



Modelling Unmanned Aerial Swarms Using Unreal Game Engine and AirSim Simulator

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Introduction

The aerial swarm will be autonomous with a unified, cohesive behavior that will be able to collect data from a three dimensional environment. For this project our product owner is Professor Akbas.

Benefits:

- Safer for use in dangerous situations
- Easier for use in time constrained missions
- Faster to deploy

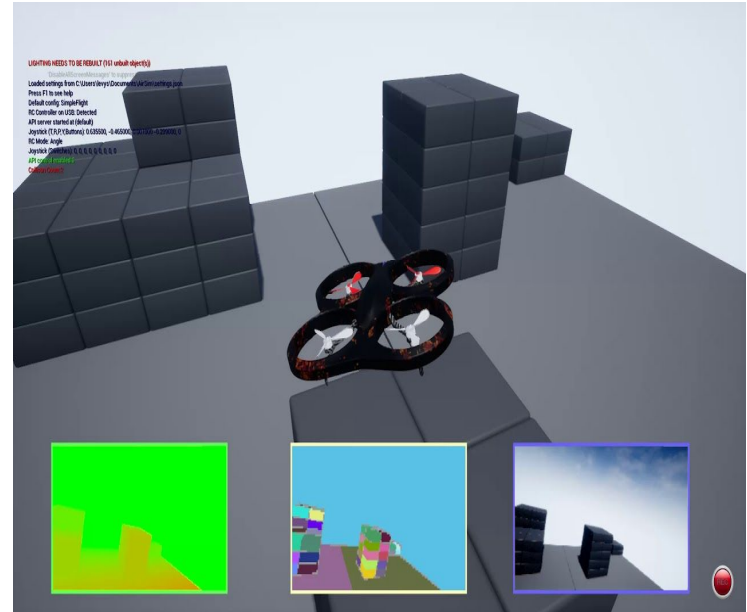


Project Vision

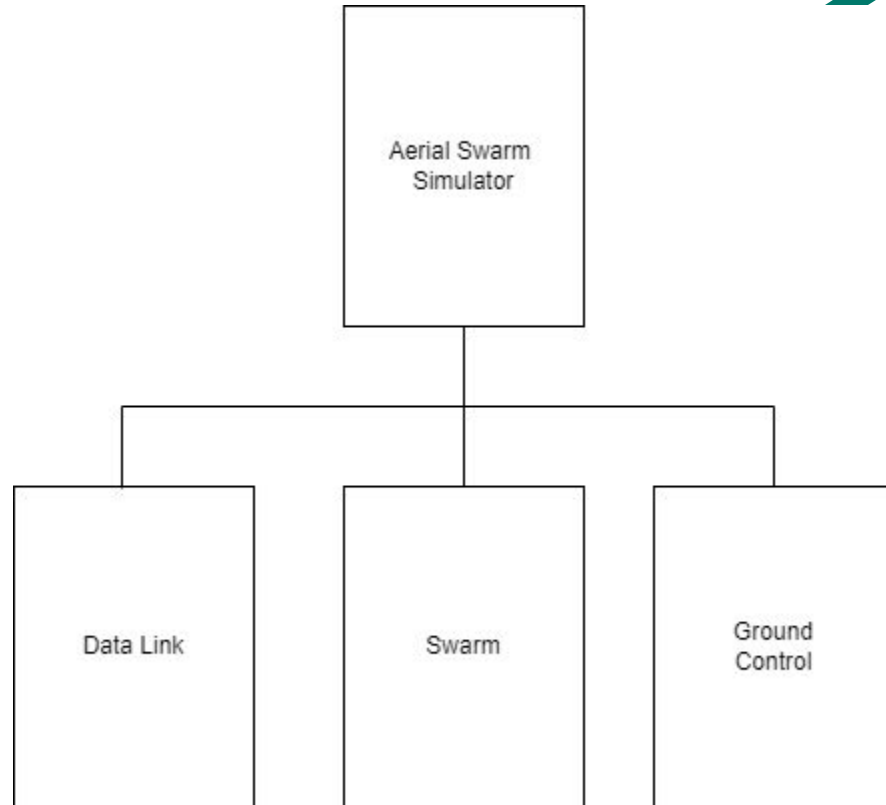
- Simulation of UAV
- UAVs communicate between each other
 - Position
 - Activity status
- Moves within a three dimensional environment
- Collects data to calculate volume
 - Irregular objects (plume of smoke)
 - Regular objects (cube)
- Reports to ground station

