



Team E3 | Graduating Gardeners

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Use case

- ❖ Create a gardening environment at home
- ❖ Automate conditions
 - Lighting, temperature, soil moisture
 - Specific to plant species
 - Option for manual control
- ❖ Detects growth status and defects
- ❖ Monitor plants live

Areas covered: Software, Hardware



Requirements (Hardware)

Component	Requirement
Soil Moisture	Maintain target soil moisture with $\pm 5\%$ range
Temperature	Maintain target temperature with $\pm 5\%$ range
Light Intensity	Maintain light between compensation point and saturation point
Speed of Adjustment	If changes made, new target reached within 1 hour

Requirements (CV, Software)

Component	Requirement
Growth Stage and Defect Detector	Detect bending of vines/ stems, defects, Classify growth stages (germination, sprouting, harvest)
Automation of Maintenance	Based on type of plants and external variables, algorithm adjusts greenhouse to ideal conditions
User Information	Account securely mapped to greenhouse
Live Stream	Day and night vision Wide field of view 24/7 real-time monitoring
Alert / Notification	User receives alerts/ notifications through web app. on status of plant

Technical Challenges (Hardware)

- ❖ Keep response time low between hardware + software
 - Hardware -> Cloud database -> Software
- ❖ Construct feedback loop without overshoot / taking too long
- ❖ Confine system within the greenhouse
- ❖ Maintain reliable connection between hardware + software

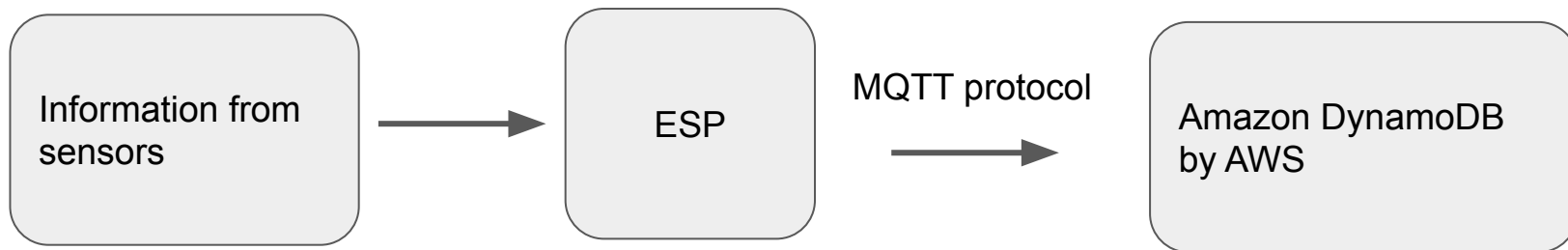
Technical Challenges (Software)

- ❖ Detect defects of the plants when defected part covered
- ❖ False negatives of growth stages and defects
- ❖ Different conditions for different types of plants
- ❖ Website being slow and laggy

