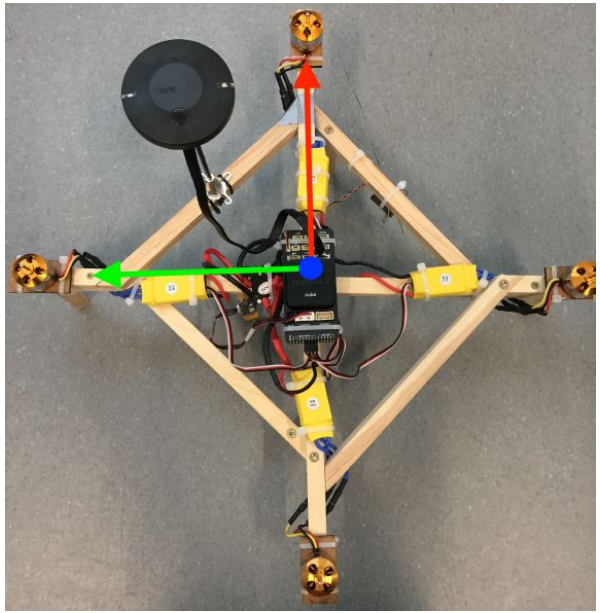


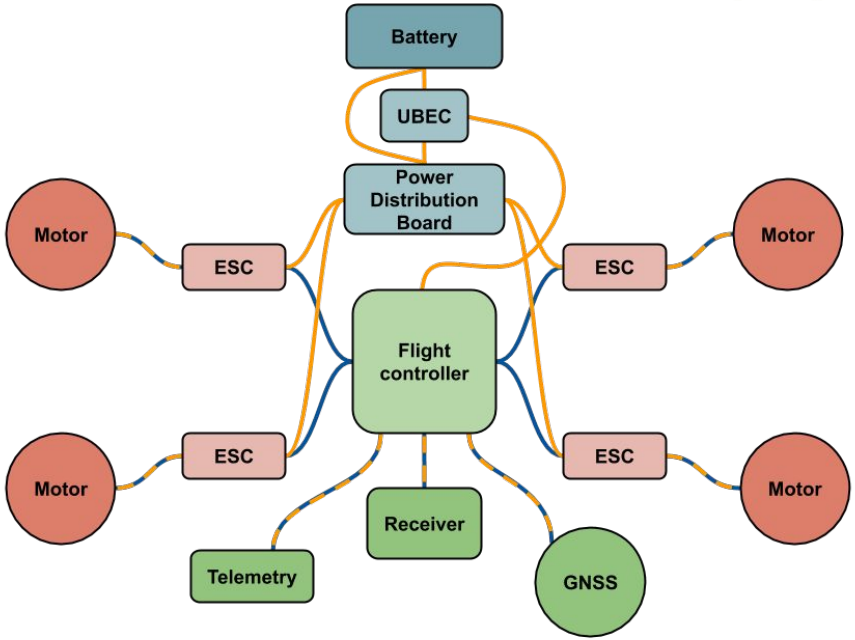
Introduction to Unmanned Aerial System (UAS) technology

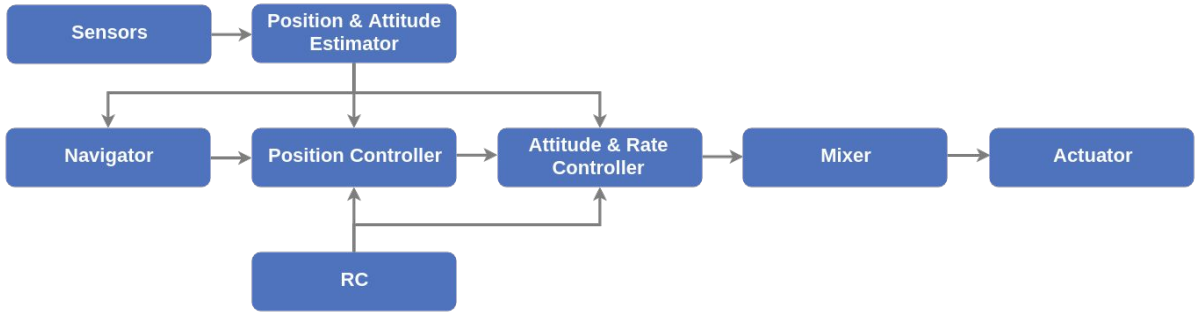
Summer School 2021, SDU UAS Center

Overview

Drone components

- Materials (wood, zip ties, etc.)
- Receiver and Transmitter
- Flight controller
- Motors and Electronic Speed Controllers (ESC)
- Power Distribution Board (PDB)
- Universal Battery Elimination Circuit (UBEC) / Power module
- Global Navigation Satellite System (GNSS)
- Telemetry
- Batteries and charger

