

EE/CprE/SE 492 Weekly Report

2/19 - 2/26, 2026

sdmay26-20

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:

- Frontend
 - Integrated $\frac{2}{3}$ of all needed frontend API checks
 - Configured API checks to validate the user using the cached JWT for user data security
 - Created field selection and confirmation pages
 - Field persistence works per session, but is not tied to the backend yet
 - Field changes are full integrated with the main branch and have light & dark mode functionality
 - Refactored frontend code to put styles in css files and general bug fixes
- Backend
 - Tested recently created image API to ensure proper transfer and image archiving
 - Explored different storage approaches for easier retrieval
 - Started overall API refactor in order to maintain consistency to allow frontend better data retrieval
- Cloud
 - Reconfigured the Cognito identity pool to properly accommodate federated user authentication
 - Terraform changes to accommodate federated user authentication
- Drone
 - Finalized and printed drone mounts, and mounted the Pi and the camera to the drone.
 - Connected and developed a controller for a status LED on the Pi that will be used to indicate when the drone is connected and ready for takeoff.



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- Image data is accessible and written into storage however it is not organized into images and still YUV 4:2:0.
- AI
 - Acquired and validated the G2F dataset (temporal RGB drone imagery).
 - Evaluated flight altitude resolution and determined precise V-R stage leaf counting is not feasible at 25m (about 80ft), necessitating a pivot to estimating Fractional Canopy Cover.
 - Developed a programmatic data pipeline (auto_labler.py) to eliminate manual labeling.
 - Implemented computer vision algorithms to automatically slice and sort orthomosaics into 6 distinct YOLO-ready growth stages based on plant biology.
 - Excess Green (ExG) Index: Applied the ExG mathematical formula $(2 * \text{Green} - \text{Red} - \text{Blue})$ to accurately calculate fractional canopy cover by isolating green plant pixels from bare soil.
 - HSV (Hue, Saturation, Value) Color-Space: Utilized HSV mapping to detect late-stage biological markers like yellow tassels, brown crop dry-down. HSV was chosen over standard RGB because it separates true color from sunlight or shadows and making outdoor imagery processing significantly more robust.

Plans for Coming Week + Action Items:

- Jongmin Lee - Plan to deploy automated labeling script (auto_labeler.py) to the Nova cluster, which will allow processing the massive scale of the G2F dataset efficiently without being limited by local hardware bottlenecks. Once deployed, I will focus on calibrating the HSV color thresholds using late-season flight data to accurately capture the Tesseling and Senescence growth stages. Plus, I will generate the complete, auto-labeled training dataset and initiate the YOLOv8 model training on the cluster's GPU nodes. For the last, merge the frontend nav-bar I've worked on into the main branch.
- Z Harvey - Finish Field persistence and API connection with backend. Will allow the user to save, select, and store fields that they create and it will be tied to users.
- Andres Lopez - Fix code to write different images to its own file and then try to use matlab command yuv2rgb to see if the image is even right, if it is then it is done however if corrupted going to write a way to sort the pixel data so it can be converted into rgb. If that is completed by the week then start to implement MSP commands between raspberry pi and flight controller. Some legal stuff idk.
- Alex Pallan - Finish the design of our poster, including layout and information. I also plan to review any other deliverables we will have for this semester so that we can present our project properly. Additionally, starting work on an EC2 container in AWS to house the backend API (or a similar alternative).
- Camden Senneff - With the team, decide on the height above the field the drone should fly at, then put in the order for the lens that will be able to handle that height best. Make sure we submit all of the necessary paperwork to ISU to allow us to begin performing autonomous tests with the main flight loop. Attempting to implement SITL (Software in the Loop) simulation of our drone software through INAV and X-Plane – will require implementing a mock TCP UART interface.
- Caleb Zea - Finish API calls, currently only need to PUT/POST location data, but running into new error formats (likely because the field is an array of locations). Make sure we can pass images through these API calls as well, and that they will transfer correctly
- Srdan Kopunovic - Need to complete the file saving and pathing format to figure out the best system so it is more approachable for the frontend. Need to meet with the frontend part of the team to go over which API's need to be re-done for better consistency and what needs to be added to better help the app retrieve data.

Pending Issues:

- Jongmin Lee
 - Our automated labeler relies on baseline color thresholds that still require precise calibration for late-season data. Specifically, we need to test the script against actual July and August drone imagery to finalize the exact color ranges for identifying tasseling and crop dry-down under real-world lightning conditions before we can generate the final dataset.
- Z Harvey
 - Nothing right now
- Andres Lopez
 - Fix code to write image data into each file, look into if the image is stored in a correct format or if need to rewrite order, fly drone legally.
- Alex Pallan
 - Nothing from AWS/Terraform standpoint, but in the future when the API is complete containerizing that will become an issue, but isn't yet
- Camden Senneff
 - Ordering a new lens (so it sits properly in the mount and reduces the weight) requires that we finalize the flying height now for proper focus. We need to make sure that we're able to get the level of detail we need for whatever we choose.
- Caleb Zea
 - API errors regarding trying to PUT and POST location data, likely just need trial and error to find the correct format
- Srdan Kopunovic
 - Figure out which API's need refactored to improve consistency across the whole data transfer system, as well as what requests to add in order to allow the frontend for a smoother and more efficient data exchange.

Individual Contributions:

Team Member	Contribution	Week Hours	Total Hours
Jongmin Lee	Investigated public agricultural drone datasets and acquired the G2F Texas 2017 - 2019 UAV dataset. Analyzed the imagery, identified physical resolution limitations for precise V-stage detection at standard altitudes, and pivot strategy to utilize Fractional Canopy Cover. Developed an automated data-labeling Python script that uses ExG and HSV computer vision algorithms to slice high-resolution orthomosaics and automatically sort them into YOLO-ready growth stage folders, bypassing the need for manual bounding boxes.	9	32
Z Harvey	Refactored our frontend files so styling is stored within a css file. Finished the merge of the main field functionality. General bug fixes with the frontend UI. Started implementation on field persistence for users. Currently fields are persistent through session. Implemented dark and light mode functionality for field screens.	12	25
Andres Lopez	Wrote code that now access the image data and added LED and code on the drone.	10	24
Alex Pallan	Worked on the poster design and layout for presenting our project at the end of the semester, reviewing others designs from previous semesters as well as the published outline. I plan to finish this in this upcoming week and I plan to review other deliverables for us.	5	20
Camden Senneff	Modeled the drone and camera in CAD to confirm mount fit, then finalized design. Exported and tuned to print with TPU, then printed them and installed the Pi and camera on the drone. Added status LED and wrote the controller code for it. Completed documenting required MSP flows so we can begin implementing the flight loop.	16	49
Caleb Zea	Extracting JWT from the current authenticated user's session, Terraform changes for federated user authentication, adding identity pool federated authentication role, frontend/backend API integration, merge request reviews	12	19
Srdan Kopunovic	Updated the existing API to handle images (both single object and array format), with an initial storage system. Explored potentially more efficient ways to save the images that would help keep the storage more understandable, as well as more efficient for retrieval. Arranged a meeting with frontend portion of the team with the goal of understanding which additional API calls would be helpful for more efficient data transfer	9	23

