

Introduction to Drone Technology (IDT)

Module 09 - Build a Drone

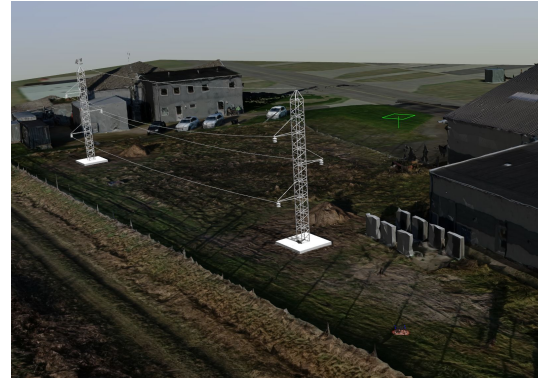
Welcome to the SDU UAS Test Center

Center Objective

"We focus on research, education, innovation, and collaboration in the UAS domain for the benefit of society."

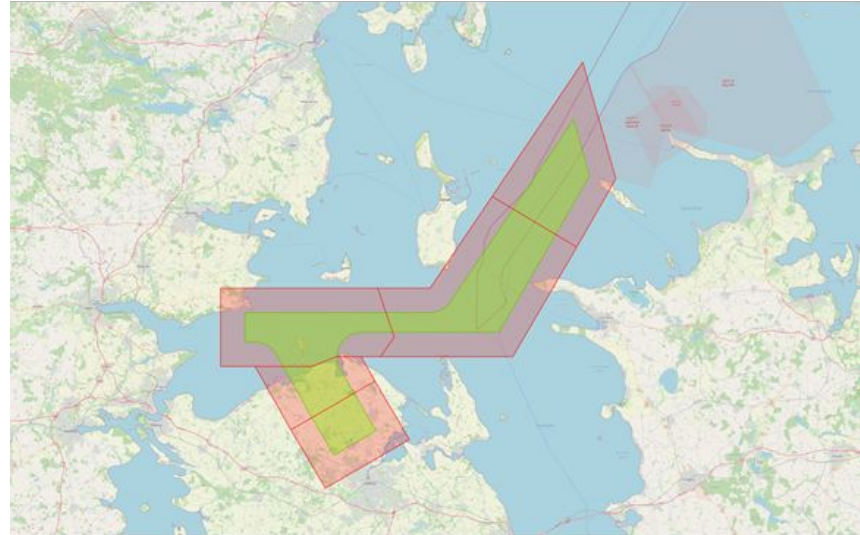
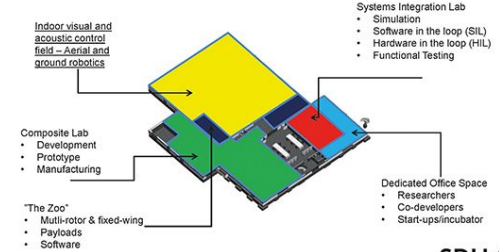
Facilities

- Indoor Optitrack System
- Dedicated Drone Airspace for BVLOS
 - 1900 km² airspace
- System Integration lab
- Infrastructure Inspection Setup
- Composite lab
- Start-up hub



Aerial Systems Laboratory

- Located at Hans Christian Andersen Airport, 15km from SDU
- 2200 m²
- Access to designated airspace



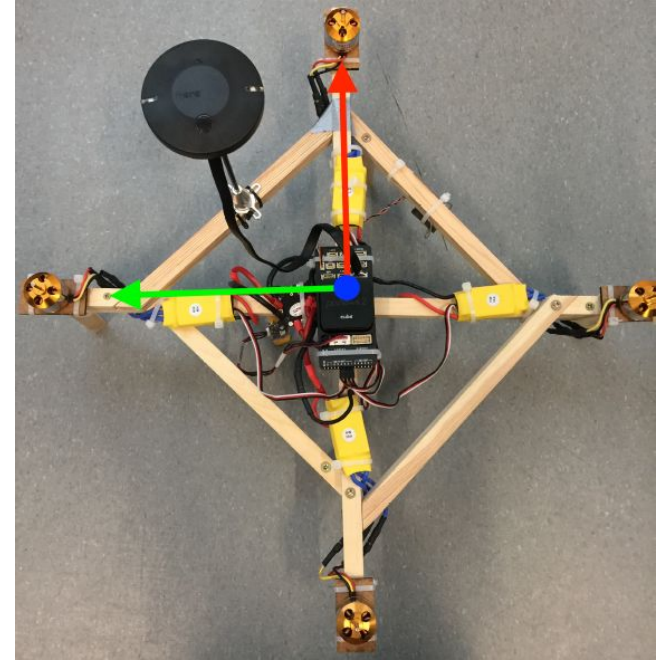
Schedule

0845 - 0900	Introduction, Drone Components Overview
0900 - 0930	Safety Briefing, Facility Tour
0930 - 1545	Drone Building
1545 - 1615	Transport Back to SDU