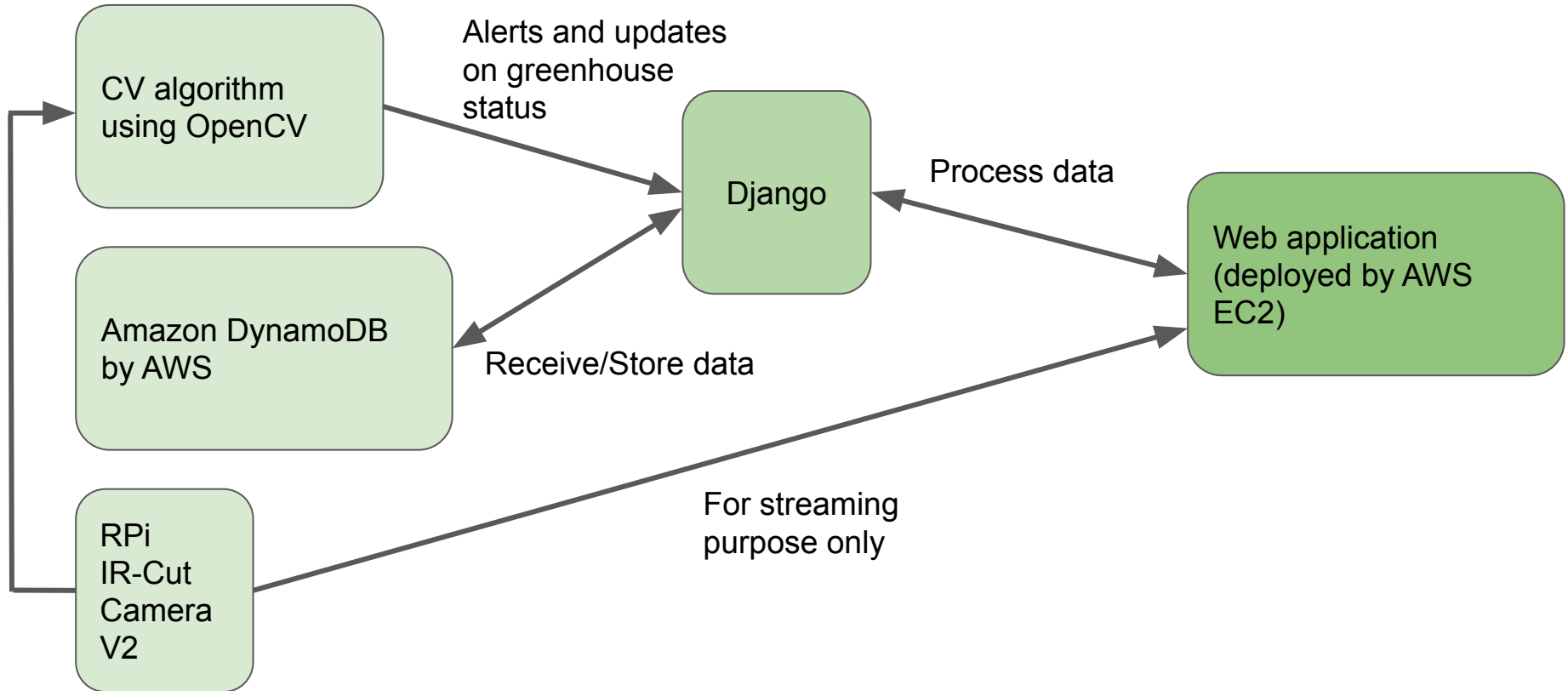


Solution Approach (Hardware)

- ❖ Rotating camera / Install 2~3 cameras
- ❖ Sensors connected to ESP32
- ❖ “SMART” water irrigation system for houseplants



Solution Approach (Software)



Testing, Verification and Metrics (Hardware)

Functionality	Testing Strategy	Metrics
Temperature	Place in <45°F and >75°F	Reach 55 - 65°F within 1 hour
Lighting	Place in dark/sunlight	Lights turns on in dark, stays off in sunlight
Watering	Test sensor with dry/saturated soil	Waters dry soil within 1 hour, does not water saturated soil
Sensor Data Transmission	Modify greenhouse conditions	Adjust conditions within 1 hour Web application notified < 1 minute

Testing, Verification and Metrics (Software)

