

Modules 9 - 11

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1 Drone Design & Construction

When building our drone, we chose to go with an H-type quadrotor. We chose this type because it is made primarily using right angles, making it easy to build and fix. After crafting the wooden arm beams, we added a platform in the center of the drone to hold the main electronics along with some feet to offer stability upon landing and takeoff. We spent quite a lot of time trying to place the flight controller in a good location, allowing the wires between the ESCs and the power distribution board to remain fixed without being stretched too much.

Although we overcame this issue with a somewhat insignificant amount of work, it was also a bit of a struggle to map out the different components in a way where the ESCs and Power Distribution Board (PDB) didn't interfere with the GPS, radio communication, and telemetry in the PX4 Hub. The main source of disturbance from the ESCs and PDB was the high-frequency switching of electronic signals, which caused the magnetic fields in the wiring harness to switch, leading to significant electromagnetic interference (EMI).

The drone ended up being rather heavy and thus consumes a lot of power when flying, significantly reducing flight time to around an hour. A schematic drawing as well as a picture of the final drone design can be seen in Figures 1,2.

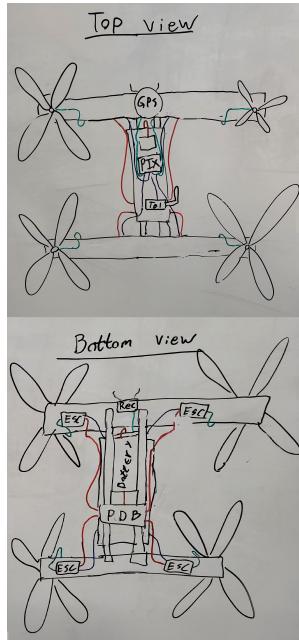


Figure 1: Drone diagram

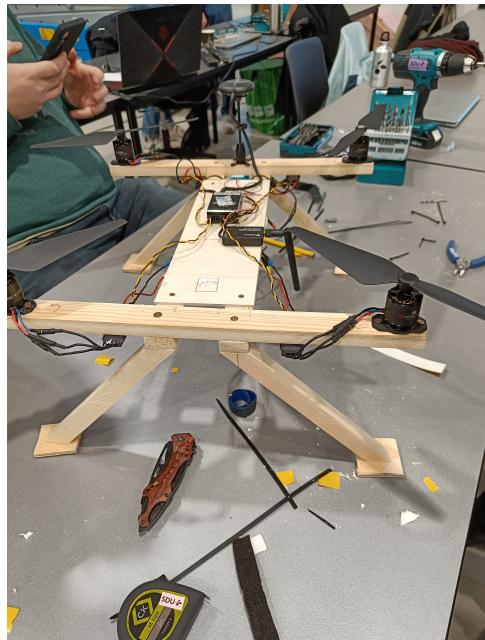


Figure 2: Final drone

2 Progress towards autonomous flight

The drone achieved one successful autonomous flight. We added the pre-programmed plan to the flight controller through QGroundControl using the Micro-USB cable and prepared the drone for takeoff. When we armed the drone and set the control type to mission, it shot up in the sky at much higher altitudes than we expected. This may have happened because we logged the altitudes in feet instead of meters during the manual flight. Although there was a small issue with the heights, the general shape flown matched the logged plan perfectly.

When attempting to fly additional autonomous missions, we discovered an issue with the radio communication. This occurred when tasked with transferring a pre-programmed mission to the drone. We could transfer the mission just fine through USB and fly it while getting telemetry back from the drone to the ground station, however, we never got the radio transfer of the mission to work. This will be the focus point of the last trip to the airport.

3 Experiences from flight test

The first attempt at flying the drone in the drone cage with stabilized mode ended up causing it to crash which we believe was due to us commanding too much throttle while moving it forwards at takeoff. Luckily only one of the rotorblades ended up getting damaged. At the next attempts, giving more throttle while keeping the drone still with roll and pitch ended up proving successful for takeoffs. The crashed drone can be seen in figure 3.

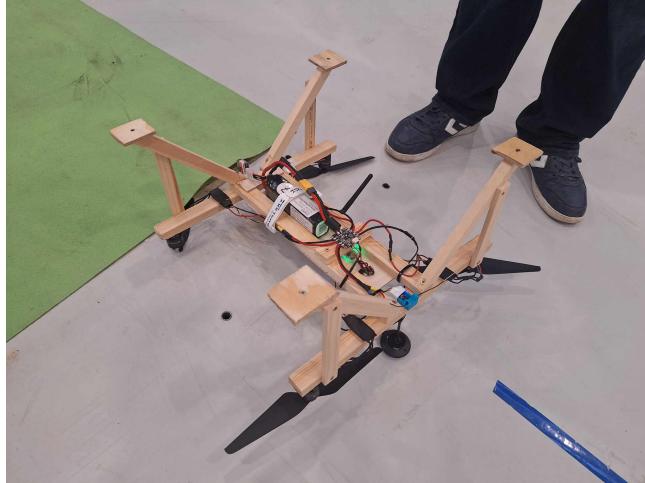


Figure 3: Anders crashed the drone and the top left rotorblade is destroyed.

This problem ended up being less impactful when flying in position mode which was much easier to control in general due to the drone attempting to stay in its geographical place. The importance of having a person as ground station monitoring the status messages from the drone, the power level, number of satellites and position, became clear when flying, especially when having to abort several missions due to radio communication failing when transferring the plan to the flight controller.



Figure 4: Getting ready to test fly the drone outside

4 Videos from flights

We made sure to record videos from all our flights. The following album contains the videos from the flights in stabilized mode in the drone cage, positional mode on the outside and lastly there is a 4 min long video of our autonomous/preprogrammed flight.

Video Album <https://photos.app.goo.gl/N19DyRCNoDMygCft5>