Design Considerations

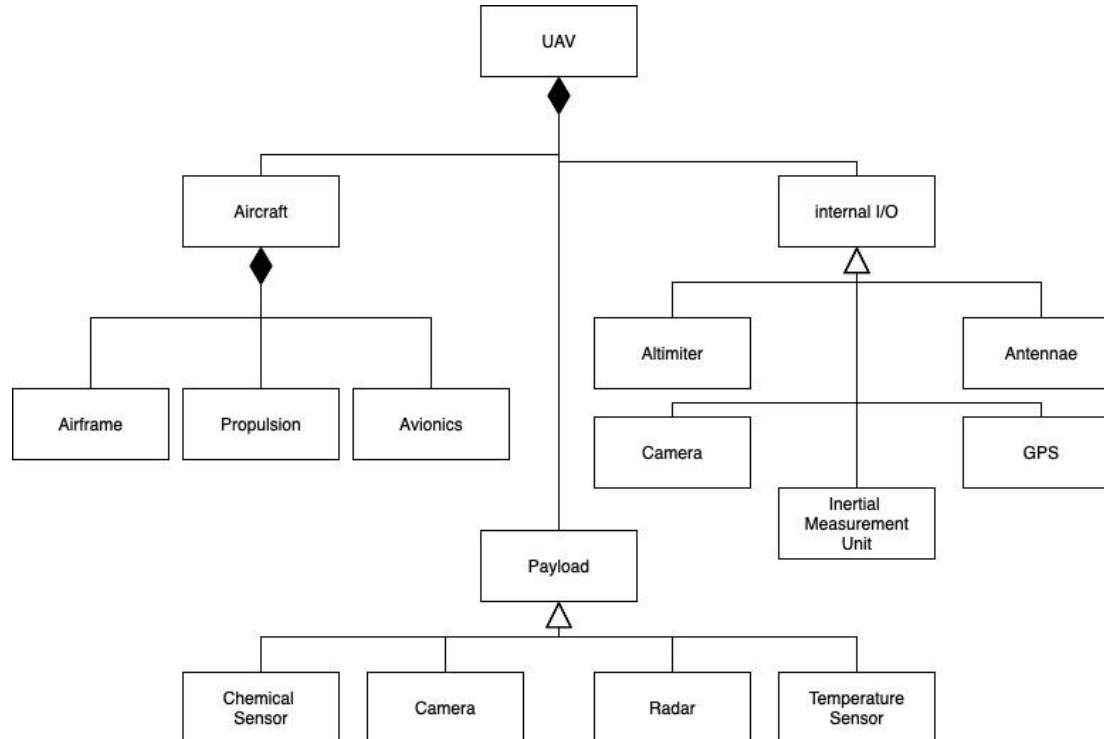
- Assumptions
 - Minimum of 3 drones in swarm to measure an object
 - Measured objects are solid and uniform
 - No objects in swarm path
 - No collision in object measurement
- Dependencies
 - Microsoft's AirSim Simulator
 - Unreal Engine 4
 - Visual Studio 2019
 - Python based instead of C++
- Design Constraints
 - Limited to Unreal Engine 4 environment
 - Collisions/object constrained



