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CELLULAR NETWORK CONTROL IN UNMANNED AERIAL VEHICLES

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The use of Unmanned Aerial Vehicles is rapidly growing in many industries and the requirement for longer range in these vehicles is imminent. RC Radios, though a very effective way to control these vehicles, are fairly limited. The use of cellular networks to connect and control the vehicle can make the range virtually unlimited.
Keywords: UAV, cellular network, glider

A cellular network or mobile network is a communication network that is distributed over land areas called "cells", each served by at least one fixed-location transceiver, but more normally, three cell sites or base transceiver stations. These base stations provide the cell with the network coverage which can be used for transmission of voice, data, and other types of content. A cell typically uses a different set of frequencies from neighbouring cells, to avoid interference and provide guaranteed service quality within each cell [1].

Although the cellular network (preferably 4G) is also a Radio Frequency connection, but the availability of pre-installed multiple fixed-location transceivers makes it more reliable and available over longer distances. There are multiple radio control devices which can provide connection over 100 kilometers but very few are available commercially not to mention the weight of the equipment. In contrast, using the pre-existing ground transceivers that the cellular companies use, reduces the bulk and is considerably cheaper.

Setup

1. Recognize a platform to use for long distance flights and make changes to it.
2. Integrate a modem in the system of the vehicle to receive and transmit data.
3. Setup a ground station with connection to the internet to relay signals to the vehicle and receive data.
4. To account for the delay in relaying commands to vehicle install a failsafe radio.

The UAV platform for testing navigation algorithms mentioned in [2] seems like a really good candidate to make the said modifications, but it lacks the capacity to traverse long distances due to heavy power draw.

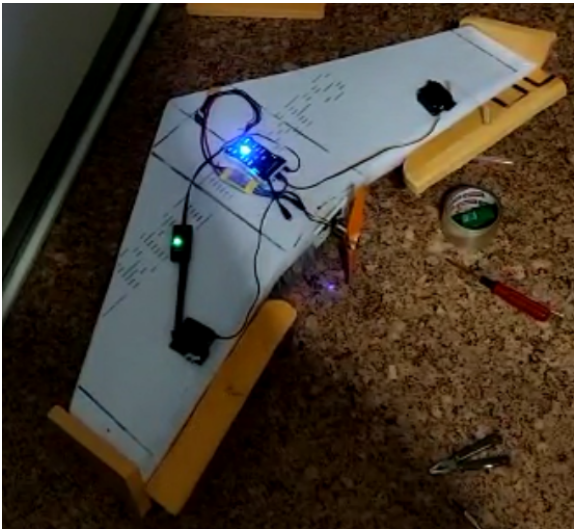

Figure 1. Glider

A generic glider design (seen in figure 1), with a similar architecture from [2] is a perfect candidate for long distance flights.

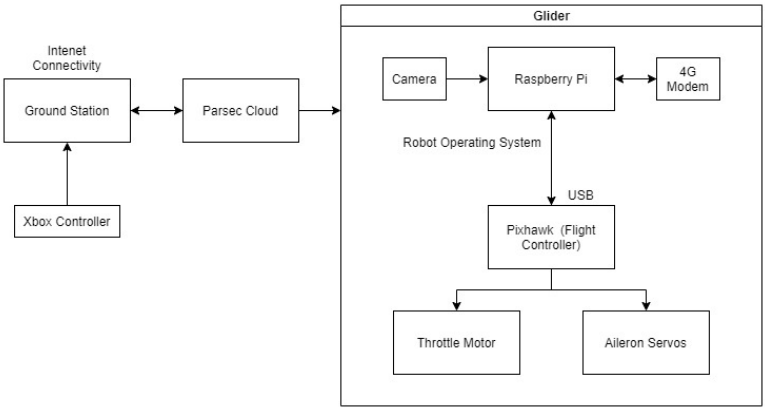

Figure 2. Architecture

As seen in figure 2, a Raspberry Pi 3 with a camera was used as an on board computer in the glider, which is connected to the flight controller

PixHawk [3] using a USB interface. A 4G Modem (dongle) with an active data connection is also connected to the raspberry pi to connect to the ground station. An Xbox controller from Microsoft was used to control the pitch and roll of the vehicle. On the software side, ROS (Robot Operating System) installed in the Raspberry Pi was used to coordinate signals to the flight controller and receive telemetry data. A low-latency streaming application, Parsec [4] is used to stream the screen from the raspberry pi to the ground station.

Once this architecture in realized and parsec is setup, we can connect to the raspberry pi from the ground station and see its desktop. Assuming that everything is setup and the Xbox controller configured in ROS as the primary input for the /joy topic**,** the MAVROS Package in ROS [5] should be used and the messages from the joy topic should be published in the *~manual_control/send* topic, thus establishing control of the glider. The live feed from camera can be viewed on raspberry pi using VLC or any other application which can play RAW Video from the input device. This device in now ready for testing and use.

The tests performed had RC transmitter as a failsafe as a last resort if cellular networks fail.

Multiple tests were done locally but were limited to a short distance of approximately 10 kilometers with excellent results, but since this relies on the pre-existing cellular network, the reliability of this system depends on the network connection of commercially available telecom provider's connection strength in the given area.

Conclusion

In the 21st century, cellular network coverage has reached in most of the remote places in the world and having a UAV which can traverse and transmit images from virtually anywhere on Earth with cellular network coverage, is a very advantageous tool to have with numerous applications.

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