

EE/CprE/SE 492 Weekly Report

1/29 - 2/7, 2026

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AI Integrated Drone for Smart Crop Health and Growth Monitoring

Faculty Advisor/Client: Md Maruf Ahamed

Team Members:

- Jongmin Lee, jongminl@iastate.edu - Frontend/AI
- Z Harvey, zdharvey@iastate.edu - Frontend/Backend
- Andres Lopez, andresl4@iastate.edu - Hardware/Firmware
- Alex Pallan, apallan@iastate.edu - Cloud/Security
- Camden Senneff, csenneff@iastate.edu - Frontend/Drone SW
- Caleb Zea, calebzea@iastate.edu - Frontend/Backend
- Srdan Kopunovic, srdank@iastate.edu - Backend/Cloud

Summary of Work:

The team implemented and refactored frontend and backend systems for efficient data and image transfer, began integrating AWS Amplify with Cognito for authentication, and configured CloudWatch, IAM roles, and Terraform-managed cloud resources. Drone development advanced with successful hardware assembly, resolution of communication protocol issues, improved Raspberry Pi builds, and new C++ functionality enabling microSD-based data exchange. On the AI side, a YOLOv8 Nano model was successfully trained with strong overall performance and a working real-time inference demo, though disease detection remains an area for improvement. The document also outlines upcoming action items for each team member, ongoing challenges such as merge conflicts, Amplify integration issues, Terraform inconsistencies, and dataset limitations, and identifies key technical risks that will guide next steps.

- Frontend
 - Implemented a controller and basic frontend view for data communication (flight plans, drone config, flight logs, images) between the drone and frontend over microSD.
 - Started researching AWS Amplify for ease of use in UI elements related to Authentication, as well as easy authentication implementation with the Cognito backend
 - Refactored and re-commented all of the field creation logic and files to prepare for a large merge request.
- Backend
 - Refactored image API for handling image data transfer more efficiently

- Updated file based storage for a more structured flight image directory
 - Researched middleware configurations for handling user sessions
- Cloud
 - Created AWS amplify application with terraform code. This looks like it simplifies much of the process we had in mind for this application.
 - Configured and learned AWS CloudWatch for more reliable event detection and debugging
 - Started tinkering with roles and policies to give proper permissions to interact between AWS services
- Drone
 - Assembled the drone and got it powered on.
 - Discovered an issue with the protocols the controller and drone communicated with (our controller didn't actually work with ExpressLRS, despite listing it in the product description), so we ordered an ExpressLRS adapter and now they can communicate.
 - Created and merged in the C++ code that enables the drone to communicate flight plans, flight logs, analytics, and general configuration with the frontend over microSD.
 - Redid the Raspberry Pi build process so dependencies are properly linked.
- AI
 - Trained Prototype Model (YOLOv8): Successfully trained a YOLOv8 Nano model on the "Capstone-Maize-Growth-v2" dataset for 50 epochs.
 - Performance: Achieved an overall mAP@50 of 91.2%.
 - Accuracy by Class: Detection of Growth Stages 2, 4, and 5 is near-perfect (>98%). Stage 1 (Seedling) is reliable at 91%.
 - Developed Inference Demo: Created a local Python application using Streamlit to perform a real-time demo with the trained model. This serves as the initial proof-of-concept for the Vision subsystem's user interface.

Plans for Coming Week + Action Items:

- Jongmin Lee -
 - Investigation of "Unhealthy" Class: The model currently struggles with disease detection (63% accuracy). I plan to investigate whether this is due to image resolution (small features disappearing) and test whether higher-resolution photos from the drone camera improve performance.
 - Research on more data that's aligned with our needs. Plus, research on data augmentation techniques is necessary for our current dataset, and I need to determine how to convert this visual phase into the V-R Scale.
- Z Harvey -. Create a merge request for a large chunk of the frontend implementation, then develop frontend pages for image capture and display from the drone and pages to display and store/select multiple fields per user.
- Andres Lopez - Gonna finish implementing camera by writing whats in memory into the SD card and perhaps getting a user input snapshot of an image. Start flying the drone too
- Alex Pallan - Figure out why the terraform didn't recreate the AWS resources when they were manually destroyed. Also getting the current iteration of the web app up and running and accessible (with or without authentication) is the main goal for me for this week.
- Camden Senneff -
 - Perform the first drone flight with just the controller.
 - Create models and 3D print the adapters that will mount the Raspberry Pi and camera to the drone. I've found models for the drone and camera online which should make this easier.
 - Once the Pi and camera are attached, work with Andres to wire up the Pi to the drone FC's 5v power with a switch, connect the camera, and wire up the TX and RX lines for MSPv2 UART communication between the drone and FC.
- Caleb Zea -
 - Continue Amplify research
 - Try to get a working connection between a test Amplify branch and the working backend

