Team: sdmay22-33

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1.1 Problem Statement

Develop a system that will enable investigating the trade-offs between energy expenditure and operational lifetime in collaborative drone surveillance systems. The objective is to have a simulation-oriented solution which, in turn, will also be tested with a small fleet of drones. Specifically, we will consider scenarios where an area that can be covered by a single drone, may still need another "extra" drone to complete the surveillance task. In such settings, we will investigate the overall operational lifetime of the fleet and enable planning of battery-swapping.

1.2 Requirements and Constraints

a. Functional req.s
   i. The drones must be able to call other drones for help when the battery is low.
   ii. The drones must be able to relay information to the UI through pictures or video streams.
   iii. The system must be able to estimate the energy/battery status of:
      1. Individual drones;
      2. Lifetime of the fleet as a whole;
   iv. The application should enable investigating of the trade-offs in an "offline" manner.

b. UI Requirements:
   i. The user needs to be able to control the drone flight paths.
   ii. The user will be able to turn on/off the drones.
   iii. The user will be able to designate an area to map
   iv. The drones will return viewable information to the user about the area being flown over.
   v. The user must be able to switch between cameras on the active drones

vi. The user must be able to select which drones are active.
vii. The user must be able to control when a drone will help another drone.

c. Resource Requirements:
    i. The project will require 2-3 usable/testable drones.
    ii. The project will require a server.
    iii. The project must be completed by May 2022. (Constraint)
    iv. The weekly load should not exceed 4 hours per person, or 720 total hours. (Constraint)
    v. The purchases should not exceed $2K. (Constraint)
    vi. Familiarizing with FAA protocols for flying drones. (Constraint)
d. Qualitative Requirements:
    i. The final product must be able to survey an area and return relevant information gathered by the drones while preserving battery usage as much as possible, and enable a simulation-based planning.

1.3 Engineering Standards

e. Aerial Communications and Networking Standards, IEEE P1920.1
f. Wireless Networking, IEEE 820.11
g. IEEE Standard Interface Requirements and Performance Characteristics of Payload Devices in Drones, IEEE Std 1937.1
h. IEEE standard for testing (unit/integration/…) IEEE 1008-1987 - IEEE Standard for Software Unit Testing

1.4 Intended Users and Uses

i. Agriculture
    i. Drones survey fields to monitor crop growth and health
j. Emergency Services
    i. Drones conduct damage assessment for areas affected by natural disasters
        1. Wildfires
        2. Floods
        3. Volcanic Activity
        4. Weather damage (hurricanes, tornados, etc.)
    ii. Firefighters

1. Use multiple drones to estimate shape of fire.
2. Guide multiple fleets/vehicles.

iii. Police use

1. Survey large areas of land in missing persons cases
2. Track crimes.

k. Transportation of Goods?

i. Delivering supplies for disaster relief

l. Infrastructure

i. Inspect damage to roads, buildings, etc. without physically sending people