Primarily Work

Overview

The project involves designing a UAV drone system capable of autonomous flight and search operations. The system uses a flight controller for navigation and swarm technology for communication between drones. The primary goal is to identify a target object based on specific criteria (height and color) and communicate this information to other drones in the swarm to stop their search.

Components and Workflow

1. Flight Controller:

- Responsible for the drone's flight stability and navigation.
- Common controllers: Pixhawk, ArduPilot, DJI Naza.

2. LIDAR Sensor:

- Used to detect objects and measure their dimensions.
- Example: LIDAR-Lite v3.

3. Color Sensor:

- Used to identify the color of detected objects.
- Example: TCS3200/TCS34725.

4. Swarm Technology:

- Facilitates communication between drones.
- Can be implemented using Wi-Fi (ESP8266) or RF modules.

5. Communication Protocol:

- Establishes a method for drones to share data (e.g., position, detected objects).

6. Test Flight:

- Conduct open field tests to validate autonomous flight, target detection, and communication.

Detailed Explanation with Code

Autonomous Flight and Search

The Python code demonstrates the basic logic for the drones using the `dronekit` library. This is a high-level representation and should be adapted for specific hardware and software environments.

The code is in the file <u>"Code.py"</u> in the same repo.

Block Diagram

The block diagram illustrates the components of the UAV fleet, including the three drones equipped with LIDAR and color sensors and the central controller coordinating their actions.

The Block Diagram is in the file <u>"Block_Diagram.ipynb"</u> in the same repo.

Calculations

LIDAR Sensor Calibration

1. **Distance Calculation:**

- LIDAR sensors measure the time it takes for a laser pulse to reflect off an object and return.
- *Distance* = (Speed of Light * Time) / 2
- *Example:* If the round-trip time is 30 ns, the distance is:

$$\text{Distance} = \frac{3 * 10^{8}\ m/s * 30 * 10^{-9}\ s}{2} = 4.5\text{m}$$

Battery Life Estimation

2. Battery Calculation:

- *Power Consumption* = Voltage * Current

- *Example:* If a drone operates at 11.1V and draws 10A, the power consumption is:

$$\text{Power} = 11.1V * 10A = 111W$$

- *Battery Capacity* = 5000 mAh (5 Ah)
- *Flight Time* = Battery Capacity / Current Draw

$$\text{Flight Time} = \frac{5\,A}{10\,A} = 0.5h = 30min$$

References

1. LIDAR Technology:

- *"LIDAR for Self-Driving Cars"* - IEEE Spectrum: [Link](https://spectrum.ieee.org/lidar-on-a-chip)

2. Color Sensor:

- *"Color Sensing with TCS3200 and Arduino"* - Adafruit Learning System: (https://learn.adafruit.com/adafruit-color-sensors)

3. Swarm Technology:

- *"Swarm Intelligence and UAV Applications"* - MDPI Drones: (https://www.mdpi.com/2504-446X/3/1/2)

Views About the Project

This project demonstrates a significant advancement in autonomous technology, showcasing the potential for UAVs to perform complex tasks without human intervention. By leveraging swarm technology, the drones can work collaboratively, ensuring efficient and coordinated operations. The integration of LIDAR and color sensors enhances the drones' ability to detect and identify targets accurately.

Advantages:

1. **Efficiency:** Automates the search process, reducing the time and effort required by humans.
2. **Accuracy:** Uses advanced sensors to precisely detect and identify targets.
3. **Scalability:** The swarm technology allows easy scalability by adding more drones to the fleet.
4. **Safety:** Minimizes human involvement in potentially dangerous search missions.

Challenges:

1. **Communication Reliability:** Ensuring consistent and reliable communication among drones is critical.
2. **Battery Life:** Managing battery life to ensure drones can complete their missions without frequent recharges.
3. **Environmental Factors:** Drones must be able to operate effectively in varying weather conditions and terrains.

Overall, this project represents a forward-thinking application of UAV technology, highlighting its potential to transform various fields, from military operations to search and rescue missions. The ability to autonomously search, identify, and communicate findings significantly enhances operational efficiency and safety.