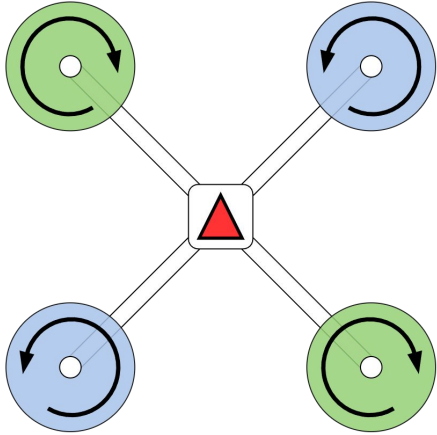
- Reminder: Fill out the Guest Access Form
 - Available on itsLearning
- Course notes and guide on Confluence:
 - <https://sdu-dronecenter.atlassian.net/wiki/spaces/IDT/pages/>

Task overview

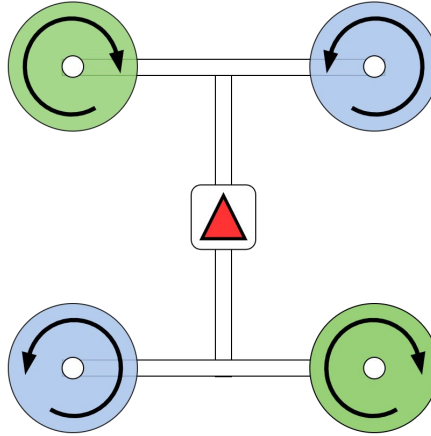
- **Step #1: Build a frame**
 - Design considerations
- **Step #2: Mount and connect hardware**
 - [Pixhawk 4 Mini Wiring Quick Start](#)
- **Step #3: System Configuration and Calibration**
 - Continues work from Module 06
- **Step #4: First flight and tuning (inside the drone cage)**
 - [Multicopter PID Tuning Guide](#)
- **Step #5: Outdoor flights (both manual and mission)**
- **Step #6: Autonomous Outdoor Flights (using recorded flight plans)**



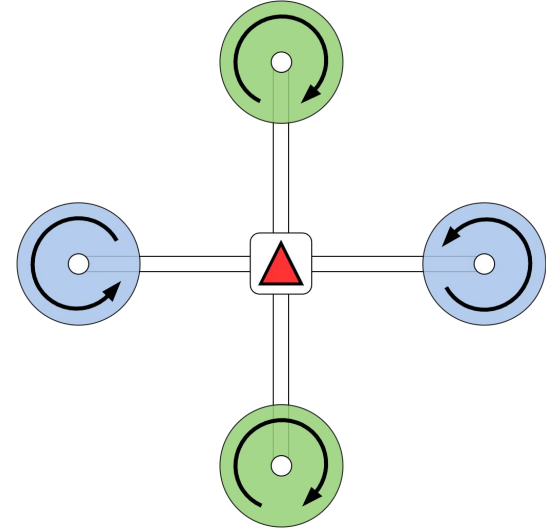
Recap - Recommended Configurations



X Type



H Type



+ Type

Recap - Design Considerations

- Weight vs Time - tradeoffs
- Repairability in mind - Keep it simple, easy to fix in event of crash
- Mounting battery to frame
 - Must be removable
 - Easy to access connector (in Case-of-Emergency)
- Positioning of components
 - Flight Controller placed near centre of mass
 - Propulsion electronics and control hardware
- Landing legs
 - Ability to withstand heavy landings
 - Provide clearance from grass

