PiQuad™

PiQuad™ is a quadcopter built upon the Raspberry Pi, a single board computer serving as the flight controller and realizing key functions needed in a remotely piloted air vehicle – guidance, navigation, control, sensor data reception, motor command transmission, and a remote pilot interface.

Offered as a turnkey system, it is well suited for use as a laboratory platform for control system design and experimentation. Users have open access to the functional interfaces present in the code, to the hardware interfaces on the Raspberry Pi, to the source code of the top level and several modules, and to the features provided by the Linux OS.

Included

-- Raspberry Pi A+

-- Turnigy 9x 2.4 GHz radio controller

-- Ultimate GPS receiver

-- 5000 mAHr LiPo battery and charger

-- WiFi

-- Operation and flight instruction manuals

-- Tether clips for constrained flight testing

Optional Equipment

-- 12 MP 1080p camera & stabilized mount for on-board video capture

-- FPV camera for real-time downlink of HD analog video

-- RPi Camera for video downlink via WiFi

Target Projects & Labs

-- Plant parameter measurement

-- IMU calibration

-- PID & LQG/LQR attitude control design

-- Cooperative multi-node formation flying

-- Differential GPS landing system

-- Vision-aided navigation

FEATURES

-- Built upon Linux and coded in Python

-- Open architecture, open interfaces

-- Inertial Navigation:

- **IMU—angular rates, linear accelerations**
- **magnetometer**
- **baro-altimeter**

-- Flight data logging and in-flight plotting

-- Lost RC link controlled auto-land

-- 8 Ch Remote Pilot Command interface with 2 spare channels

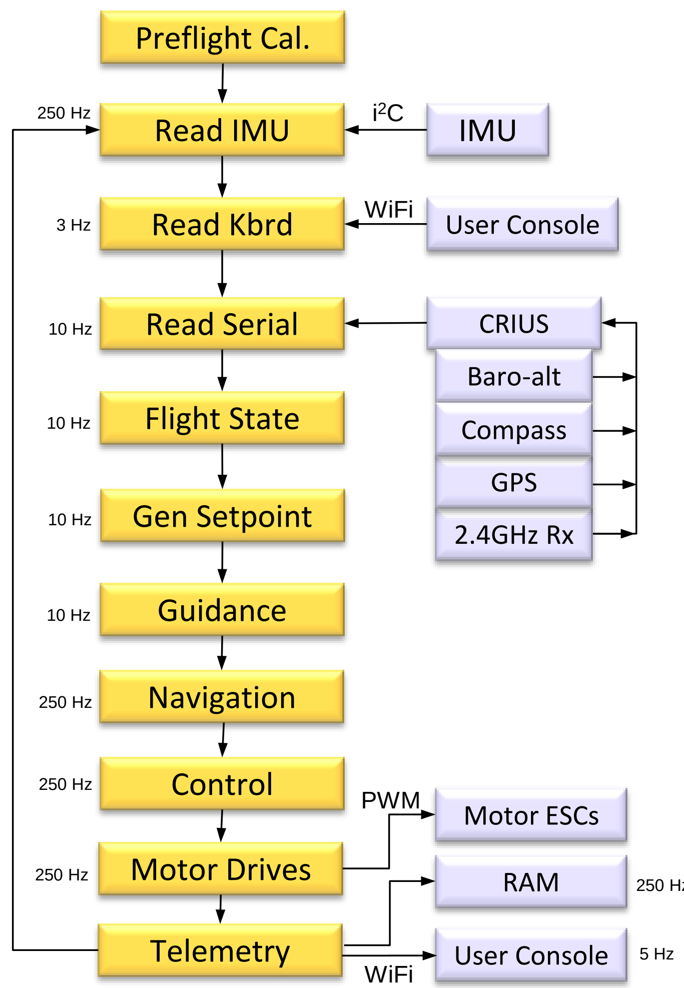
COMING ENHANCEMENTS

-- GPS-aided waypoint navigation

-- Pilot commanded return home

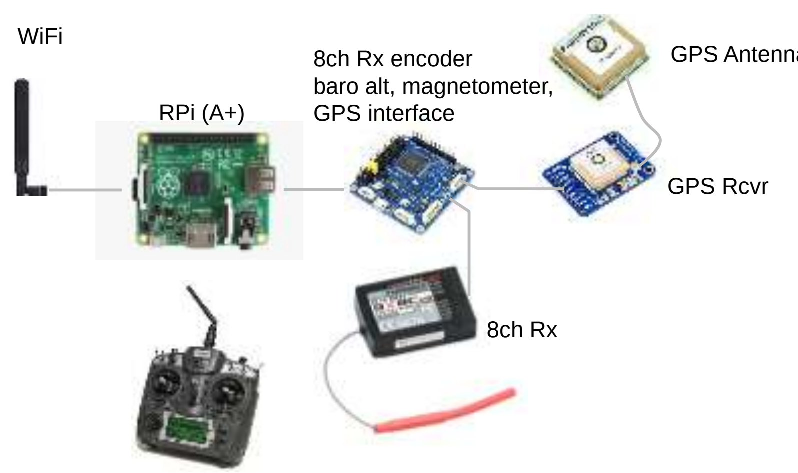
BLOCK DIAGRAM

PiQuad's software and hardware architectures are open, shown at right and described in an Interface Control Document (ICD) at roboticsinflight.com. This document defines for each module, their interfaces (symbol names, definitions, data types, update rates) and the functionality realized therein. Users have access to and can modify these interfaces as desired – they can substitute inputs signals with their own or even replace entire blocks. The main loop shown at right runs at approximately 250 Hz. Angular rates and linear accelerations are received from the Inertial Measurement Unit (IMU). Sensor biases identified during preflight calibration are used in IMU error compensation. Flight state changes (Idle, Flight, Cal) are pilot controlled thru the radio control (RC) link and WiFi connected laptop. Altitude, GPS location, pilot commands, and magnetometer data are received over a serial link and processed within the navigation module to estimate the vehicle's current location and attitude. Setpoints derived from pilot commands are sent to the guidance law which defines the altitude, heading and attitude needed to drive the vehicle toward a desired location. An LQG/LQR controller stabilizes the platform about the attitude and velocity commands it receives. Four control signals (roll, pitch, and yaw torques, and vertical thrust) are converted to PWM signals that feed Electronic Speed Controllers which drive the motors and propel the vehicle.



REALTIME TELEMETRY

GPS location and other user selectable data (altitude, attitude, velocity, etc.) are transmitted via WiFi at 5 Hz for real-time visualization of the flight trajectory. A limited time window, user-triggered capture at 250 Hz is stored locally.



CONTACT INFORMATION

roboticsinflight@gmail.com