Follow The Leader

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Project Goal

In our project, we focus on having an autonomous follower drone to follow a primary leader drone. The project would help improve military technology by exploring ways for a single drone to communicate or control multiple autonomous drones.

Background

Drones are currently used in military surveillance. Although drones are a useful piece of technology, there is a need for better drone coordination; drone coordination still has room for improvement, which will greatly improve surveillance operations.

Materials & Methods

Computations to obtain desired heading:

We enabled and calibrate the drone's magnetometer then obtain the drone's magnetic heading as well as current coordinates. Next, we calculate the desired heading which is the direction of the leader drone relative to the follower drone. The drone then rotates until it achieves the desired heading and then flies forward. The drone also increases its elevation until it is within a certain threshold of the leader drone.

Drone connection will be established via a router. The router will allow a connection between a Raspberry Pi that will be attached to our Leader drone, the autonomous follower drone, and a laptop that will act as our base station. The Raspberry Pi will collect GPS coordinates of the Leader drone and perform the computation needed to alter the flight path of the follower drone. The flight controller is implemented in NodeJS.

Conclusion

The Raspberry Pi (attached to leader drone) will be used for computing the flight control for the follower drone.The follower drone receives NodeJS flight control commands to correct its path to follow the leader. The raspberry PI also sends data to the laptop so that it can display it in the GUI.

Progress

Placeholder

Image

Figure 1: Figure caption

We connected the drones to a single router which will allow the base station to be able to access GPS data from both of the drones at the same time. This can be done because we can specify the drone ip addresses. This then allows us to find the difference based on the coordinates and compute the appropriate distance and heading that the follower drone needs to move in.

The GUI has been implemeneted so that the user can change the threshold difference between the follower drone and the leader drone. Real-time graphs are created so that both of the GPS locations of the leader drone and the follower drone are displayed; each graph represents the latitude, longitude, and elevation of each drone.

Placeholder

Image

Figure 2: Figure caption

Challenges

Our approach to completing the task of one drone autonomously following another drone is to move the follower drone towards the leader drone. To accomplish this, we pulled the GPS data from the GPS modules that are attached to a raspberry pi and sent it back to the base station where it could calculate the appropriate way to move. However, we quickly realized that the GPS data was only obtainable from a single drone at a time due to the method we were using to control the drone. Another problem we ran into was the relaying data between the GUI and the base station. These were both written using incompatible programming languages and thus raised problems for us. Another issue that we ran into was understanding the control flow of Node JS which was a language we were unfamiliar with. Changing certain things resulted in unexpected behavior and caused us trouble.

References

1 P. Bouman, et al. Dynamic Programming Approaches for the Traveling Salesman Problem with Drone. Networks, vol. 72, no. 4, 2018, pp. 528–542.

2 L. Mottola et al. Team-Level Programming of Drone Sensor Networks. Proceedings of the 12th ACM Conference on Embedded Network Sensor Systems - SenSys '14, 2014.

Future Research

Object detection through a camera attached to the drone will allow the drone to avoid obstacles while flying towards the GPS coordinates of the leader.

The drone's ability to autonomously return back to the base station will also be impilemented. The drone will either backtrack using previous GPS coordinates, or calculate the shortest distance and fly straight to the base station.

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