Materials and Resources

Materials

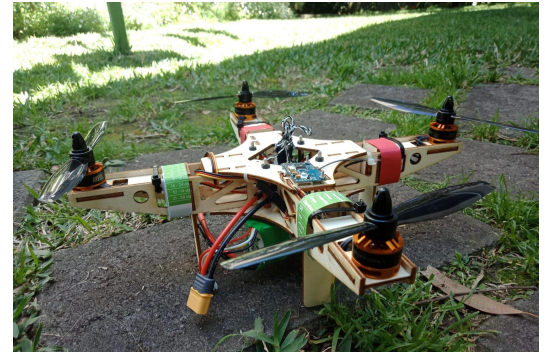
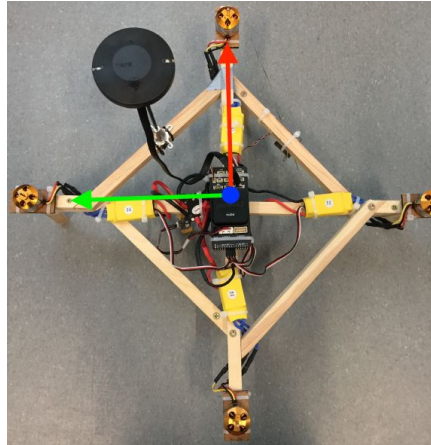
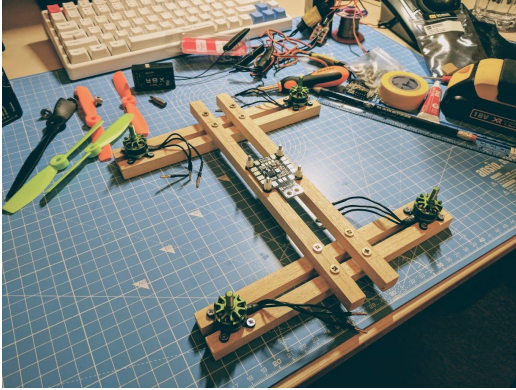
- Wood Spars (assorted thicknesses)
- Plywood Plates
- Wood screws
- Assorted Nuts/Bolts
- Zip ties
- Tape
 - Double sided
 - Electrical

Resources

- Workbenches
 - 2 teams per workbench
 - Toolboxes and workbench are colour-coded
- Tool Boxes
 - Drilling
 - Filing
 - Sawing/cutting



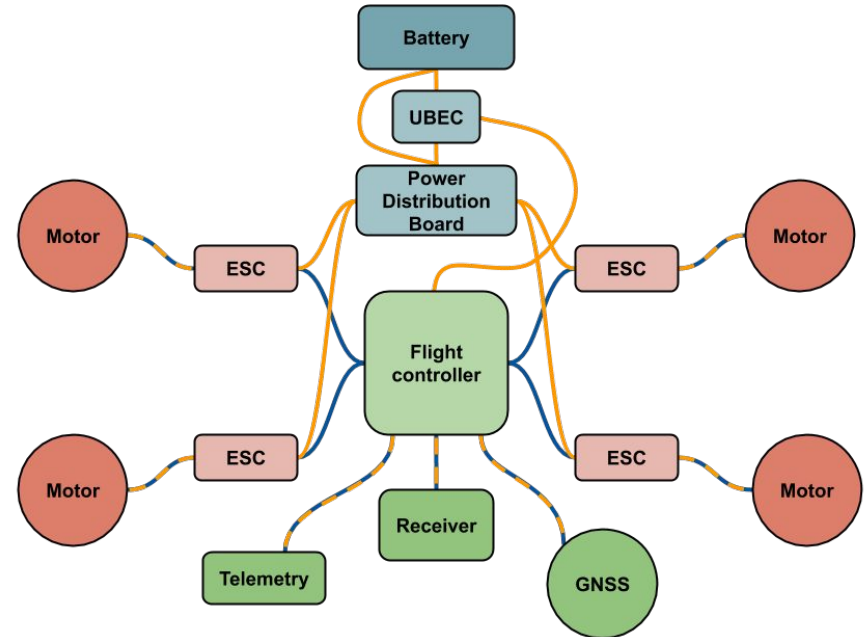
Design inspiration



Drone Components

Drone Overview

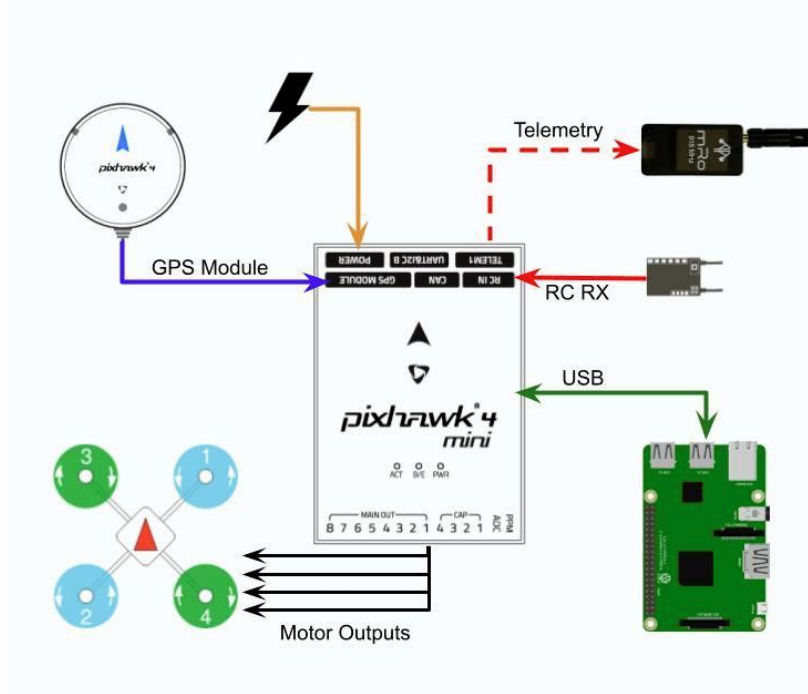
- **Airframe**
 - Materials
- **Flight Hardware**
 - Flight Controller (FC)
 - Global Navigation Satellite Systems (GNSS)
- **Powertrain**
 - Motors and Propellers
 - Electronic Speed Controllers (ESCs)
- **Communication and Control**
 - Telemetry
 - User Control
- **Input Power**
 - Batteries and Chargers
 - Power Distribution
 - Battery Elimination Circuit (BEC)
- **(Payload)**



