Implementation Schedule - September 2025

Lesson 1 - Introduction to autonomous flight.

Lesson Focus:

The focus of this lesson is to have students get introduced to coding by seeing a real world example of a drone conducting an autonomous flight.

Knowledge & Understanding

- Identify the key components required for autonomous drone flight (e.g., GPS, flight controller, sensors).
- Explain the basic principles of how drones achieve autonomous flight using GPS waypoints or computer vision.
- Describe safety protocols and regulations related to autonomous drone operation.

Application

- Program a drone to follow a pre-defined GPS waypoint mission using software (e.g., Mission Planner, DroneDeploy, or Tello EDU).
- Configure basic autonomous flight settings on a flight controller or drone software.
- Use a ground control station (GCS) to upload and monitor an autonomous mission.

Analysis

- Analyze flight logs to determine if the autonomous mission executed correctly.
- Compare different types of autonomous navigation methods (e.g., waypoint-based, SLAM, vision-based).
- Interpret sensor data (e.g., from GPS, IMU, altimeter) to assess flight behavior.

Evaluation

- Evaluate the performance of an autonomous flight mission and suggest improvements.
- Critically assess the reliability and safety of autonomous systems in different environments (e.g., indoors vs. outdoors).

Materials Required:

- Mavic 2 Pro
- iPad
- Pix4Dmapper software
- Landing pad

Activities:

Field Trip Outside - Conduct an autonomous flight : To give the students a real world example of an autonomous flight. We will have a drone conduct an autonomous flight outside taking pictures at a set interval. The programming will be happening behind the scenes, but it gives the students an idea of what we are conducting at a basic level.

Process project - We will take the drone inside to unload the pictures and have the software PIX4D begin processing the project to recreate the area in 3D. Using the 3D scan of the area, we can then take measurements and see a real life application of the data we collected.

Lesson 2 - Conduct Project Using Block Coding

Lesson Focus:

The focus of this lesson is to introduce students to coding through the usage of Block Coding. Students will observe a drone flight using block coding commands and then will have the opportunity to write their own block coding example to accomplish a task.

Knowledge & Understanding

- Identify and describe the main parts of the drone (e.g., motors, camera, sensors).
- Understand the basic principles of drone flight (lift, thrust, pitch, roll, yaw).
- Recognize key programming blocks used to control drone actions (e.g., takeoff, land, move forward, turn).
- Explain the sequence of commands and their impact on drone behavior.

Application

- Use a block-based coding interface (e.g., Scratch, DroneBlocks) to program a drone to perform basic maneuvers (takeoff, hover, land).
- Create a program using blocks to make the drone fly in a specific pattern (e.g., square, figure eight, zigzag).
- Program timed or distance-based movements using loops and delays.

Analysis

- Predict the outcome of a sequence of block code commands before running them.
- Troubleshoot and correct errors in a block-based drone program.

- Compare different code sequences to find more efficient or accurate solutions.

Evaluation

- Test and evaluate the performance of a drone flight mission coded in blocks.
- Reflect on how changes in code affect flight accuracy, timing, or safety.
- Assess the limitations of block coding vs. text-based programming for drone control.

Materials:

- CoDrone or drone capable of block and python coding
- Batteries
- Landing pads
- Obstacles for obstacle course

Activities:

We will return to the lab and conduct a flight using the CoDrones that were purchased using the funding from the CREEDS project. The drones will be programmed by the students and will try to fly autonomously through coding. We will break the process into the following steps:

> I do - I will demonstrate the block coding process to the students and have the drone go through an obstacle course using some straight forward commands. The demonstration will cover the commands that the students will have access to and what each command does.
>
> We do - As a group, the students will give suggestions on what commands will help the drone accomplish the task. I will set up the drone and have it fly based on the commands and suggestions from the class. We will conduct this flight as a group.
>
> You do - I will break the students into two groups and have them go through the process of navigating the drone through an obstacle course. The students must create a code and execute the code for the drone to fly through. Students will be assessed on successful completion of obstacle courses.

After completion, students will be pointed towards reviewing the block coding they created and viewing the coding they used in a python version. Students will observe the difference between the code they wrote with block coding and the code in python. Students will compare and take note of how the commands they wrote are written in python.

Lesson 3 - Conduct Project Using Python Coding

Lesson Focus

The focus of this lesson is to move beyond block coding learning into more advanced concepts like syntax, logic, automation, and real-world applications of programming. Students will continue the previous lesson but will utilize python coding instead of block coding. Students will observe the original code they used and rewrite the code using python. Students will be encouraged to aim for efficiency in having their code run the obstacle course in a faster time.

Knowledge & Understanding

- Describe the basic components of a drone that can be controlled using Python (e.g., motors, sensors, flight controller).
- Understand how a drone software development kit (SDK) or API enables Python-based control.
- Recognize Python syntax used in drone programming (e.g., function definitions, loops, conditionals).

Application

- Set up the development environment to connect a Python script with the drone
- Write a basic Python script to execute drone actions such as takeoff, move, rotate, and land.
- Use Python to create a flight routine that performs multiple coordinated movements.

Analysis

- Debug and fix errors in a Python drone control script.
- Analyze the output or telemetry data to determine flight behavior or issues.
- Compare different programming structures (loops vs. manual commands) for controlling flight efficiency.

Evaluation

- Evaluate the reliability and accuracy of the programmed flight path.
- Assess how changes to code (e.g., timing, speed, distance) affect drone behavior.
- Critique the use of Python vs. other programming methods (e.g., block coding or C++) for drone programming.

Materials:

- CoDrone or drone capable of block and python coding
- Batteries
- Landing pads
- Obstacles for obstacle course

Activities:

We will return to the lab and conduct a flight using the CoDrones that were purchased using the funding from the CREEDS project. The drones will be programmed by the students and will try to fly autonomously through coding, but this time PYTHON will be used. We will break the process into the following steps:

> I do - I will demonstrate the python coding process to the students and have the drone go through an obstacle course using some straight forward commands. I will have some basic commands using block coding and then look at the code in Python. I will then begin writing out the code
>
> We do - As a group, the students will give suggestions on what commands will help the drone accomplish the task. I will set up the drone and have it fly based on the commands and suggestions from the class. We will conduct this flight as a group.
>
> You do - I will break the students into two groups and have them go through the process of navigating the drone through an obstacle course. The students must create a code and execute the code for the drone to fly through. Students will be assessed on successful completion of obstacle courses.

After completion, students will look over the code that they wrote and make a comparison to their code that was written with blocks and determine the structure of how python is used. Students will write out an observation of how they perceive python based on the code. Assessment for the module will consist of a review of the students' code and whether the students were successful in accomplishing the obstacle course using python.

Students will also be challenged to complete a more complex program of having the drone complete a grid pattern flight over the classroom simulating the autonomous drone flight that we experienced on the first day of the lesson. Students will be assessed on the successful completion of their program to fly the grid pattern over the classroom. Students will also write a reflective essay talking about the challenges and obstacles they had to overcome in this lesson and their personal takeaway at the innovation of programming and drone flight.