- Project Charter
    - The charter provides a high level description of your project
    - Project Overview – Describe the project briefly in layperson's terms (e.g., one that your grandmother could understand). This should not be more than a few sentences.
    - Project Approach – Provide more technical detail (one that other students could understand). List the team members and their roles.
    - Project Objectives, Milestones and Major Deliverables – List your objectives and milestones without getting too detailed (you will do that later). What are the specific goals of the project for this quarter? What are potential longer term goals? Deliverables should include a description, a date, and the persons who are responsible.
    - Constraints, Risk and Feasibility – What are the potential stumbling blocks? What is realistically feasible here? The quarter goes by very quickly. The better approach is to over-deliver on what you promise, rather than under deliver on a set of unrealistic goals. Be sure to include risks – a list of things that could go wrong and how to avoid them.
- Group Management
    - What are the major roles in your group's management?
    - How will decisions be made? By leader, consensus?
    - How will you communicate? Email, meetings in the lab, discussion board?
    - How will you know when you're off schedule, and how will you deal with schedule slips?
    - Who is responsible for which deliverables and milestones?
- Project Development
    - What are the development roles and who will handle them?
    - What hardware/software will you use? What do you have available? What do you need?
    - If there is software/hardware that is needed, provide a justification for its cost. Where will you order it? When will it arrive?
    - How will you do testing?
    - How will you do documentation?
- Project Schedule
    - Define a set of milestones with a specific definition of what each milestone is, what it means to complete each milestone, and when you expect to complete them. **You must be able to demonstrate the completion of each milestone.** For example, take a video of something work. Or make a graph showing how the data is processed.
    - Define the milestones at two scales, a high level set of key milestones, and a low level set of weekly milestones.
    - Prioritize and organize your milestones. Some are necessary, others are useful, some are hopeful if time permits, etc. Gantt charts are helpful to better visualize the milestones and understand their dependencies.
    - A good rule of thumb is one milestone per person per week. You are expected to work at least 10 hours/week. So that should give you plenty of time to perform a milestone that is demonstrable.

Bird Nest Detection System:

Project Charter:

Habitat restoration and other land management practices are vital to the continued health of open spaces, ecosystem functioning, and provision of ecosystem services, e.g., forestry, and agricultural production. On-the-ground ecological land management activities can be disruptive and require extended land modification, transitioning the state of the art for land management to UAV based work. We propose a novel technique to improve and speedup ground-based ornithological surveys for nesting migratory birds using mounted Long Wavelength Infrared (LWIR) and visual spectrum sensors on a multirotor UAS platform. With the ability to downlink data in different bands, we are able to automatically derive GPS coordinates of potential bird nests for in-field verification and ecological land assessment.

Our project is divided into two sub-teams: multispectral camera and system integration. The multispectral camera team is responsible for developing and building a working multispectral camera with the ability to capture images using different visible wavelength filters. The high-speed camera will continuously capture images while a rotating disk of different light wavelength filters spins in front of the camera lens. A closed feedback control system will handle the camera and disk coordination to ensure useful photos are taken in a multitude of different light wavelengths. The system integration team is responsible for (i) gathering all the data from various sensors and cameras, (ii) packaging them together, and (iii) transmitting them to the ground station computer for analysis of the data. The system will consist of a flight controller which is responsible for movement and tracking positional information, and cameras that record visual input in multiple spectrums. All of this data will be aggregated and packaged by a microprocessor and transmitted over radio. We will be playing with a multitude of different cameras, radios, and microprocessors and integrating them together to create a stable system that can gather and transmit data in real time.

Group Management:

Team Lead: Dominique Meyer
System Integration Team: Aniket Mathur, Sriram Venkatesh, Matthew Yu
Multispectral Camera Team: Dominique Meyer, Monica Hung, David Yang

Decisions will be made by Dominique Meyer since he has had a lot of experience in a previous similar project. We will mainly communicate via email for announcements and meeting locations, but also utilize Facebook Messenger for sub-team communication. We will also host weekly group meetings for syncing up as a group.

Project Development:

Team lead is responsible for managing the sub-teams and integrating the final product onto a drone, acting as a payload for a fully functional and stable system.

System integration team will include two roles:

1. Radio transmission from ground station computer to drone computer, with real-time data transfer
2. GPS and camera syncing metadata and integrating that into data to be transferred

Multispectral Camera will include 2 roles:

1. Design the control system for the camera, motor, encoder, and filters (Monica/David)
2. Build the assembly to combine each moving part in a single system (Dom)

Hardware and Software to be used:

1. Drone
2. Ubiquiti Wireless Radios+Antennas
3. Emlid Reach RTK GPS Sensors+Antennas
4. Raspberry Pi V2.1 Camera
5. Raspberry Pi ⅔
6. Intel Joule or UP Board
7. RSync software
8. EMLID Reach Proprietary SW
9. Thermal Camera
10. Depth Camera
11. Visual Camera
12. Multispectral Camera
    a. Motor/Motor controller
    b. Encoder
13. Laser Altimeter
14. Inertia Measurement Unit (IMU)

Project Schedule:

- Milestones for System Integration Team
  - **MS 1 - Initial setup (week 4):**
    - Setting up EMLID RTK GPS Sensor configuration for dual sensor mode for centimeter GPS accuracy, flash to latest firmware
    - Setting up the Raspberry Pi, camera, SSH configuration, wifi network
    - Setting up the Ubiquiti Wireless radios, flash to latest firmware and sync them for real-time data access
  - **MS 2 - Obtaining GPS data and transmitting of data (week 6)**

        - Determine a methodology/process for obtaining raw GPS data from EMLID for future processing by the Pi
        - Configure necessary SW for porting the GPS raw data to the Raspberry Pi
        - Establish connectivity with Ubiquiti Wireless Radios from both ends
        - Set up RSync, on-board be server, and mirror data from drone to ground-station computer.
        - Transition: Switch from Raspberry Pi board to Up board
    - **MS 3 - Embedding GPS data and Data Sync (week 7)**
        - Perform timing analysis to make sure all equipment can operate at a specified frequency
        - Taking real-time GPS data and time-sync with camera data

- Milestones for Multispectral Camera
    - **MS 1 - Multispectral camera part selection (Week 4):**
        - Research possible motors (brushed, brushless, etc), motor controls, encoders (magnetic, optical, etc), system control systems (PID, etc)
        - Deliverables: Select pieces/implementations for each, order parts
    - **MS 2 - Build test system and combine testing parts (Week 5):**
        - Build test system with possible pieces in Dom's lab?
        - Deliverables: Have a working platform with which we can test our control algorithms
    - **MS 3 - Implement working camera control feedback system (Week 6):**
        - Using test platform, write control feedback loop algorithms for closed loop filter/motor/camera control
        - Deliverables: Create working control loop system
    - **MS 4 - Build final pieces system/select best filters (Week 8):**
        - Dependent on when ordered parts arrive
        - Build final product using ordered parts
        - Select filters most helpful to our goal: finding bird nests
        - Deliverables: Build final camera/control system which will be used on drone
    - **MS 5 - Combine with systems integration team (Week 9):**
        - Combine final multispectral camera product with drone
        - Deliverables: Final drone complete, total control of multispectral camera