

Ministry of Education and Science of Ukraine
NATIONAL UNIVERSITY OF KYIV-MOHYLA ACADEMY
Department of Informatics, Faculty of Informatics



Hardware design, assembling, and configuration for FPV UAV.

Volodymyr Rastiehaiev

Thesis supervisor - Andrew Kurochkin

Research objective and problem research

- FPV drone hardware
- UAV assembling
- Integrating FPV hardware with custom flight controller
- Low-level implementation of hardware communication protocols

Components of FPV drone

There are ten of them

- Flight Controller
- Electronic Speed Controller
- Motors
- Motion Measurement Unit
- Radio receiver
- Camera
- Video transmitter
- On-Screen Display chip
- Accumulator
- Frame

Flight Controller

Available on market

- F0, F1, F3, F4, G4, F7, H7
- Based on STM32 microprocessors
- F0, F1, F3 outdated
- F4 is better, but no hardware-supported inversion
- G4 was made because of the global chip shortage
- F7, H7 are most advanced

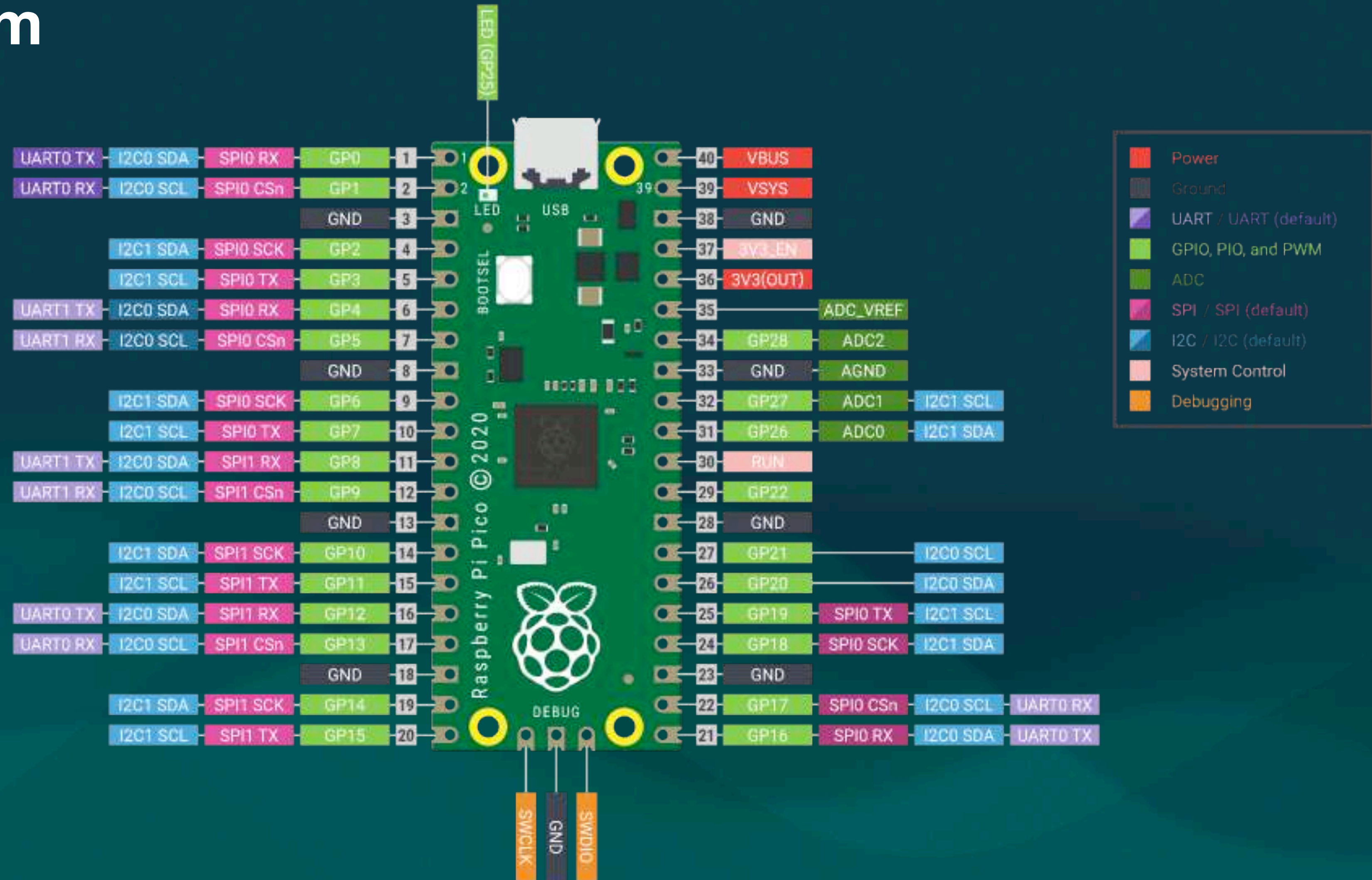
Flight Controller

Raspberry Pi Pico

- Has RP2040 chip based on Arm Cortex M0+
- Has two cores
- No FPU
- Cheap
- Great documentation available
- Has Programmable I/O

Raspberry Pi Pico

Pinout diagram



Motors

Brushed & brushless

- Work principle
- Brushless are better for FPVs
- Size & KV

Electronic Speed Controller

Types and used protocols

- Required to control the motors
- Can come as a separate units or as a single unit called 4-in-1 ESC
- Higher current for weight and size tradeoff
- Uses standard PWM & other analog protocols
- New DSHOT protocol as a digital and reliable alternative

Motion Processing Unit

Small but extremely important thing

- Measures angular speed and linear acceleration
- Data is sent to FC using I2C
- Helps to stabilize the UAV in space and achieve smooth flight

Accumulator

Powers the whole thing

- LiPo accumulators are used due to their size and price
- Consists of cells, each cell having a nominal voltage of 3.7V
- Capacity is represented via milliampere-hours
- Maximum current & C-rating

Radio receiver

Allows to control the drone

- Uses 2.4GHz or 900MHz
- Has different protocols
- ELRS is the best choice as of now

Video transmitter & Camera

Eyes of drone

- Signal is transmitted at 5.8GHz
- VTX heats quickly, should be treated with care
- Digital and analog combinations exist
- Video quality is more dependent on camera used
- Digital system offers better quality but higher latency

Frame

Hold everything in place

- Made of carbon fiber
- Size is for propeller length
- 5 inch is the best choice for this project

Q & A