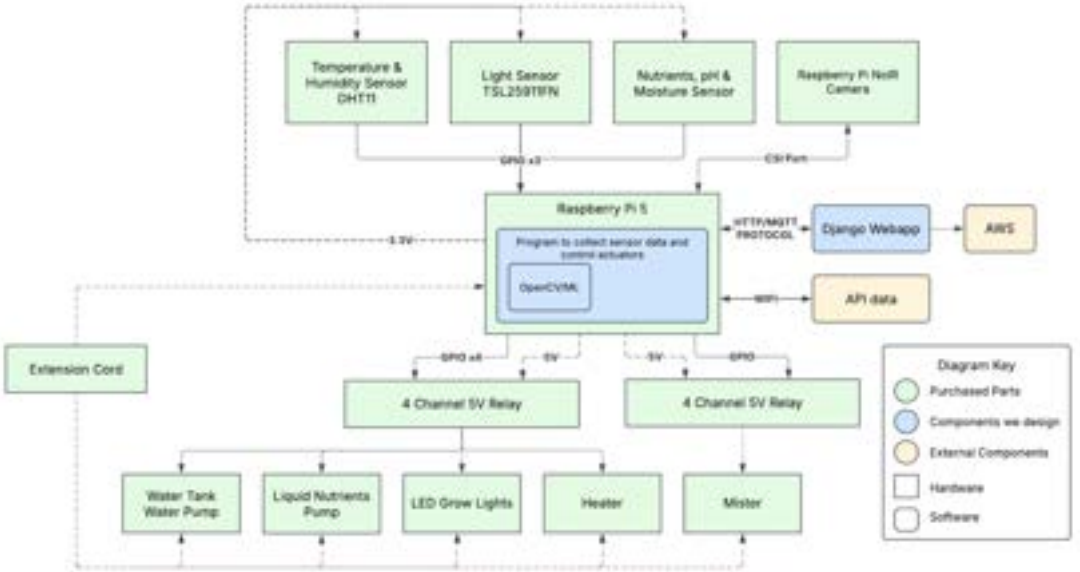
Use Case	Design Requirement	Quantitative
Real Time for User Experience (Sensor to Web Latency <5 sec)	Sensor to Web Latency	<5 sec
Accurate Control (within 10% of target)	Sensor Accuracy Actuator Accuracy Enclosed environment	±2°C/±5% ±2°C/±10% -
Quick Response (conditions reach target <1 hour)	Response Time Stabilization time	<1 min <1 hour
24/7 Live Streaming (latency <2 sec)	Streaming Latency Resolution FPS	<2 sec 1080p 1 fps

Use Case & Design Requirements - Continued

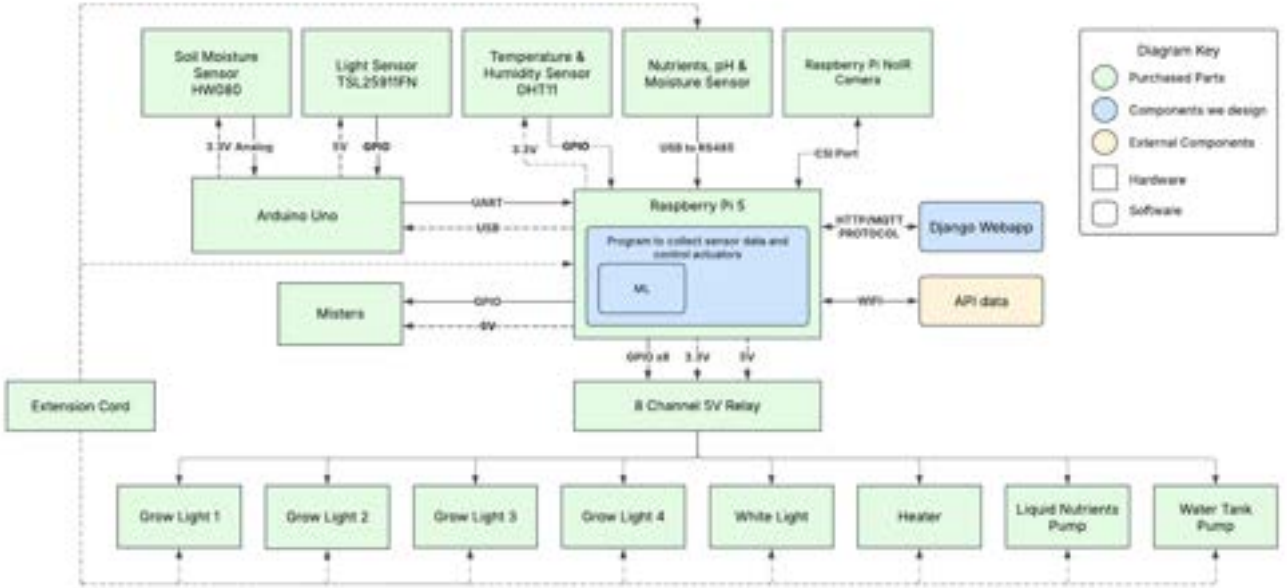
Use Case	Design Requirement	Quantitative
Health Classification (FPR <10%, FNR <5%)	FPR, FNR Accurate Data (Sensor & Image)	<10%, <5% -
Plant Classification (TPR >90%, Recall >90%)	TPR, Recall Good Quality Image Data	>90%, >90% -
Water Capacity (1 week without refill - 3 Plants)	Sufficient Water Supply for Irrigation + Mister	2.5 Gallons
General Functionality	Operating Temperature Range Soil Sensors IP Rating	10-31°C IP65+
Safety/Privacy	Separation of Electronics from Water Ventilation No images/videos stored	- - -