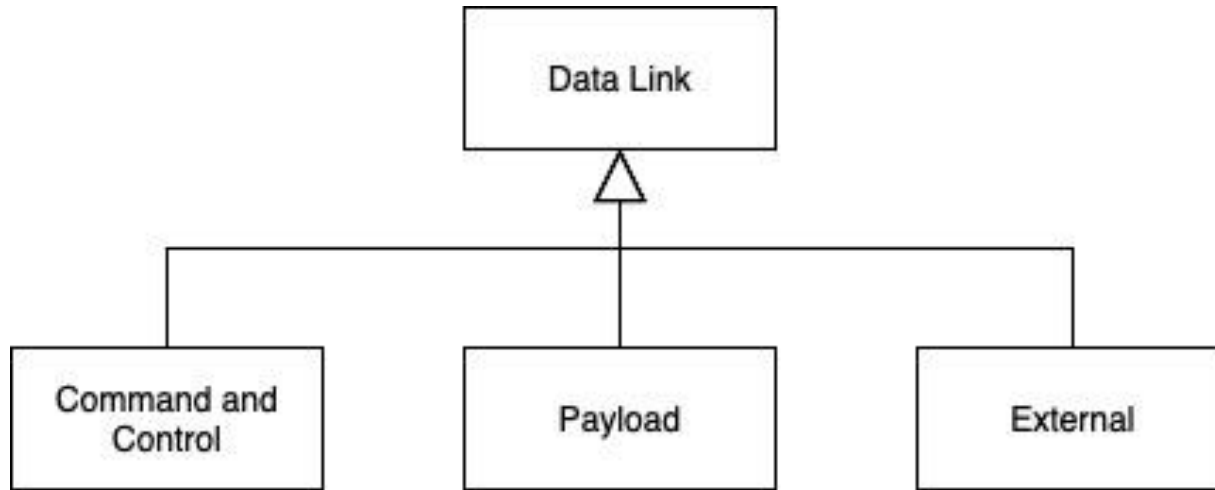
System Architecture (High to Low)



