Autopilot Preliminary Research

1. NAZA-M V2 + GPS

* Price: $299
* AP/RC hobbyist
* multi-rotor
* independent LED module
* independent PMU module
* function extensions
  + Zenmuse H3-2D (pitch control)/NAZA OSD/NAZA BT module/IOSD/**Ground Station**
* 3-axis gyroscope
* 3-axis accelerometer and barometer
* inner damping
* measure flying altitude and attitude
* add-on: plug and play GPS module
* Hovering accuracy is approximately 2.5m horizontal and 0.8m vertical
* Support is also included for optional Bluetooth LED module to allow parameter adjustment via a mobile APP
* GPS course automatic compensation
* GPS & Compass sensor calibration
* PPM, S-BUS & Ordinary Receiver Supported
* Motor Arm and Motor Dis-arm
* Built-in Gimbal Stabilization Function (for camera)
* Specs:
  + Supported Multi-Rotor: Quad-rotor I4, X4, Hex-rotor I6, X6, IY6, Y6, Octo-rotor I8,V8,X8
  + Supported ESC output: 400Hz refresh frequency
  + Recommended Transmitter: PCM or 2.4GHz with minimum 4 channels
  + Working Voltage Range: MC: 4.8V~5.5V, VU Input: 7.4V~26.0V (recommended 2S~6S Lipoly),Output (V-SEN port red wire): 3A @ 5V (burst current: 7.5A)
  + Power Consumption: MAX: 1.5W (0.3A @ 5V), Normal: 0.6W (0.12A @ 5V)
  + Operating Temperature: -10°C ~ 50°C
  + Assistant Software System Requirement: Windows XP sp3/Windows 7/Windows 8
  + Dimensions: MC: 45.5x32.5x18.5mm, PMU: 39.5x27.5x10mm, GPS & Compass: 46mm (diameter)x10mm, LED: 25x25x7mm
* Flight Performance:
  + Hovering Accuracy (GPS Mode): Vertical: +/-0.8m, Horizontal: +/-2.5m
  + Max Yaw Angular Velocity: 200°/s
  + Max Tilt Angle: 35°
  + Ascent/Descent: 6m/s, 4.5m/s
* <http://hobbyking.com/hobbyking/store/__51633__DJI_Naza_M_V2_Multi_Rotor_Flight_Controller_GPS_Combo.html>
* http://store.dji.com/product/naza-m-v2?from=related\_products

1. 3DR Pixhawk (from the looks of it. It's a combination of px4FMU autopilot and px4io airplane/rover and i/o module. here is the schematics for both if needed. https://github.com/PX4/Hardware/raw/master/PX4FMUv2.4.5.pdf)

* Price: 199.99 (3drobotics.com)
* supports X configuration
* 3 axis 16 bit gyroscope
* 3 axis 14 bit accelerometer
* 5x UART, 2x CAN
* SBUS compatible
* PPM signal input
* I2C
* SPI
* Supports GPS

1. HK Pilot32 autopilot

* $190.82
* hobbyist
* PPM-input (RC input from a single cable to the receiver)
* SBUS
* Features:
  + 32 bit ARM Cortex M4 Processor running NuttX RTOS
  + 14 PWM/servo outputs (8 with failsafe and manual override, 6 auxiliary, high-power compatible)
  + Connectivity options for additional peripherals (UART, I2C, CAN)
  + Backup system for in-flight recovery and manual override with dedicated processor and stand-alone power supply
  + Multicolor LED indicator
  + High-power, multi-tone piezo audio indicator
  + MicroSD card for long-time high-rate logging
  + Super precise digital GPS with compass
  + Telemetry with OSD (433Mhz)
* Specs:
  + Input Voltage: 2~10s (7.4~37V)
  + Size: 81x44x15mm
  + Weight: 33.1g
* Microprocessor:
  + 32-bit STM32F427 Cortex M4 core with FPU
  + 168 MHz/256 KB RAM/2 MB Flash
  + 32 bit STM32F103 failsafe co-processor
* Sensors:
  + ST Micro L3GD20 3-axis 16-bit gyroscope
  + ST Micro LSM303D 3-axis 14-bit accelerometer / magnetometer
  + Invensense MPU 6000 3-axis accelerometer/gyroscope
  + MEAS MS5611 barometer
* Interfaces:
  + 5x UART (serial ports), one high-power capable, 2x with HW flow control
  + 2x CAN
  + Spektrum DSM / DSM2 / DSM-X® Satellite compatible input up to DX8 (DX9 and above not supported)
  + Futaba S.BUS® compatible input and output
  + PPM sum signal
  + RSSI (PWM or voltage) input
  + I2C
  + SPI
  + 3.3 and 6.6V ADC inputs
  + External microUSB port
* GPS:
  + Ubox super precision LEA-6h with compass