Solution Approach - Old



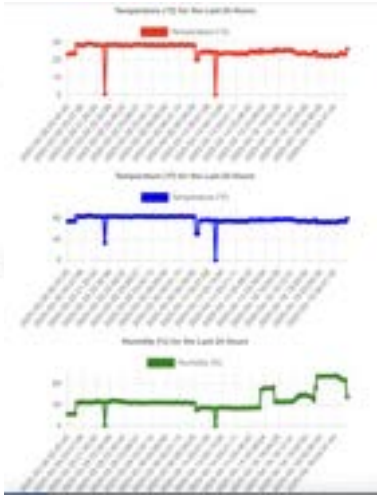


Solution Approach - Updated



Complete Solution

- Add and edit plants on webapp
- Show current state of the greenhouse and turn on/off actuators
- Greenhouse will adjust to automatic schedule setting or manual control



Testing Plans

	Testing Method	Metrics
Sensor Accuracy	Compare sensor to reference values	Accuracy: ±5%
Real-Time Data	Measure web app input time from RPi	Sensor-Web latency: <5 sec
Actuator Control	Measure time from target set to actuator response Monitor every 10 min until target reached	Accuracy: ±10% Response: <1 minute Stabilization: <1 hour
Camera	Measure video latency using software tool Monitor feed quality	Latency: <2 seconds Quality: 1080p at 1fps

Testing Plans (continued)

	Testing Method	Metrics
Species Classification	Test multiple images of 14 plants across 4 species	True positive rate: >90% Recall: >90%
Health Classification	Test data from plants across 4 species	False positive rate: <10% False negative rate: <5%
Web App User Experience	Users rate 1-5 on ease of use, design, functionality, performance	Average per category: >4
Durability	Monitor components for overheating or rust	Function without failure or overheating (>50°C)

Testing Results - Hardware

	Testing Method	Results
Sensor latency	Send data from hardware to webapp Calculate difference between timestamps	Sensor-Web latency (rpi): 0.5s Sensor-Web latency (arduino): 2.8s
Sensor accuracy	Compare sensor values to calibrated instruments Compare sensor value to actuator response	Accuracy: ±1.51% Data collection frequency: ~1 min
Actuator accuracy	Compare set values to recorded values after stabilization	To Be Tested
Actuator stabilization time	Measure time from target set to actuator response Monitor every 10 min until target reached	To Be Tested

Testing Results - Identification & Health Classification

Collected image and sensor data of 14 plants from 4 species over 10 days (~500 data points)

	Method	Metrics	Results
Species Classification	Test our image data	TPR: >90% Recall: >90%	TPR: 100% Recall: 100%
Health - Image Model	Test online image data	FPR: <10% FNR: <5%	FPR: 8.24% FNR: 3.47%
Health - Sensor Model	Test online sensor data	FPR: <10% FNR: <5%	FPR: 6.67% FNR: 2.22%
Health - Late Fusion Model	Test our image and sensor data	FPR: <10% FNR: <5%	FPR: 4.90% FNR: 7.27%
Live Streaming Latency	Compare timestamps of frame capture vs web app display	<2 seconds	1.950 seconds

Testing Results - Trade-Offs

Design Trade-Off	Reasoning	Impact
Sensor Latency	Added Arduino for sensor interfacing (initially only RPi)	**Increased latency** (~2.3s), but improved system stability and modularity
Image Model	Chose ResNet18 over deeper (ResNet50) or lighter (MobileNet) alternatives	Faster inference on edge device with good accuracy
Plant Diversity	Limited testing to 4 species due to time and dataset constraints	ML model generalizability to unseen species is unknown
Data Collection Frequency	Changed from once per second to once per minute to reduce overhead and memory usage	Less data processing load

Project Management

Zara

Sensors:
- Temperature/Humidity
- Light Sensor
- Soil Moisture
- Soil pH/Nutrients

Controls:
- Heater
- Water/Nutrients Pump

Automatic Control Logic

Web Scraping for Ideal Conditions

Yuna

Web Application Development:
- User Interface
- Manage Plants
- View Real-Time Data
- Notifications for Plant Health

Manual Control via web application

RPi-WebApp Communication

Jana

Machine Learning:
- Sensor & Image Data Collection
- Health Classification

Plant Species API

Camera Setup

Controls:
- LED Grow Lights
- Mister

Schedule - Updated