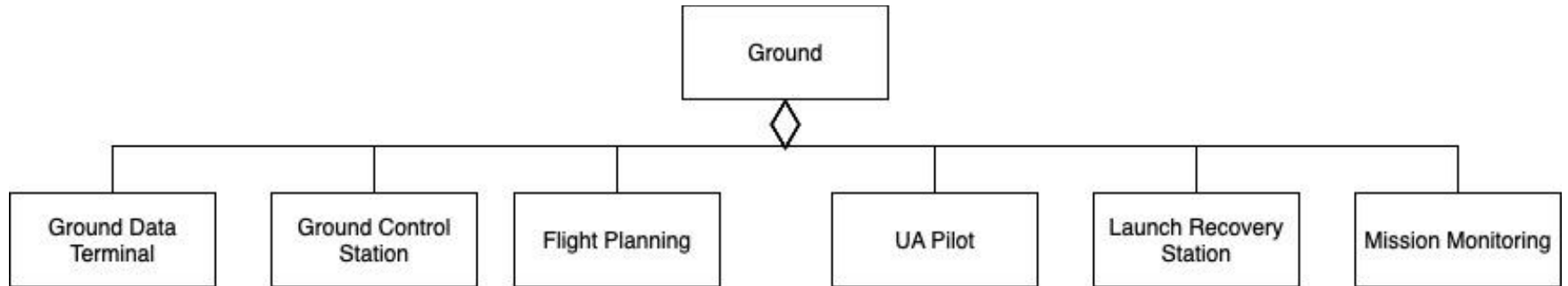
Sub-System Design - Swarm



Sub-System Design - Data Link



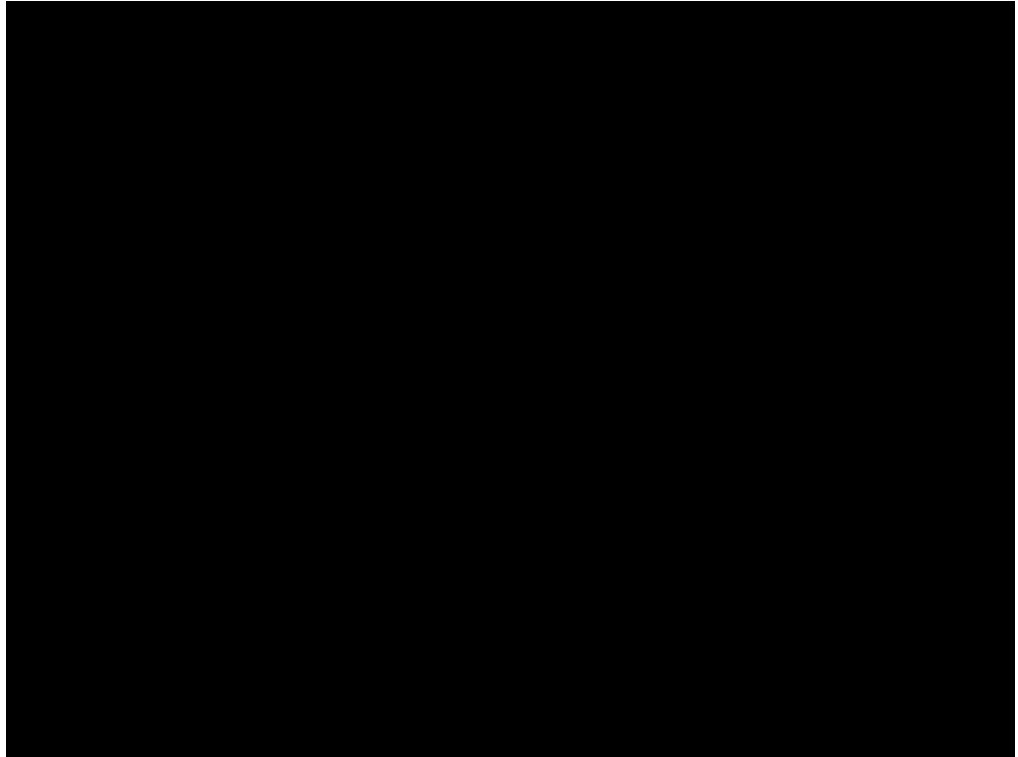
Sub-System Design - Ground Control



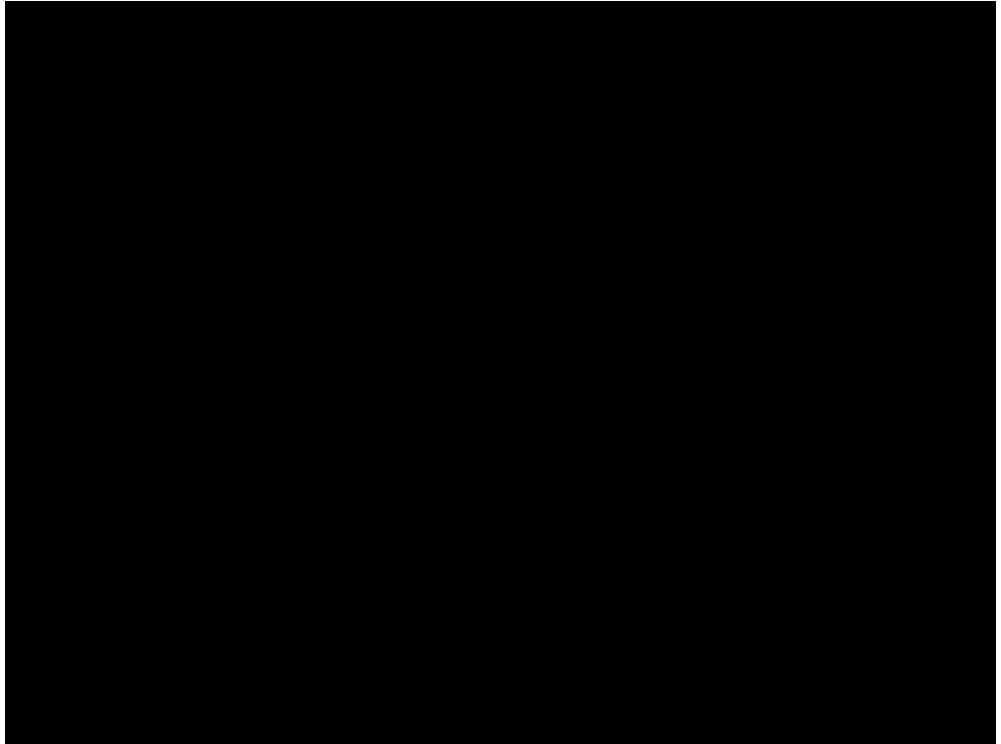
Settings File

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settings.json  Swarming.py  AlgTest.py  objectMeasurement.py  StackList.py
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2  "SettingsVersion": 1.2,
3  "SimMode": "Multirotor",
4  "ClockSpeed": 1,
5  "Vehicles": {
6    "Lead": {
7      "VehicleType": "SimpleFlight",
8      "X": 0,
9      "Y": 0,
10     "Z": -2,
11     "Yaw": -180,
12     "Sensors": {
13       "MyDistanceLead": {
14         "SensorType": 5,
15         "Enabled": true,
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17         "PointsPerSecond": 10000,
