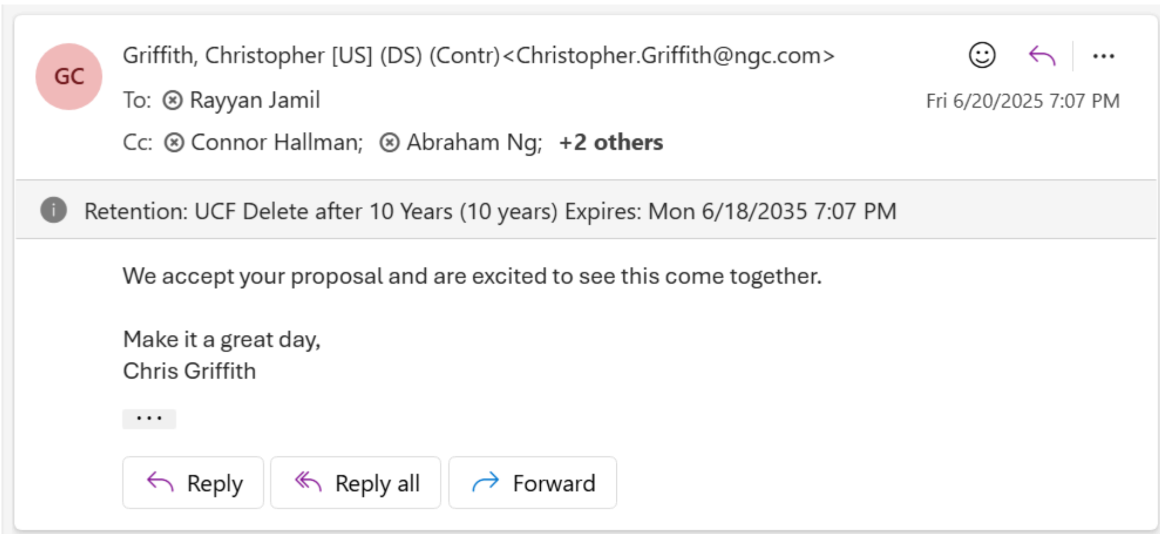
Early Status Report Assignment

Acceptance Email



GC

Griffith, Christopher [US] (DS) (Contr)<Christopher.Griffith@ngc.com>

To: Rayyan Jamil

Fri 6/20/2025 7:07 PM

Cc: Connor Hallman; Abraham Ng; **+2 others**

Retention: UCF Delete after 10 Years (10 years) Expires: Mon 6/18/2035 7:07 PM

We accept your proposal and are excited to see this come together.

Make it a great day,
Chris Griffith

...

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The Minimal Viable Product

The minimum viable product (deliverable) for our group project might be best described as “a system of drones (2+) that can autonomously scan a three-dimensional environment and create a virtual version of that environment”. An example use case of this would be improving Google Maps to be three-dimensional, not limited to street view. This project would let people view objects from any height or angle.

A React dashboard is also a core part of the minimum viable product, but there are no hard requirements for it from our sponsor, beyond a bare minimum of being able to monitor the drones. One of our potential stretch goals would be to have the dashboard show the virtual environment being created in real time. Another stretch goal would be for the human user of the dashboard to be able to tell the drones how to prioritize points of interest, or even to take over the drones with manual control.

We have also come up with additional potential stretch goals. One such idea would be a three-dimensional difference-finding algorithm, where if the drones performed two scans of the same field at different times, the algorithm would be able to determine what objects had been moved, added, rotated, or removed. Another stretch goal would be to optimize how the drones interact. Initially, we will have the two drones just work on the different sections of the environment at a time. We could however optimize this to be more efficient by having the drones interact or communicate in some way on top of their autonomous scanning.

Progress And Accomplishments To Date

Our team has made significant progress so far, particularly in research and setting up the necessary tools for development. We started by examining how drones are able to fly autonomously and scan real-world environments. We then looked into both pre-built drones like the DJI Tello and more customizable options that would work with Robot Operating Systems (ROS) in order to see what design fits our goals the best.