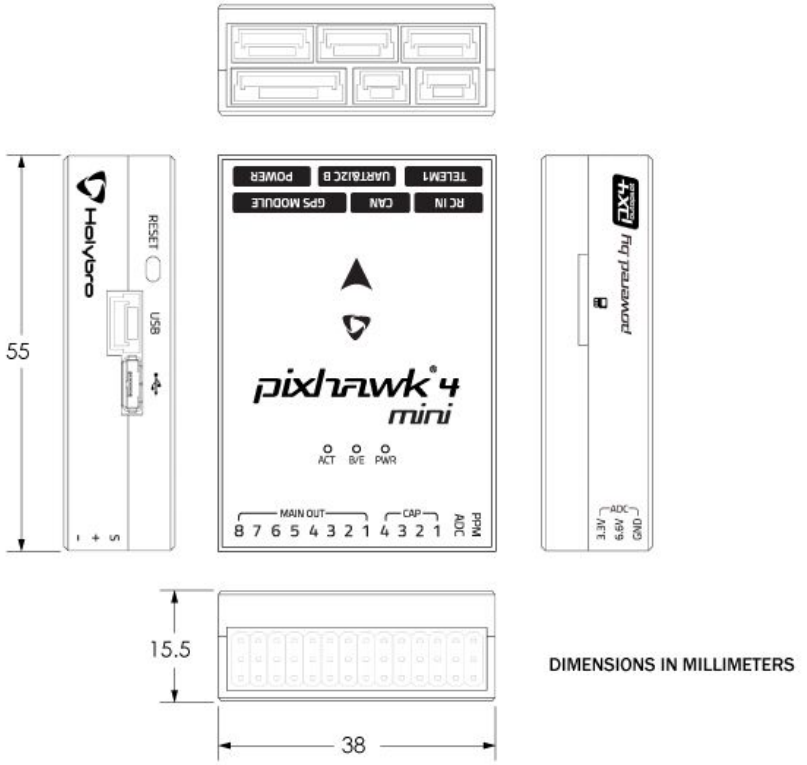




Flight controller

Hardware

- Pixhawk4 Mini



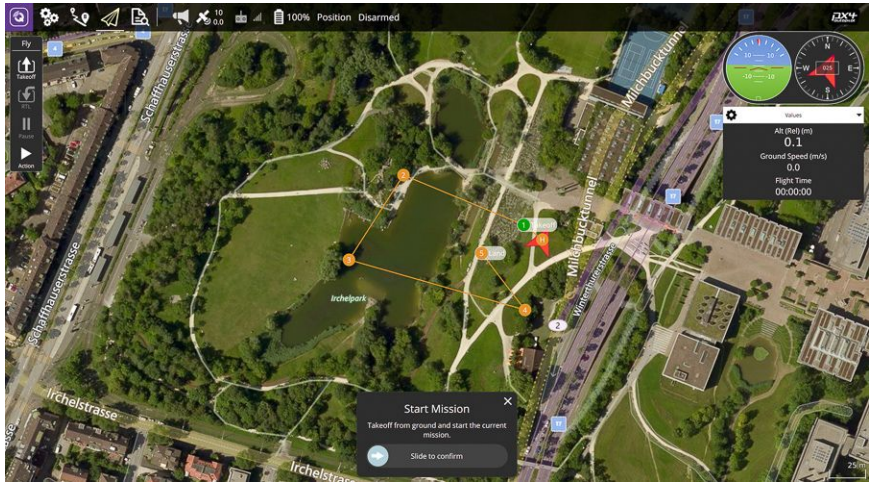
PX4 Developer guide:

- 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

Flight controller

Ground Control Station software

- Download QGroundControl
  - http://qgroundcontrol.com/downloads/
- Flash firmware
  - Flight stack: PX4
- Configuring the flight controller
- Sensor calibration
- Monitor the flight



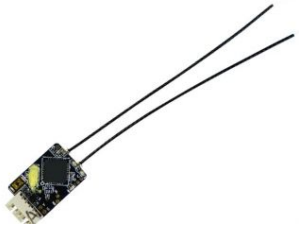
QGroundControl User Guide

- https://docs.qgroundcontrol.com/master/en/getting_started/quick_start.html
- https://docs.qgroundcontrol.com/master/en/index.html