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19         "Y": 0,
20         "Z": 0,
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23         "Roll": 0,
24         "DrawDebugPoints": true
25       }
26     }
27   },
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29     "VehicleType": "SimpleFlight",
30     "X": 0,
31     "Y": 4,
32     "Z": -2,
33     "Yaw": -180,
34     "Sensors": {
35       "MyDistance1": {
36         "SensorType": 5,
37         "Enabled": true,
38         "NumberOfChannels": 4,
39         "PointsPerSecond": 10000,
40         "X": 0,
41         "Y": 0,
42         "Z": 0,
43         "Yaw": 0,
44         "Pitch": 0,
45         "Roll": 0,
46         "DrawDebugPoints": true
47       }
48     }
49   },
50   "Drone2": {
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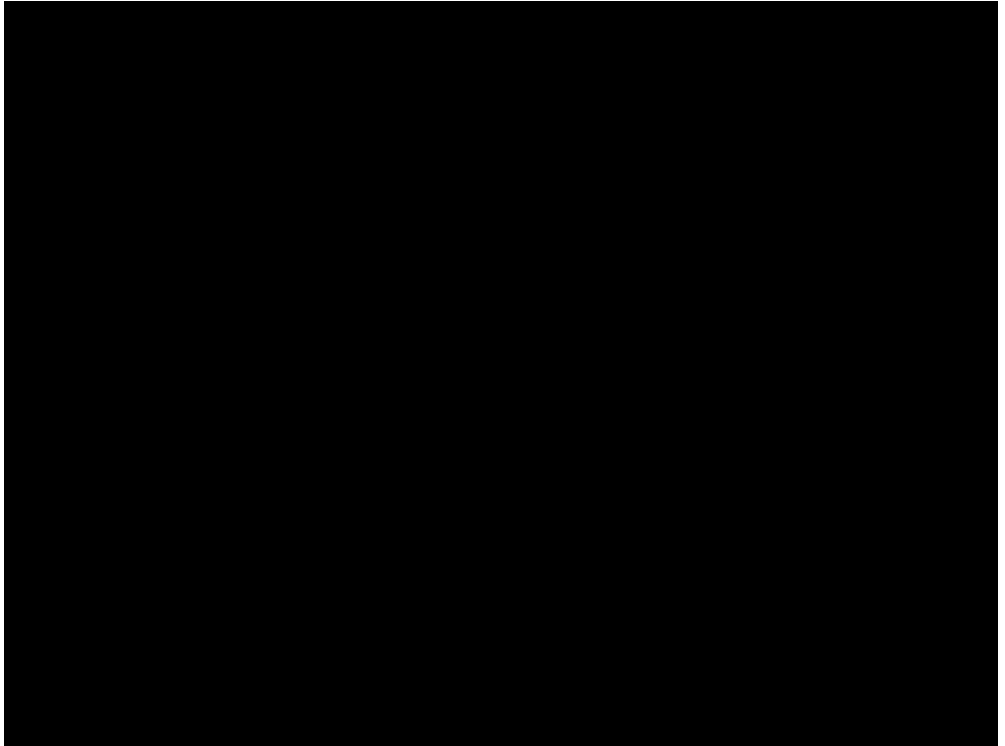
Swarming Formation



