Tracking of a Fleet of Paparazzi Drones

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***Abstract*—The safety pilot of a drone can almost only rely on their eyes to determine the state of a drone they are monitoring. In the context for instance of a search and rescue mission, many drones could be involved, and the pilot may lose sight of the drone they are monitoring. This project proposal describes briefly the possibility of designing a smartphone app to monitor and control a fleet of drones with an interface similar to that of GoogleSky.**

I. Introduction

Paparazzi is a free and open-source software project [1] comprising the hardware and software necessary deploy a drone autopilot system. Paparazzi has been used by universities, private companies and drone enthusiasts.

Paparazzi is articulated around a ground control system (GCS) and the actual drone. The drone is composed of modules for receiving orders from the ground station, modules for sending status reports to the ground station, and flight control systems and actuators. The GCS is generally a computer running the Paparazzi software, with an antenna to emit and receive messages to and from the drone and a standard RC transmitter.

During the flight of a drone, there are two pilots:

- the GCS operator inputs flight parameters and sees the flight data in real-time. He follows the trajectory of the drone on a map;
- the safety pilot observes the drone and holds ready to take command of in case anything unexpected happens. He follows the trajectory of the drone in the sky.

However, this system has several limitations. The safety pilot communicates with the GCS operator (for instance by talkie-walkie) in order to get the drone flight data. Therefore, the safety pilot does not have real-time information and the transmission can be of poor quality, resulting in incomprehensions. Furthermore, the safety pilot has no way of easily finding the position of a drone, and the safety pilot can not identify a drone that they see without prior knowledge.

Furthermore, the safety pilot usually has only a standard RC model remote control, so typically a pilot only follows one drone at a time. This limits the feasibility of a fleet of drones.

II. Related Work

Following an aircraft in flight has been the subject of a number of studies over the years.

Many smartphone based solutions such as FlightAware [2] or Flight Radar [3] enable the user to know the position, flight status and other information concerning most commercial flights in the world, and follow flights live.

Solutions also exist for controlling drones with a smartphone. For instance ARDrone Flight is the companion app to the Parrot ARDrone for controlling the drone and recording videos [4], [5]. However, it does not provide visual tracking using the phone's camera, and it is not open-source. The PPRZonDroid [6] is an application that you can use to control Paparazzi aircraft with your android device. However, it only replaces the GCS and the user can only follow the trajectory of a drone on a map.

GoogleSky [7] features tracking. It is a Google app that shows the celestial sphere on the smartphone screen by linking the screen display with the screen orientation. In the case of this project, the stars of GoogleSky would be replaced by a fleet of micro-drones.

Recent studies have also been done on the subject of swarming of ground robots or aerial drones [8], collective behavior, and flying ad-hoc networks (FANET) [9], [10]. Many applications for such FANETs are envisionned such as meteorological studies [11], thermal detection for hang-gliders [12] or search and rescue missions [13].

Studies in [14], [15] shows how the ad hoc network in the context of unmanned aerial systems (UAS) is a promising solution.

The apps that currently exist do not integrate drone control, drone monitoring and tracking of multiple drones in a single app. Therefore, even though this project is inspired by existing applications, it is unlike each of those applications.

III. Implementation

IV. Tests

V. Conclusion

The conclusion goes here.

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References

[1] "Paparazzi, The Free Autopilot," paparazziuav.org, Release of 2015-01-20. [Online]. Available: http://wiki.paparazziuav.org/wiki/Main_Page
[2] "FlightAware, Live Flight Tracking," flightaware.com, Release of 2015-01-20. [Online]. Available: http://flightaware.com/
[3] "Flight Radar 24, Live Air Traffic," flightradar24.com, Release of 2015-01-20. [Online]. Available: http://flightradar24.com
[4] "ARDrone Flight Recorder," ardrone2.parrot.com/apps/flight-recorder/, Release of 2015-01-20. [Online]. Available: http://ardrone2.parrot.com/apps/flight-recorder/
[5] "Parrot AR.Drone," ardrone2.parrot.com, Release of 2015-01-20. [Online]. Available: ardrone2.parrot.com
[6] "PPRZonDroid," wiki.paparazziuav.org/wiki/PPRZonDroid, Release of 2015-01-20.

[7] "Google Sky Maps," play.google.com/store/apps/details?id=com.google.android.stardroid, Release of 2015-01-20. [Online]. Available: https://play.google.com/store/apps/details?id=com.google.android.stardroid

[8] G. Vàsàrhelyi, Cs. Viràgh, G. Somorjai, N. Tarcai, T. Szrnyi, T. Nepusz, T. Vicsek, "Outdoor flocking and formation flight with autonomous aerial robots," *IEEE IROS Conference*, 2014.

[9] Q. Vey, A. Pirovano, J. Radzik, and F. Garcia, "Aeronautical ad hoc network for civil aviation," in *Communication Technologies for Vehicles - 6th International Workshop, Nets4Cars/Nets4Trains/Nets4Aircraft 2014, Offenburg, Germany, May 6-7, 2014. Proceedings*, 2014, pp. 81–93. [Online]. Available: http://dx.doi.org/10.1007/978-3-319-06644-8_8

[10] M. Royer, A. Pirovano, and F. Garcia, "Survey on context-aware publish/subscribe systems for VANET," in *Communication Technologies for Vehicles, 5th International Workshop, Nets4Cars/Nets4Trains 2013, Villeneuve d'Ascq, France, May 14-15, 2013. Proceedings*, 2013, pp. 46–58. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-37974-1_4

[11] G. Hattenberger, G. Cayez, and G. Roberts, "Flight tests for meteorological studies with MAV," in *IMAV 2013, International Micro Air Vehicle Conference and Flight Competition*, Toulouse, France, Sep. 2013, p. pp xxxx. [Online]. Available: https://hal-enac.archives-ouvertes.fr/hal-00936235

[12] J. Eckert, D. Eckhoff, and R. German, "Flying Ad-Hoc Network Communication for Detecting Thermals: Feasibility and Insights," in *3rd International Conference on Innovative Computing Technology (INTECH 2013)*. London, UK: IEEE, August 2013, pp. 333–338.

[13] G. D. Cubber, D. Doroftei, Y. Baudoin, D. Serrano, K. Berns, C. Armbrust, K. Chintamani, R. Sabino, S. Ourevitch, and T. Flamma, "Search and Rescue robots developed by the European ICARUS project," vol. 1, 2013.

[14] O. Bouachir, A. Abrassart, F. Garcia, and N. Larrieu, "A Mobility Model For UAV Ad hoc Network," in *ICUAS 2014, International Conference on Unmanned Aircraft Systems*, Orlando, United States, May 2014, pp. pp 383–388. [Online]. Available: https://hal-enac.archives-ouvertes.fr/hal-00998651

[15] O. Bouachir, "Design and implementation of communication architecture for civil mini-UAVs," Theses, Université Toulouse 3 Paul Sabatier (UT3 Paul Sabatier), Dec. 2014. [Online]. Available: https://tel.archives-ouvertes.fr/tel-01092318