1. ZeroUAV YS-X6-P \*standard device for the China National Mapping Bureau

* $999
* professional and hobby applications
* GPS included
* auto-navigation
* target-lock
* self-leveling
* position/altitude holding
* ARM+FPGA classic structure
* high-precision sensor elements
* advanced temperature compensation
* industrial attitude arithmetic
* 400MHz refresh rate
* 10 way points \*main difference between this and YS-X6
* 8 channels for ESC
* 3 channels for pan-tilt
* 8 channels for radio RX
* SBUS
* 3 communication ports
* WIFI module to connect to ground station
* Android/IOS flight control
* live telemetry for flight statistics
* auto take-off/landing
* click and go on Google Earth from ground station
* auto tracking (the multi-rotor can follow ground station like a dog)

### Specs:

### Operating voltage: 3.7~22.2V (no UBEC is required)

### MC: 92x61x18mm

### MU: 48.5x40.5x22mm

### GPS/Compass:55x11mm

### 2.4ghz WiFi unit: 65x40x14.5mm

### Weight (w/all components): Approx. 212grams

### Way points: 10 Programmable as standard (Upgradeable)

### Flight performance (Hover Automatically under GPS mode):

### Vertical Direction: 0.5m

### Horizontal direction: 2m

### Wind resistance: - 8m/s(17.9mph/28.2km/h)

### Maximum Tail Rudder angular velocity: 180degree/Sec

### Maximum Tilt Angle: 25

### Maximum Climb Rate: 4M/S

### Maximum Descent Speed: 4M/S

* <http://hobbyking.com/hobbyking/store/__40254__ZeroUAV_YS_X6_P_10_Waypoint_Autopilot_GPS_Flight_Control_System.html>
  + most expensive on this website

1. Erle brain

* Price: (euros) [269.00 - 319.00](https://erlerobotics.com/blog/erle-brain/)
* linux based
* Supports GPS
* Sensors (29x total via 4x modules):
  + [MPU6000](http://store.invensense.com/datasheets/invensense/MPU-6050_DataSheet_V3%204.pdf) — 3x accelerometers, 3x gyroscopes, temperature sensor
  + [MPU9250](http://store.invensense.com/datasheets/invensense/MPU9250REV1.0.pdf) — 3x accelerometers, 3x magnetometers, 3x gyroscopes, temp.
  + [LSM9DS0](http://www.adafruit.com/datasheets/LSM9DS0.pdf) — 3x accelerometers, 3x magnetometers, 3x gyroscopes, temp.
  + [MS5611-01BA](http://www.hpinfotech.ro/MS5611-01BA03.pdf) — digital pressure (barometer), temp.
* Wireless — 82.11ac WiFi (2.4GHz/5GHz) only on WiFi and WiFi+MicroSD models
* Networking — 10/100 Ethernet port
* Other I/O:
  + Micro-HDMI out port at up to 1920×1080 with stereo audio support
  + USB 2.0 host port
  + Mini-USB 2.0 client port (can be used for power)
  + 4x UARTs
  + ADC connector
  + CAN
  + 3x I2C
  + 12x PWM output
  + PPM/S.Bus in and out for RC
  + Spektrum interface
  + Optional 20-pin debug interface (20-pin CTI JTAG, serial header)
  + Expansion connectors — McASP0, 2x SPI, up to 69x GPIO, LCD, GPMC, 2x MMC, 7AIN (1.8V max.), 4x timers, 4x serial, CAN, EHRPWM(0,2), XDMA interrupt, power button, expansion ID for up to 4x stacking; 5V, 3.3V, VDD\_ADC (1.8V) 3.3V I/O on all signals
* Other features — reset, boot, and power buttons; LEDs including 4x user; buzzer out; safety switch
* Power — 5V supply via mini-USB, DC jack, or 5VDC expansion header; TPS65217C PMIC regulator and 1x additional LDO; battery backup (LiPo)
* Weight — 110 g
* Dimensions — 95.6 x 75.27 x 36.2mm
* Operating system — Debian 7.5 “Wheezy” Linux; APM 3.2-rc14; ROS Hydro Medusa