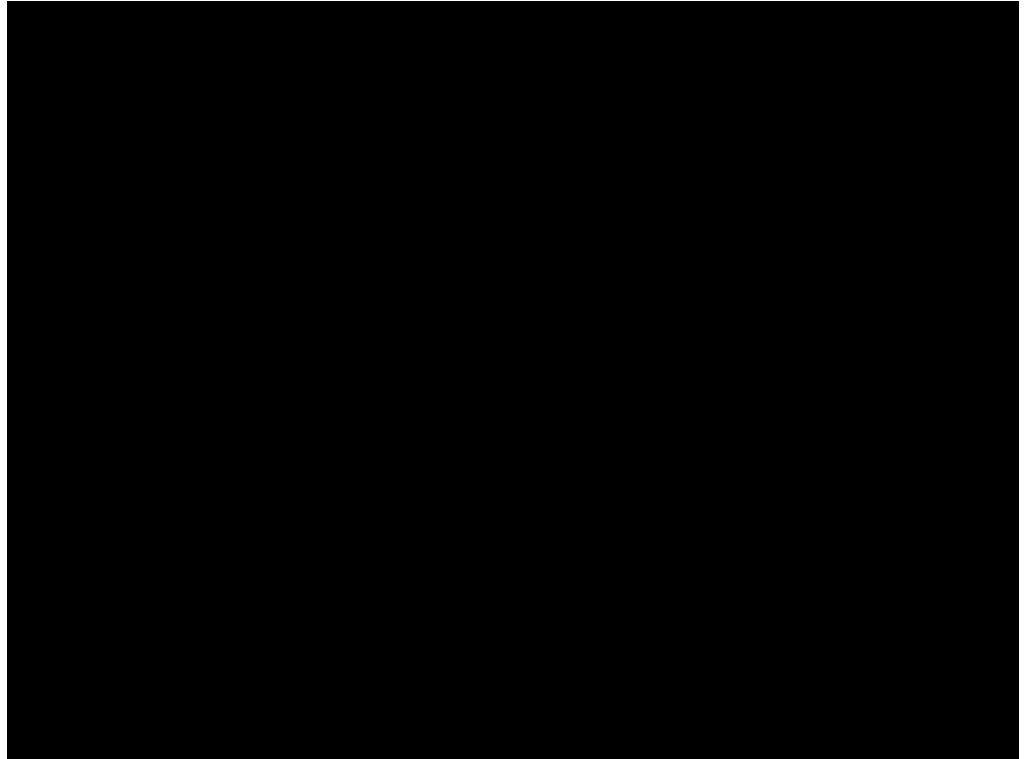
Swarm Unified Flight



Drone Loss Contingency



Object Measurement



Challenges Faced and Lessons Learned

- Collaboration
 - Increase in productive in-person meetings
- Communication
 - Communication hub (I.E Discord)
- Meeting Deadlines
 - Set mini-deadlines to help meet end-goal
- Steep “economy of scale”
 - Utilize online resources (I.E videos and papers)
- Design versus implementation
 - Temper our design
- Reinventing the wheel
 - Utilize available tools in Airsim

Project Road Map

- **Must Have**

- Object Detection – **Sprint 4**
 - Collision avoidance
 - Dimension id (volume measurement)
- Swarm Autonomy – **Sprint 5**
 - Pathing on mission
 - Task completion
- Ground Control Station – **Sprint 4**
 - Swarm data display
- Object Measurement – **Sprint 4**
 - Complex objects

- **Want to Have**

- Agent Based Aerial Swarm – **Sprint 5**
 - Individual agent jobs and behaviors
- Ground Control Station
 - Dynamic mission tasking – **Sprint 5**
 - Saving data – **Sprint 6**

- **Nice to Have**

- Environment Measurement – **Sprint 6**
 - Additional sensors



Thank You

Questions?