Flight controller

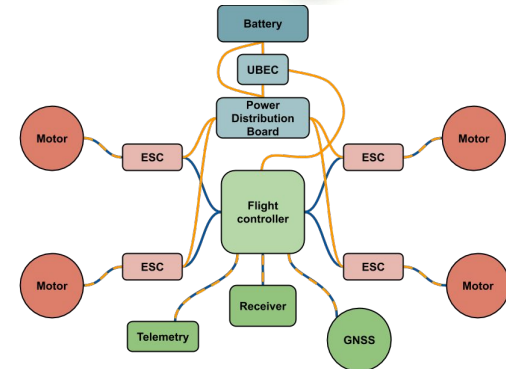
Hardware

- Pixhawk 4 Mini
- Pixhawk 6C Mini



PX4 Developer guide:

- Pixhawk 4 Mini Wiring Quick Start
 - https://docs.px4.io/master/en/assembly/quick_start_pixhawk4_mini.html
 - https://docs.px4.io/master/en/flight_controller/pixhawk4_mini.html



Motors, ESCs and Propellers

Hardware

- AIR2216 880kv/920kv
- T1045 self-locking propellers (CW/CCW)
- AIR20A V2 compact ESC



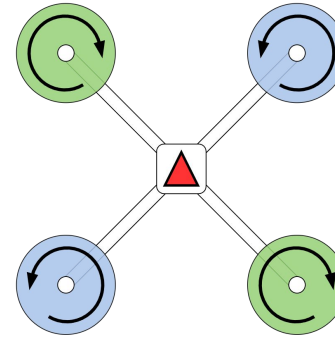
AIR 2216x4



AIR 20Ax4

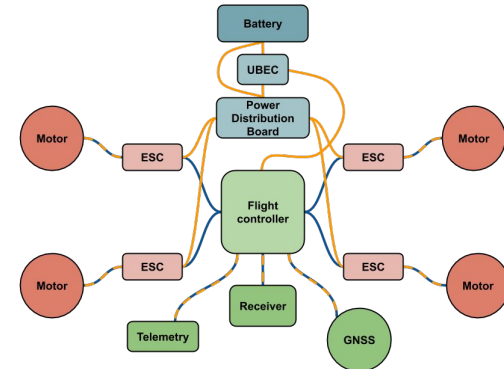


T1045(CW&CCW)x2



PX4 Developer guide:

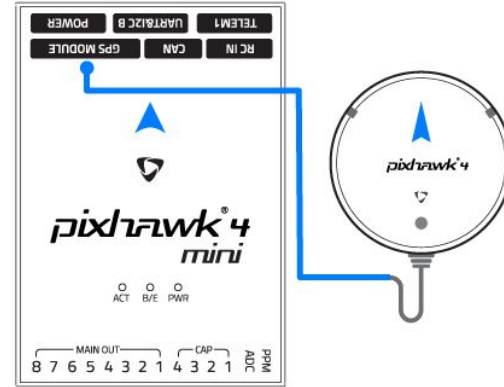
- ESCs & Motors
 - https://docs.px4.io/master/en/peripherals/esc_motors.html
- PWM Servos and ESCs (Motor Controllers)
 - https://docs.px4.io/master/en/peripherals/pwm_escs_and_servo.html



Global Navigation Satellite System (GNSS)