1. NAVIO+
   * Sensors
     1. MPU9250 as main accel, gyro and compass ([specs](http://store.invensense.com/datasheets/invensense/MPU9250REV1.0.pdf))
     2. MS5611 barometer ([specs](http://www.hpinfotech.ro/MS5611-01BA03.pdf))
     3. U-Blox M8N GPS ([details](https://www.u-blox.com/sites/default/files/products/documents/NEO-M8_ProductSummary_%28UBX-13003449%29.pdf))
   * Power
     1. Triple redundant power supply
   * Interfaces
     1. UART, SPI, I2C
     2. PWM Sum input
     3. Futaba S.BUS input
     4. 13 PWM servo outputs
   * Dimensions
     1. Weight 12g (shield) + 54g (RPi2)
     2. Size: 55x65mm (shield only)
   * Price: [$168.00](http://www.emlid.com/shop/)
2. ZeroUAV YS-X6

### Professional and hobby

* + ARM+FPGA classic structure
  + temperature compensation
  + 400MHz refresh rate
  + 4 way points standard
  + 8 channels for ESCs
  + 3 channels for pan-tilt
  + 8 channels for radio RX
  + SBUS
  + 3 communication ports
  + WIFI link up to 300-500m

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### Maximum Tilt Angle: 25

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### Maximum Descent Speed: 4M/S

* + http://hobbyking.com/hobbyking/store/\_\_25925\_\_ZeroUAV\_YS\_X6\_Autopilot\_GPS\_Flight\_Control\_System.html

1. Zero Tech YS-X4 V2
   * inner damping
   * controllers
   * 3-axis gyroscope
   * 3-axis accelerometer and barometer
   * measure flying altitude and attitude
   * Features
     1. All-in-one Design
     2. Click And Fly to Pointed Place
     3. Realtime Voice Broadcast
     4. Phone Attitude Control
     5. Follow Me
     6. Convenient WIFI Communication
     7. Nine Types of Multi-rotors Supported
     8. Defined Waypoints (128 waypoints available)
     9. Data Configuration On Handheld Device Available
     10. Supporting Futaba S-bus & PPM & Common receiver
     11. Failsafe (Auto Hover-Go Home-Landing)
     12. Low Voltage Vibration Alert (Phone Terminal)
     13. Multi-rotor One-Motor Fail Protection
     14. Advanced & Improved Attitude Stabilization Algorithm
     15. Multiple flight control mode/ Intelligent Switching
     16. Software & Firmware Online Update
     17. Precise Position and Altitude Hold
     18. OSD Supported
     19. Intelligent Orientation Lock
     20. Intelligent Motor Arm/Disarm
     21. Remote Gain Adjustment
     22. Independent LED Module
     23. Built-in Gimbal Stabilization Function
   * http://hobbyking.com/hobbyking/store/\_\_67756\_\_Zero\_Tech\_YS\_X4\_V2\_Autopilot\_Flight\_Controller.html
2. [MicroPilot](http://www.micropilot.com/products.htm)(haven’t looked at all of them yet)\*