UAV Projects

Getting Started

Project Timeline:

For the remainder of the semester the emphasis will be primarily on projects with group meetings during class. Many weeks will include very short lectures to describe activities for the following week. In some cases (i.e., on flying weeks) these short lectures will be put on line so that you can optimize the use of class time for working with your groups.

You are expected to have high quality drafts of all deliverables due that week available prior to class and uploaded to github. Your team will receive feedback on these deliverables during class. You will then have **until the following Saturday 5.00pm** to turn in a modified version of the deliverables to github for grading.

Feb 27th	Group presentations (Hwk 5 & 6). Project planning.	Team Meetings
March 06	Group time. Initial project presentations.	Team Meetings
Spring Break		
March 20th	Project time	Team Meetings
March 27th	Project time	Team Meetings
April 3rd	Proof of concept *flying* demo due with physical UAVs	Team Meetings
April 10th	Project time	Team Meetings
April 17th	Focus on safety activities	Team Meetings
April 24th	Focus on testing activities	Team Meetings
May 1st	Formal presentation to external panel	Panel presentations
Late April	Extra flying times with instructor support available on several weekend times (tbd)	

GitHub:

By Wednesday Feb 27th you will be provided with a private Github repository for each team. Please use this repository for all of your work. For each deliverable you can create a "grading branch" by the submission deadline. Everything you turn in as a team must be in that branch i.e., slides, code, other documentation etc. To activate your private repo, please provide one team member's github name. That person will be given admin rights and can add other team members.

Help and Resources:

If you need specific help with any software or hardware – please ask the instructor. We have a diverse support team and should be able to provide help in many areas that you wish to cover in your projects. Please ask as early as possible to allow for coordination.

Deliverables:

Note: We will go flying at the first opportunity following Spring break. On "flying" weeks, each team can sign up for flying slots and is then expected to meet for team meetings in the remainder of the session. As you won't have

a formal check-in with the instructor on those weeks, please feel free to request a meeting either during office hours or at any other time convenient to your team.

March 6th	Initial Team presentation	5 points
Spring Break		
March 20th	Requirements, Architecture, and Screen Mockups due	5 points
March 27th	Design presentation + formal technical review	5 points
April 3rd	Architectural spike	5 points
April 10th	Proof of concept *flying* demo due with physical UAVs	5 points
April 17th	Safety Analysis report due + status report	5 points
April 24th	Test Case report due	5 points
May 1st	Final Presentation to external panel	10 points
May 9th	Final web portfolio due	10 points
May 9th	Final individual project report due	5 points

Point assignments for deliverables worth 5 points

Full points: A complete draft version of the deliverables are available prior to class. Any problems raised in class are remediated in the version submitted on the following Saturday by 5.00pm. This means that the working draft must show excellent thought and effort, but may be corrected prior to submission. The final deliverable is high quality.

Points will be deducted as follows:

1 -2 points: The required materials were not ready for discussion during class.

1 – 3 points: The final deliverable has specific flaws which were not addressed including low quality, incomplete, failure to address problems raised in class, turned in late.

1 -2 points: Turned in up to 24/48 hours late.

March 6th: Initial Team presentation

Present a clear vision of what your product will do and a project plan for completing it.

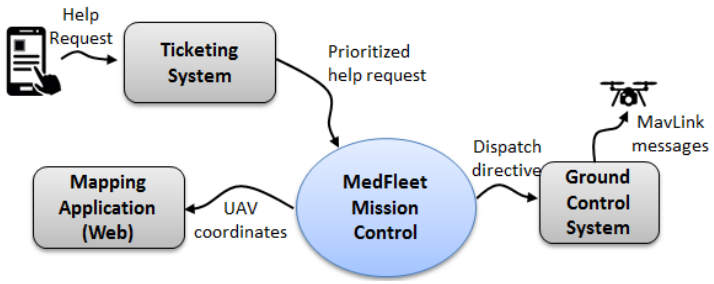
Vision Statement: As a team you should agree upon a clear statement of what your product is going to do. While working on your initial statement you can start to create a project glossary that you should update through the semester and include in your final portfolio. For example:

MedFleet uses a fleet of UAVs to deliver medical kits to users that request assistance. The requests originate from a mobile application that uses GPS to identify the current location of the user that needs help. The incoming requests are then prioritized, scheduled, and assigned to one of the UAVs in the fleet. The UAV is then dispatched to deliver the medical kit to the GPS coordinates. Usage examples include dispatching medical supplies in response to a natural disaster or in case a hiker is injured in a remote location.