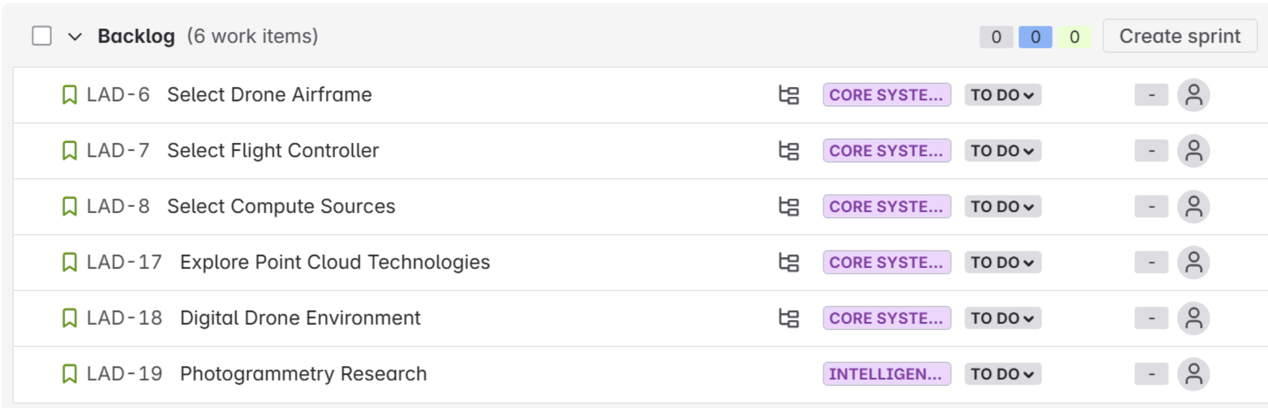
We also researched how to create a digital twin: a virtual version of a real place. For this, we plan to use Unity for the visualization platform and tools like COLMAP and Meshroom to be able to turn drone photos we receive into virtual models through photogrammetry.

On the AI side, we looked into different machine-learning models for object detection and classification in three-dimensional environments. We are currently looking at models like PointNet and CLIP-Point, which work with point cloud data, to help identify and label objects in the scanned area.

After defining our MVP, we proceeded to share it with our sponsor Chris, who then gave us his approval. We also received helpful feedback about the project's scope and expectations, which we are using to help guide us through the next stages of our project.

Lastly, we have set up our GitHub repository and created a task board in Jira to organize our progress. We have started documenting our setup so future work will be easier to manage. All of this puts us in a good position to begin with the development of our project and to make our upcoming sprints run more smoothly.

Sprint Backlog



Sprint Map / AGILE Overview

Our backlog provides a structured overview of the work required for the autonomous drone project. It is primarily organized around five core Epics, which represent major functional areas: "Core System Infrastructure & Hardware Integration" (LAD-5), "Real-time Monitoring Dashboard" (LAD-4), "Agentic AI & LLM Interface" (LAD-3), "Intelligent Object Detection" (LAD-2), and "Autonomous Drone Navigation & Control" (LAD-1). These Epics serve as the high-level goals for our development efforts.

Within these Epics, work is defined as Stories (indicated by the flag icon). We have several key Stories including "Digital Drone Environment" (LAD-18), "Explore Unity Platform" (LAD-20), "Explore Point Cloud Technologies" (LAD-17), "Select Compute Sources" (LAD-8), "Select Flight Controller" (LAD-7), "Select Drone Airframe" (LAD-6), and "Photogrammetry Research" (LAD-19). These Stories represent specific deliverables or research areas contributing to our Epics.

The Stories are further broken down into detailed Subtasks. For example, the "Select Flight Controller" Story (LAD-7) has multiple defined subtasks: "Identify Candidate Flight Controllers" (LAD-13), "Investigate Communication Protocols" (LAD-14), "Propose Selection and Justification" (LAD-15), and "Peer Review Controller and Finalize in Design Docs" (LAD-16). Similarly, "Explore Point Cloud Technologies" (LAD-17) includes the subtask "Software to convert mesh/3D data to PC data" (LAD-22), and "Select Compute Sources"

(LAD-8) contains the subtask "Explore Jetson Platform" (LAD-21). Crucially, the "Select Drone Airframe" Story (LAD-6) also has several subtasks: "Define Airframe Requirements" (LAD-9), "Identify Candidate Airframes" (LAD-10), "Propose Selection and Justification" (LAD-11), and "Peer Review Airframe and Finalize in Design Documents" (LAD-12).

June: Foundational Research, Component Selection, and Overall Design

Our main focus will be (and has been so far) on conducting technical research into the various aspects of our project, including but not limited to drones, Unity, point clouds, flight controllers, and photogrammetry.

For June Sprint 1, which will be the only one this month as we are starting it this week, we will be primarily completing project research, now that we have been able to define a clearer minimum viable product. On the hardware side, we will work on identifying potential drone candidates, and we will investigate communication protocols for flight controllers. On the software side, we will look into photogrammetry, specifically the reconstruction of a three-dimensional model based on multiple pictures from different angles. We will look into rendering point cloud data in Unity for a virtual environment in which we can conduct machine learning. We will explore various back-end databases that are suitable for our project.

July: Hardware Finalization and Software Prototyping

Our priorities this month will be to select and set up key drone components as well as begin introductory programming for virtual environments, the real-time monitoring dashboard, and the photogrammetry pipeline.