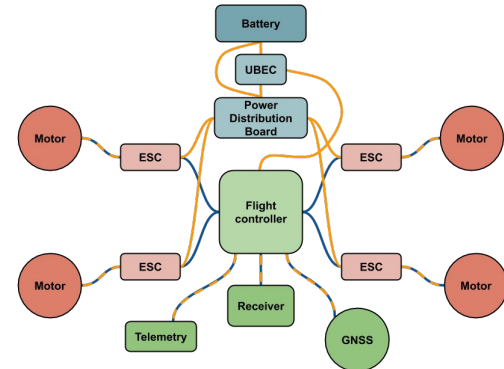
Hardware

- Pixhawk 4/6C GPS



PX4 Developer guide:

- GPS & Compass
 - https://docs.px4.io/master/en/gps_compass/



Receiver and Transmitter

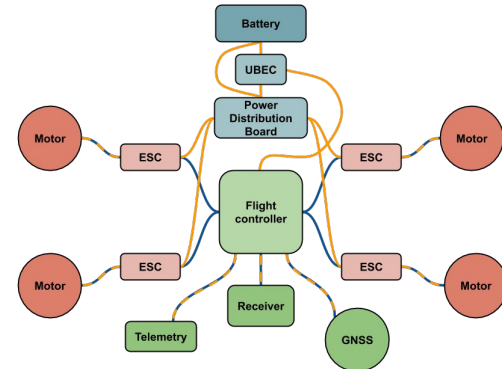
Hardware

- Taranis Q X7 transmitter
- R-XSR receiver
- 2x Li-ION Batteries
- Li-ION charger



PX4 Developer guide:

- Radio (Remote Control) Setup
 - https://docs.px4.io/master/en/getting_started/rc_transmitter_receiver.html
- Radio (Remote Control) Setup
 - <https://docs.px4.io/master/en/config/radio.html>
- Flight Mode Configuration
 - https://docs.px4.io/master/en/config/flight_mode.html



Telemetry

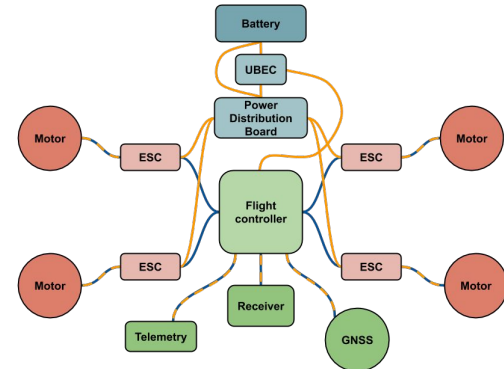
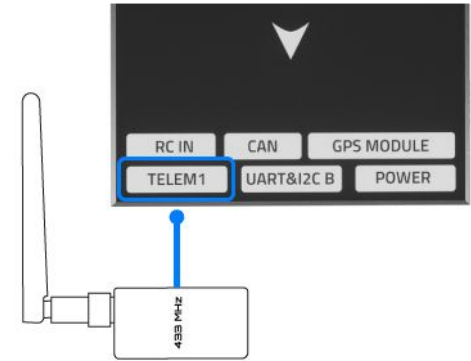
Hardware

- 2x SiK Radios



PX4 Developer guide:

- Telemetry Radios/Modems
 - <https://docs.px4.io/master/en/telemetry/>
- SiK Radio
 - https://docs.px4.io/master/en/telemetry/sik_radio.html



Power Distribution Board (PDB) and Universal Battery Elimination Circuit (UBEC) / Power module

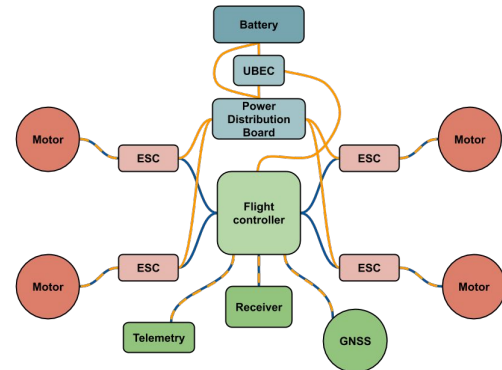
Hardware

- Pixhawk4 Mini Power Management Board (PMB)
 - Both a Power Module as well as a Power Distribution Board (PDB)
 - UBEC for powering additional peripherals



PX4 Developer guide:

- Pixhawk 4 Mini Wiring Quick Start
 - https://docs.px4.io/master/en/assembly/quick_start_pixhawk4_mini.html



Batteries and charger

Hardware

- 2x Lipo batteries
(swapping batteries, remember to include this in your design)

Don't plug in any batteries before one of your instructors has verified the connections!



Charging

- Charging of batteries must always be done in the battery room

PX4 Developer guide:

- Battery and Power Module Setup
 - <https://docs.px4.io/main/en/config/battery.html>