Glossary: (example entries)

Current Location:	Latitude, Longitude, and altitude expressed in decimal format (e.g. 41.714355, -86.228878, 20)
Dispatch Directive:	Route plan and dispatch directions represented in JSON
Help Request:	A request for help that includes the GPS location of patient and description of medical need
UAV:	Unmanned Autonomous Vehicle
GPS:	Global Positioning System

System Level Diagram: The next issue is to determine the boundaries of your system and its interactions with external systems. In other words – what is in the scope of your system and what external interactions will you expect. Because MedFleet is actually a set of interacting adjacent systems – I'm going to show here the Level 0 DFD diagram for the mission control system. The mission control receives a request for service from the MedFleet ticketing system. It computes routes etc and sends a dispatch request to the Ground Control station and also sends updates to a Mapping application.



Note that the system under focus in this diagram is shaded blue. MedFleet actually encompasses the Android App, Ticketing System, Mapping App, Mission Control, and the Ground Control System. For term projects your scope is unlikely to be as broad as MedFleets (this was a 20 week graduate project).

Your presentation should include:

Slide 1: Team Name and Members. Project Title.

Slide 2: A Vision statement explaining what your project will do. This could be augmented by a diagram or illustration.

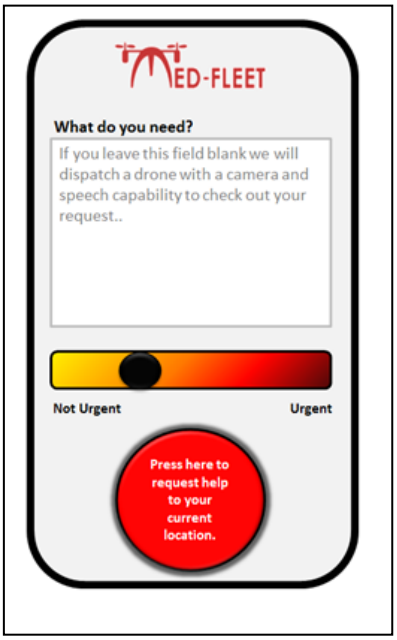
Slide 3: System level diagram (see example above)

Slide 4: An initial project plan showing your deliverables throughout the remainder of the semester. (Please reference the required time line below to create your project plan) at weekly granularity. Your initial plan should be part of your presentation; however, the instructor will meet with each team during class and plans should be modified accordingly prior to submission. The most typical problem with initial plans is associated with scope (usually over optimistic, but sometimes ill-defined). You may update your plan throughout the project; however, any reduction in scope from the original plan must be discussed with the instructor.

Deliverables: (1) In-class presentation. (2) Slides submitted to GitHub. (3) Project Plan showing major deliverables planned for each week. (could be the **updated** slide, spreadsheet, doc file, or in your favorite project management tool)

March 20th: Requirements, Architecture, and Screen Mockups

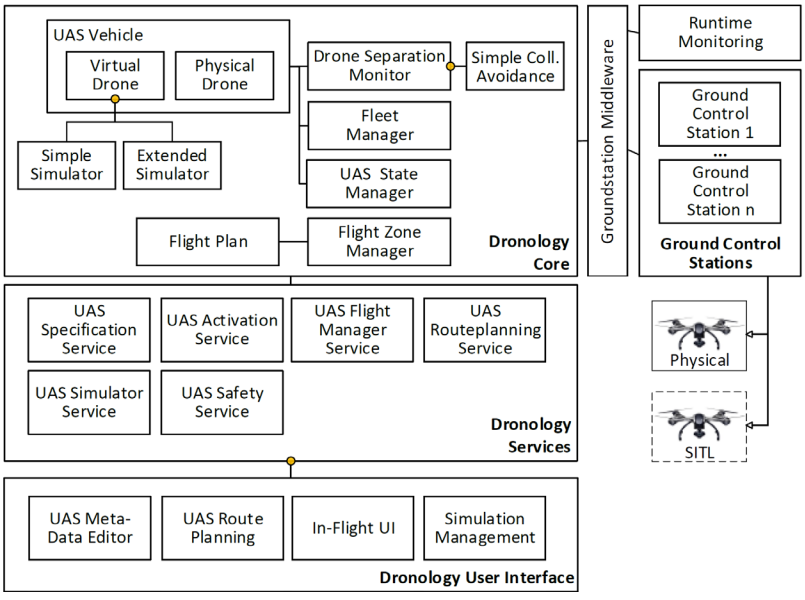
Prepare a textual use case for your planned functionality. Examples are provided on Github. Each person should individually design a candidate architectural solution and turn it in. Your team should then select the best one, or combine best parts of each of these to produce an architectural diagram (or diagrams). These are expected to be digitized (no hand sketches) and should show the major components of your solution and their connections. Box and line diagrams are acceptable. Your architectural diagram should show significant thought about how you are decomposing the problem domain into a viable solution. Finally, if you have any form of UI in your project you will need to create UI mockups. If you do not have a UI, then you will need to substitute the UI mockups with either a sequence diagram or a data flow diagram. These will be discussed with your team during class on March 6th.