- Srdan Kopunovic -
 - Complete refactor for image API, test local version, and test deployed version
 - Incorporate unit tests for updated API and Service functions
 - Create end-to-end tests for >70% code coverage for backend system
 - Test frontend-backend communication with session tokens to ensure Amplify has been incorporated properly
 - Move manual API tests from Postman platform to alternative (tbd.)

Pending Issues:

- Jongmin Lee
 - V-R Stage Granularity: A key finding this week is that our current dataset labels corn by "Visual Phase" (Stage 1–5), which is broader than the precise "Biological Stage" (V6, R1, etc.). We will likely use this model as a Phase Estimator to give a general growth report.
 - Disease Detection Reliability: The "Unhealthy Leaf" detection is currently too weak (63%) to be reliable. Since we are using static photos, we may be able to improve this by tiling large images or training on higher-resolution crops in the next iteration.
- Z Harvey
 - Struggling with hundreds of merge conflicts to sift through. Additionally stuck on how to show preview of images without taking the time to load the full image for the image capture and display frontend. Might use AI to downscale the images.
- Andres Lopez
 - Need to understand this libcamera library for the camera of the drone. Seems to be easy to work with but handling a user event has been confusing me. We are running out of memory? I don't know we'll figure that out soon
- Alex Pallan
 - Terraform didn't recreate identity and user pools when re-ran
 - The web app is only displaying the main blank page for the front end
 - Authentication isn't working with AWS Amplify
- Camden Senneff
 - First drone flight is pending – we need to flash new firmware to the drone to get the MSPv2 protocol we need to communicate with the Raspberry Pi running.

- It's somewhat difficult to find good locations to mount the Pi and camera given how compact the drone is, but we have a few ideas that should work that we'll try.
- Caleb Zea
 - Unfamiliar with Amplify, the documentation for trying to implement it into a pre-existing project is sparse
 - The test users have been accidentally deleted while trying to create the Amplify IAM user
- Srdan Kopunovic
 - Understand what changes will be needed on the backend to adjust for frontend changes made due to Amplify
 - Configure AWS platform to test API response time

Individual Contributions:

Team Member	Contribution	Week Hours	Total Hours
Jongmin Lee	Trained initial corn growth prototype (50 epochs), achieving 91.2% mAP accuracy. Built a local Streamlit dashboard for immediate post-flight batch inference and visualization. Analyzed dataset limitations regarding biological V-R stages vs. visual phases and proposed "Phase Filter" mitigation strategy.	13	13
Z Harvey	Worked through merge conflicts while refactoring to create a large merge request for field creation functionality. Additionally, the free trial ran out for the Google Maps JavaScript API, so I re-setup our Google Cloud to prepare to pay (small amounts) for the remainder of the semester to use the API that is critical for the function of our app. Started early development on picture retrieval and display pages for the frontend.	6	6
Andres Lopez	The DE-SODR extractor was utilized after the unfortunate Pi that ETG handed over to us but it was a mistake of my own decisions. Looked into how the Pi is going to be build with the drone. Mainly fixed camera code and actually tested it after so long.	9	9
Alex Pallan	Added AWS Amplify infrastructure to the account using terraform, along with some role and policy configuration.	8	8
Camden Senneff	<i>(from the start of the semester)</i> Implemented drone communication in frontend/drone software, plus later patch to fix build Worked with Andres on first drone boot, controller pairing, Pi GPIO desoldering, Pi setup, camera testing Planned and started working on drone Pi/camera mounts Overhauled drone software build process and CI	27	27
Caleb Zea	AWS Amplify research. Attempted to add an Amplify IAM user using Terraform	3	3
Srdan Kopunovic	Continued refactoring image API, changing from an array request to individual image requests with the goal of making it more scalable and adjustable. Started migrating from Postman platform to alternative for manual API testing. Set up architecture for end-to-end tests.	8	8