During the first half of July, in July Sprint 1, we will evaluate proposals for drone airframes and select our final option after peer review. We will start working on our real-time monitoring dashboard through React, primarily the front-end logic. We will assess our database options and pick one with which to proceed. We will begin programming based on our research into converting from images to mesh data to point cloud data, alongside early Unity testing.

In the second half of July, during July Sprint 2, we will begin to work with the drones we have purchased, including firmware/software flashing. We will continue to develop our dashboard, working to integrate it with the other project components such as the database. We will attempt to build a proof-of-concept of the photogrammetry pipeline as we continue to work on point clouds and the Unity framework.

August: System Validation Through Unit And Integration Tests

August will be focused on pulling together our major subsystems toward getting a rudimentary working version of our minimum viable product. This month marks the beginning of the bulk of our unit testing and integration testing as we strive to complete each of the individual parts of the project, even if in a basic or partial state.

During the first half of August, in August Sprint 1, we will concentrate on making workable versions of our project components. Unit testing will be our main theme as we test basic image capture and flight controlling, validate communication protocols, process sample image data through the photogrammetry pipeline, render models in Unity, and examine the output via the real-time monitoring React dashboard.

In the second half of August, during August Sprint 2, we will work on testing our overall hardware and software components together through integration testing as we start to combine the pieces of our project. We will also work on simulated missions as we prepare for our first major end-to-end test the following month.

September: Data Acquisition and Building Our First Real Digital Twin

Our primary goal for this month is to make sure our drones are fully ready to actually start collecting data, and we also need to establish the foundational version of our digital twin. This means establishing the environment where all our collected data will eventually live.

During the first half of September, in September Sprint 1, our main focus will be on getting our drone hardware and software fully integrated. We'll make sure both drones are operational and ready for missions. This includes confirming the cameras feed data to the entry point of our data pipeline. Alongside this, we'll establish our digital twin environment by building the Unity space. This involves defining the real-world area our drones will map and making sure this digital space can accurately represent it. By the end of this sprint, the foundational digital twin should be in place, and the drones ready for initial flight tests.

In the second half of September, during September Sprint 2, we're implementing basic autonomous data collection. We'll develop and test initial autonomous flight paths for both drones. The goal is to get them to fly over our designated area and capture images reliably and consistently. We'll focus on repeatable flight patterns and high-quality, clear images. This is our first real test of the drones successfully collecting usable data. Following data collection, we'll set up the initial photogrammetry pipeline. Finally, to keep everything organized, we'll establish a system for basic data storage and management for all raw drone imagery and initial 3D model outputs. Additionally we'll start training our machine-learning models to identify objects using point cloud data. This includes configuring computer sources to handle the training. We'll begin with basic object recognition and focus on refining these classification models for better accuracy. We'll also start integrating vision language models for a richer understanding of object identification.

October: Data Processing, Smart Classification, and Dashboard Completion

As we move into October, our focus shifts to transforming raw information into something intelligent. We'll get our 3D models into point clouds and start to teach our system to identify objects.

During the first half of October, in October Sprint 1, we'll refine our photogrammetry processing and 3D model generation. We'll optimize the workflow to ensure drone images are efficiently and accurately converted into detailed 3D models, troubleshooting any quality issues. A major task in this sprint is implementing the 3D-to-point cloud conversion. We'll integrate converted point cloud data into our digital twin. This means successfully importing and rendering these data points in our Unity environment, ensuring they accurately represent the real-world space and make our digital twin look detailed.

In the second half of October, during October Sprint 2, we'll take our trained models and other classification software and add it near the end of the pipeline to generalize on the point clouds. Finally, we'll complete the real-time monitoring dashboard. This dashboard will visualize drone status, data collection progress, and processing outputs, allowing us to monitor the system. We'll also start implementing the real-world translation mechanism this sprint. We'll begin developing the method to apply object classifications from our Unity digital twin back to the real-world environment, possibly through live overlays or coordinates.

November: Final Integration and Demo Preparation

The first couple of weeks in November are the big sprint to the finish line, our final push before the early November demo. This period is dedicated to bringing all the remaining MVP components together, ensuring everything works seamlessly, and getting our entire system polished and ready for presentation.

During November Sprint 1 (which covers the entire period leading up to the demo), we'll focus on finalizing and testing the real-world translation mechanism that we started in October. We need to make sure that the object classifications from our Unity digital twin are accurately and reliably applied back to the real-world environment. Also running full cycles: from the drone flying autonomously and collecting data, all the way through to processing that data, classifying objects, and then demonstrating those classifications in the real world. We'll identify and resolve any bugs, glitches, or integration issues. We'll also prepare clear visualizations and presentation materials. Our goal is to ensure we can confidently and effectively showcase that we've successfully met all our MVP criteria and have a working, impactful autonomous drone system. This sprint is less about new development and more about making sure everything looks great and works for the presentation.