An example screen mockup for a mobile app project is shown for the MedFleet project. Additional examples are posted on Github.

You should create some initial screen mockups for your solution. One tool (but many others are available) is here: https://moqups.com/ You can also create **high-quality** hand-drawn mockups and/or high level story boards showing the flow from one screen to another. At this stage you do NOT need every detailed screen but should show the primary ones.

An example of an architectural diagram for Dronology (which has many more components than you are expected to deliver for your team project is shown below).



If in doubt about the level of detail needed for your requirements or design document – please discuss with the instructor. For screen mockups you may produce wireframes.
Deliverables: (1) Requirements, (2) architectural design, (3) screen mockups or dataflow diagram (discuss #3 with instructor if neither fits your project well). Due Friday 22nd, 5.00pm.

March 27th Requirements and Design Presentations

Each team will give a presentation of their requirements, software architectural design, and UI design. The presentation should include the following slides: (1) updated vision, (2) use case(s), (3) architectural design, and (4) either UI design or data flow in case of no UI. Each team presentation should take 5-8 minutes.

Deliverables: (1) Presentation, (2) slides uploaded Github

April 3rd Architectural Spike

Architectural spike defined as a technical risk-reduction technique in which you write just enough code to explore the technological risks and to show that your design is viable. Examples of architectural spikes for the following projects might be:

- **Drone-formation project** – writing code that shows that you can position drones into a pattern. The spike could be completed using the "drone-on-a-pi" hardware configuration.
- **Ad-hoc wifi relay project** – show that you can set-up an ad-hoc wifi between two companion computers.
- **A search-coverage project using AI** – show that you have mastered the rudimentary elements of the search algorithm.

Note: You must identify and mitigate the *greatest* risk for your project. Selecting a minor peripheral risk to mitigate will definitely not be sufficient.

You should plan ahead for your architectural spike. It is unlikely that you can complete it in just one week. Use your project management skills to create a timeline and allocate responsibilities to team members in advance.

Deliverables: (1) A short document describing the specific risks you are mitigating and the steps you have designed to mitigate those risks, (2) informal presentation/demo during team meeting of the risk mitigation, (3) brief post-mortem analysis in the document describing the success/failure of the architectural spike and any next steps needed for risk mitigation purposes. Note: Some projects will be inherently more risky than others and may spend more time in the risk mitigation stage. This can all be discussed with the instructor – and project teams will not be penalized for trying to solve harder problems.

April 10th Proof of Concept Flying

Proof of concept flying demo. Each team needs to move their proof of concept into the air on real drones **during this session**. You should plan for it in advance of the session, but will receive help at the flying field to get it implemented. Note: This sometimes takes multiple attempts to identify problems and mitigate them. We will assign flying areas (and non-flying areas for safety) so that multiple teams can fly simultaneously during the class.

Deliverables: (1) Flying drones demonstrating some aspect of your project. (This can be discussed and agreed upon in the April 3rd session with each team) (2) Updated project plan.

April 17th Safety Analysis

Provide a FMECA for your project identifying specific safety risks, criticality levels, and potential mitigations. For each potential mitigation, specify whether you plan to address it in your project or not. Note: You are expected to be aware of all major safety hazards, but it is likely out of scope of the term project to address more than a small handful of them. You are definitely expected to make progress on your project this week in addition to working on the FMECA.

Deliverables: (1) FMECA as described above, (2) Status report showing ongoing progress towards your project goals.

April 24th Test Cases

Provide at least three acceptance tests for your project. Start keeping a log depicting each time you run your acceptance tests against either a simulation or the physical drones. Examples of acceptance tests will be provided on GitHub. Run and log results of all tests for which functionality is already available.

Deliverables: (1) Acceptance tests, (2) Acceptance test log showing the history of acceptance test executions with comments, status (passed/failed), and operator, (3) Status report showing ongoing progress towards your project goals.

May 1st Final Presentation

All teams will present their final projects to an external panel. Each team will have 10 minutes to present plus 5 minutes of Q&A. The final presentation is expected to include video of the project in action on White Field. All team members should play a role in the panel presentation and be prepared to answer questions about the project.

Deliverables: (1) Presentation to panel. (2) slides uploaded to github

May 9th Final Portfolio

Instructions for the final portfolio will be provided in a separate document by March 6th. The portfolio should be an html version of your deliverables and is expected to include all final artifacts created throughout the semester project.

May 9th Individual Retrospective & Assessment

Each person will need to write a one-page retrospective on the project. The retrospective will describe your contribution, challenges that were faced and overcome (or not), lessons learned, successes, what you would do differently if they repeated the project.

Each person will also complete an assessment of their peers that includes an evaluation of their contribution.