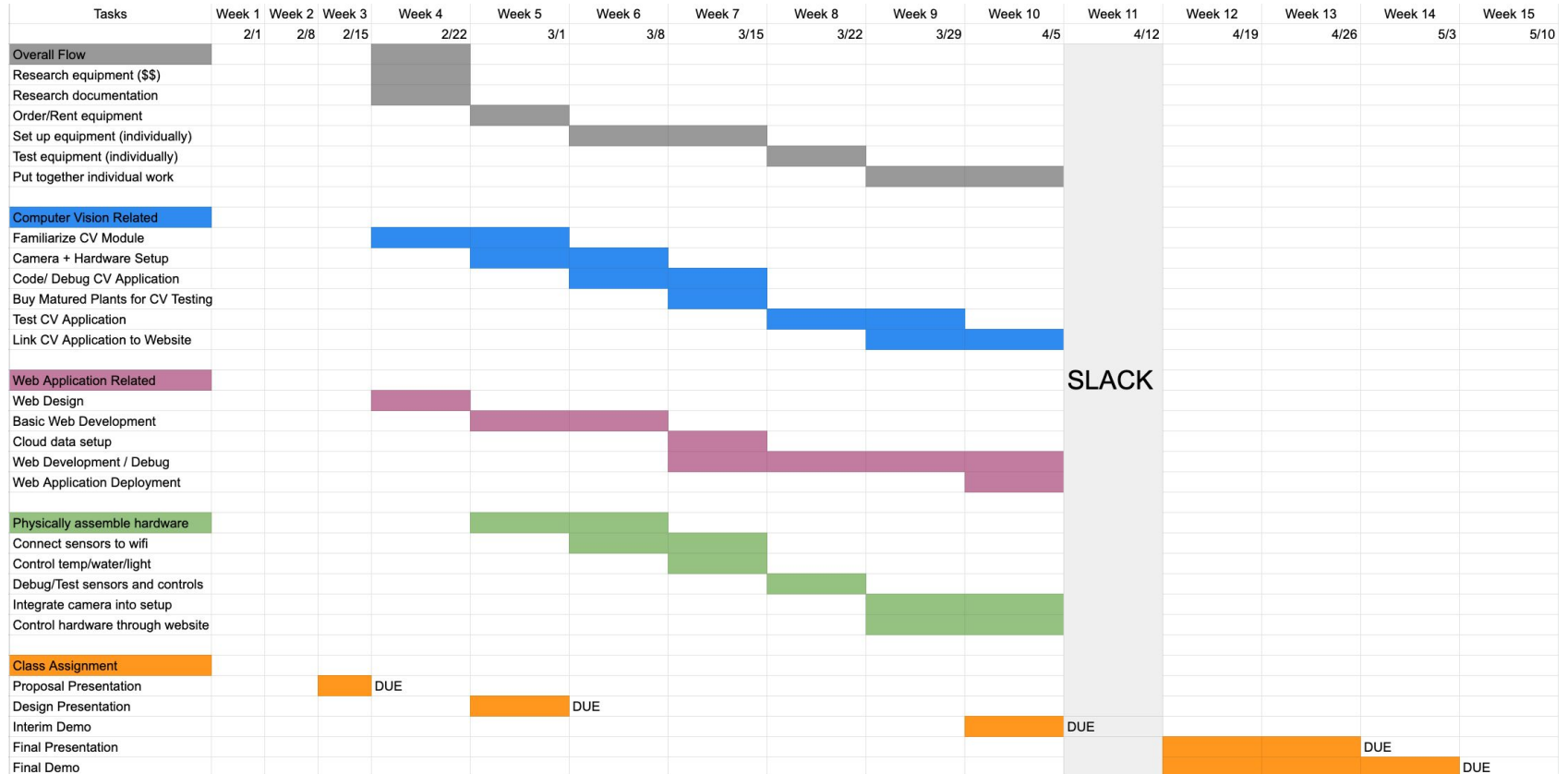
Functionality	Testing Strategy	Metrics
Defect/ Growth Stage Detection	Control vs. experimental group of discolored plants Bend vines Capture growth of pea shoots	False positive <10% False negatives <5% Vines bending >45° from stem Classifying growth stages >= 90% accuracy
Video Streaming	Software tools that measure video and network latency	Latency <= 10 seconds, Ideally <= 5 seconds
Web UI	Get random users to navigate through the web app.	The tester flawlessly and intuitively navigate through website
Data Transmission from Web App. to Greenhouse	Record time for hardware to receive commands from web app.	Hardware receives information from web app./ user < 1 minute

Tasks and Divisions of Labor

Hiroko	Sarah	Kanon
Assemble hardware	Computer Vision Application	Web Application Development
Connect devices/sensors to wifi	Detecting growth stages, defects, or misgrowth	Cloud database setup (AWS)
Watering, heating, and lighting system	Alert system on the status or urgency of plants	Receive/Send data from/to hardware to/from software
Integrate moving camera into hardware	Integrate live stream of camera onto web application	Help with hardware

Schedule

Sarah	Blue
Kanon	Purple
Hiroko	Green
Everyone	Grey
Class Assignments	Orange



SLACK

DUE

DUE

DUE

DUE

DUE