Receiver and Transmitter

Hardware

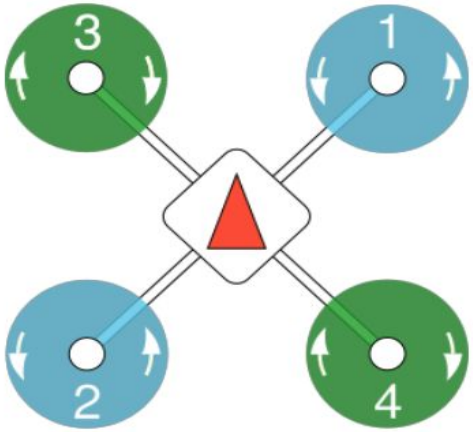
- Taranis Q X7 transmitter
- R-XSR receiver
- 2x Li-ION Batteries
- Li-ION charger



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

Motors, ESCs and Propellers



Hardware

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

AIR 2216x4

AIR 20Ax4

T1045(CW&CCW)x2

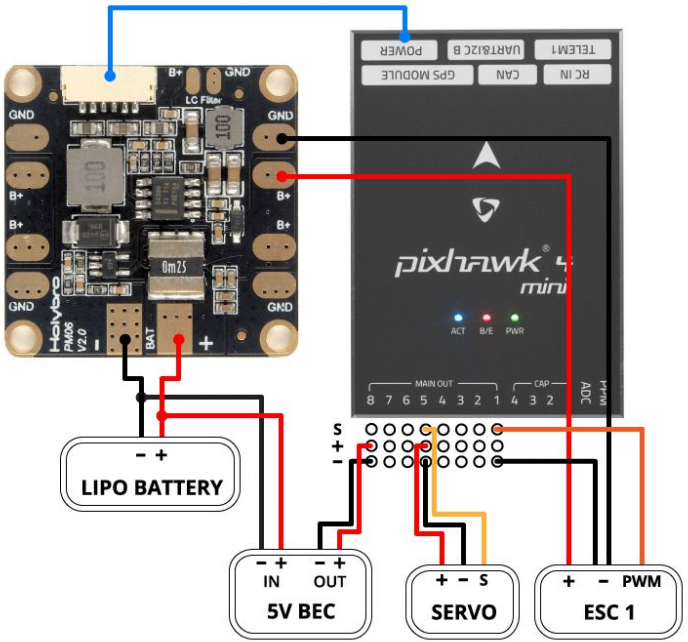
PX4 Developer guide:

- 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

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

Hardware

- Pixhawk4 Mini Power Management Board (PMB)
  - (5V BEC and Servo not needed)



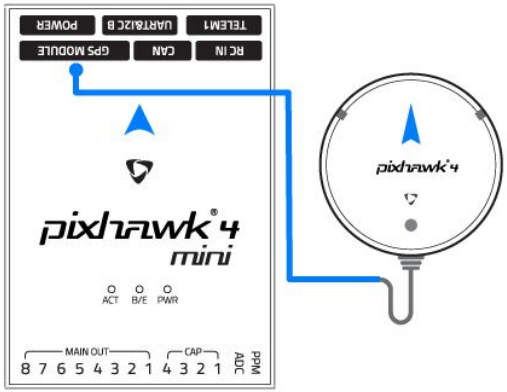
PX4 Developer guide:

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

Global Navigation Satellite System (GNSS)

Hardware

- Pixhawk 4 GPS



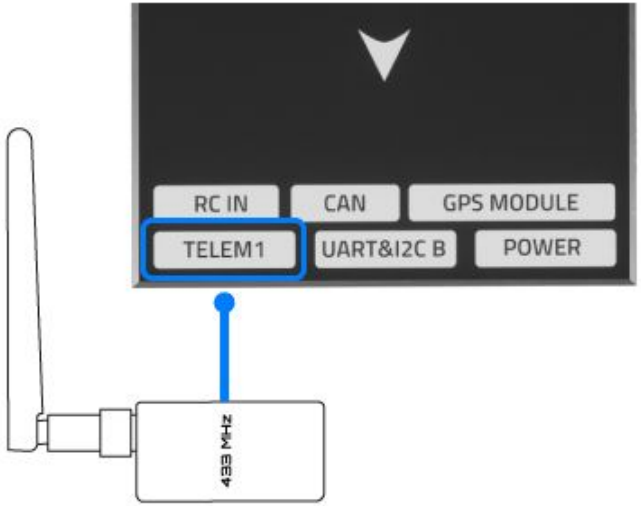
PX4 Developer guide:

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

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

Batteries and charger

Hardware

- 2x Lipo batteries
- 1x Lipo charger

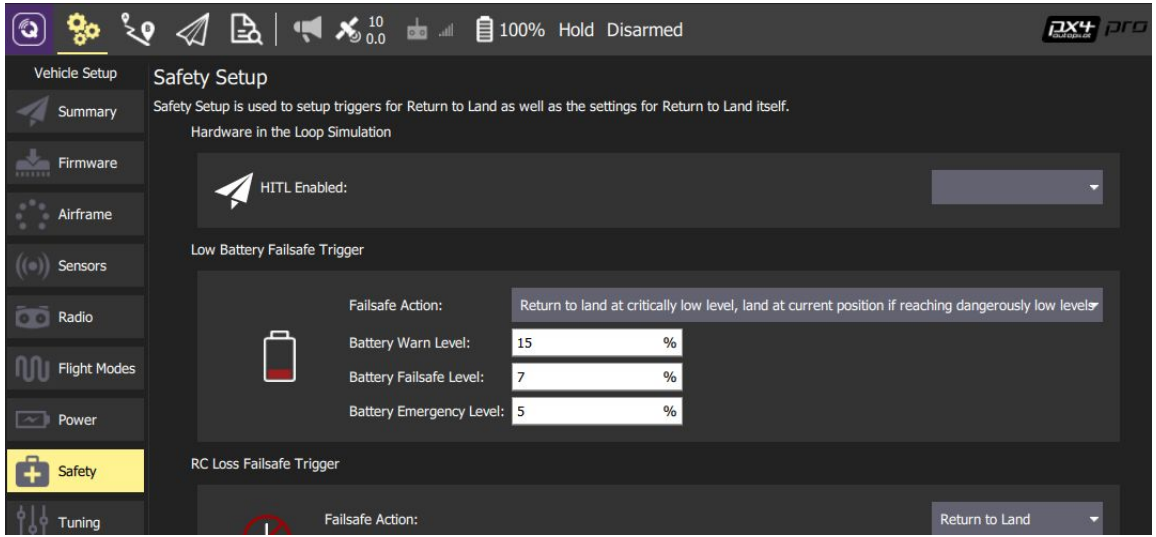
PX4 Developer guide:

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

Flight modes and safety

Flight mode

- Manual (ch5)
- Position hold (ch5)
- Mission mode (ch5)
- Kill switch (ch6)



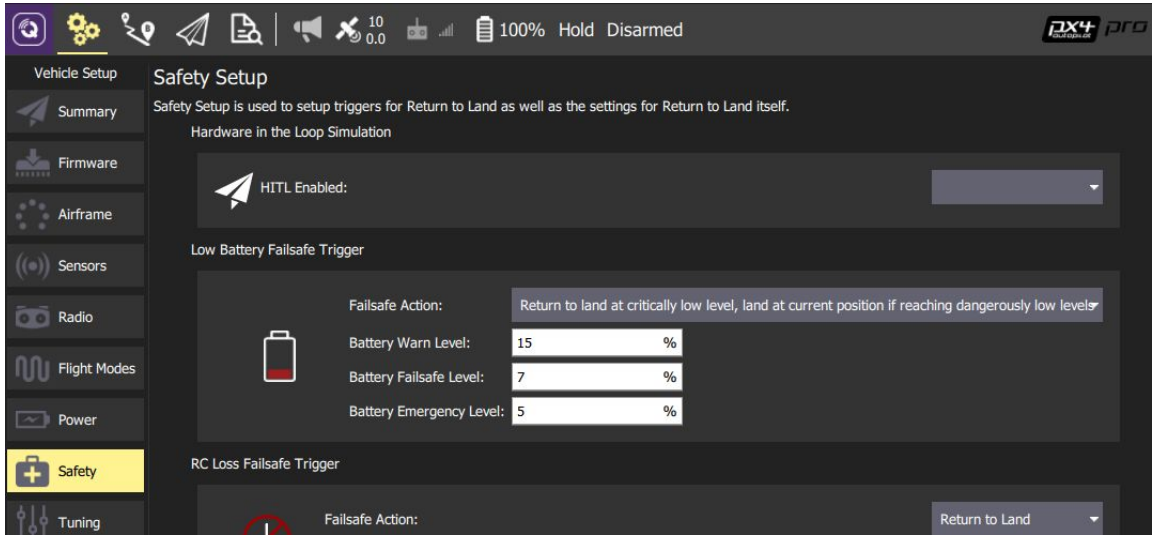
PX4 Developer guide:

- Radio (Remote Control) Setup
  - https://docs.px4.io/master/en/config/radio.html
  - Flight modes
    - https://docs.px4.io/master/en/getting_started/flight_modes.html
    - https://docs.px4.io/master/en/flight_modes/#multicopter

Flight modes and safety

Safety and failsafes

- Low Battery failsafe
- RC Loss failsafe
- Data Link Loss failsafe
- Geofence failsafe
- **Failsafe modes**
  - Hold mode
  - Return mode
  - Land mode
  - (Flight termination)

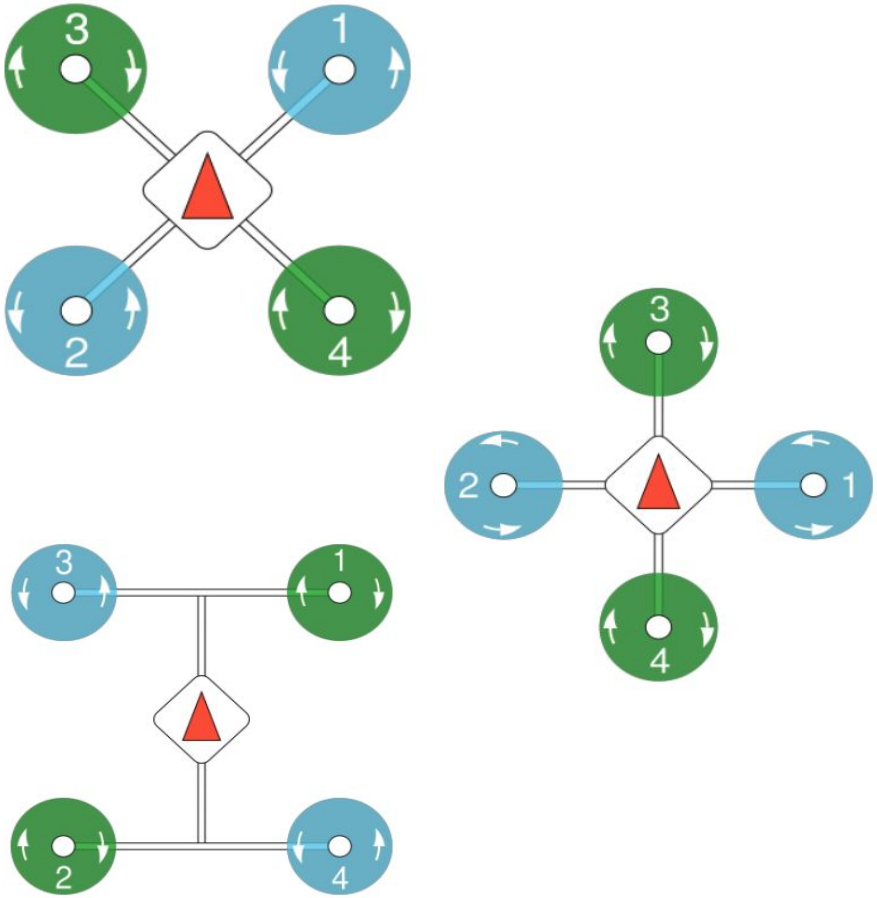


PX4 Developer guide:

- Safety setup
  - https://docs.px4.io/master/en/config/safety.html

Exercises

- Build a frame
  - Design considerations
- Mount and connect hardware
  - Pixhawk 4 Mini Wiring Quick Start
- Configure/setup the system
  - Firmware upload
  - Set the Airframe
  - Transmitter and flight modes
  - Failsafes
- Calibrate the system
  - Sensor Orientation
  - Compass
  - Gyroscope
  - Accelerometer
  - Level Horizon
- First flight (inside the drone cage)
- Tune the system
  - Multicopter PID Tuning Guide
- Test camera payload



Camera payload

Material

- Raspberry Pi A+
- Raspberry PI Camera
- Attiny with cable
- SD card
  - /home/pi/**record_images.py**
  - /home/pi/**record_video.py**
  - /etc/**rc.local**

Configure AUX port using QGC

- RC_MAP_UAX1 = Channel 6