User Manual of NyBoard V0_1

Introduction

- NyBoard is a motion control board for the robotic kitten named Nybble, the first product of OpenCat project. It's also compatible for other robots following OpenCat framework. Taking ATmega328P as the core processor, NyBoard runs at 20MHz clock to control 16 independent PWM servos with real-time adaption.
- The size of NyBoard is only 65×56mm. Components on the board are carefully laid out to precisely fit the contour of Raspberry Pi 3B and later models. There is a 2×5 socket connecting the NyBoard and Pi, which includes the power, UART, reset, I^2C and I^2C reference. Through it, the NyBoard can power Pi and communicate with Pi.
- NyBoard can accept 6~9V power inputs. Be careful with the polarity when connecting your power supply to NyBoard's battery socket. There's "+" and "-" besides the socket. **Reversed connection may damage your NyBoard!**
- To isolate voltage fluctuation caused by servos' movement, NyBoard provides two independent power management. One supplies a stable 5V power to the chips, the other supplies an adjustable voltage (4.5-7.5V) to suit most models of servos. To ensure safety during operation, please do not connect the servo to NyBoard first. Check the rated voltage of the servo, use a voltmeter to monitor the output for servos and adjust the potentiometer to obtain a desired voltage.
- NyBoard has a built-in I^2C network with ATmeg328P working as master and other peripherals as slaves, including the PWM/servo driver, the 6-Axis motion sensor and external EEPROM. NyBoard also provides a jumper switch for users to choose whether ATmega328p or Pi (or another AI chip) will be the master of the I^2C network. We hope that by providing alternatives, users can explore and find the best configuration for their projects.
- NyBoard V0_1 can be reconfigured to allow better performance with kit servos. Check this post on OpenCat forum.

Features

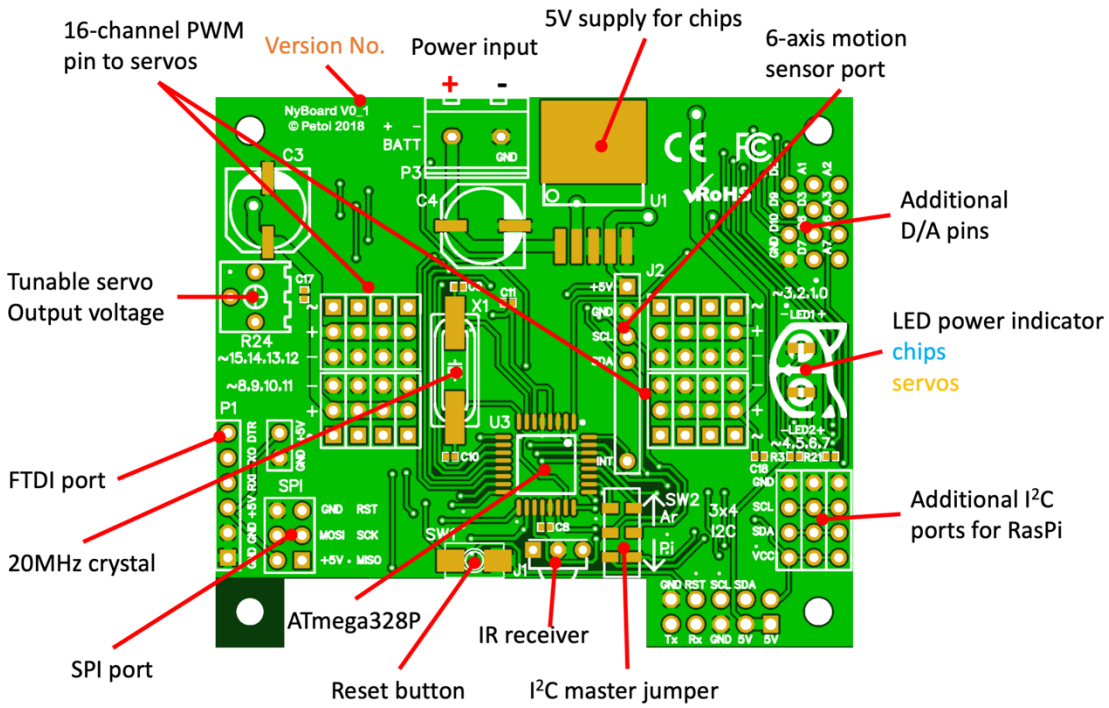
- Core processor: ATmega328P working at the frequency of 20MHz.
- Power input: DC 6-9V
- Power output: Two independent power supplies, 5V to chips (3A peak), 4.5-7.5V adjustable voltage to servos (5A peak). Dial counterclockwise will increase the voltage for servos. The stable voltage range will shift with different input voltage. Due to the resistance in chip, the maximum output will be lower than raw input. Stable 7.5V can only be achieved with 9V input. Try to use the lowest voltage that can complete your motion requirement, to reduce the wearing of your servo's gears, and increase both circuit stability and battery life.

- LED power indicators: 2 LEDs, blue for the chip, yellow for the servos.
- Servo: 16 channel PWM outputs.
- Grouped 2x3 SPI port for burning bootloader or uploading sketches.
- FTDI port: 1×6 socket for connecting the 5V serial-to-USB translator. The long pin legs allow bending to the other side of the board or other directions for convenient access.
- Motion sensor port: connects to GY521-MPU6050, which is centered on the board. Interrupt is connected to pin **D2**. Note: MPU6050 should always be facing up for measurements using default library (I2Cdevlib).
- 2×5 Socket to Pi: connects to 5V power, I^2C, I^2C reference, 3.3V UART and reset.
- I^2C switch (SW2): choose ATmega328P or Pi as the master of the I^2C network. Note that the REF pin in the 2x5 socket must be connected to the Vcc of the master board as a reference for the level converter chip.
- Additional I^2C ports: 3x I^2C ports directly connected to the 2x5 socket of Pi, leveled at 3.3V. (It's not connected to the ATmega328 's I^2C network)
- EEPROM: 8KB. Page write limit is 32 Bytes.
- Additional D/A pins: 3×4 socket with unused pins of ATmega328P
- IR receiver: Receiving frequency 38KHz (using Arduino digital pin **D4**). The long pins allow bending to the best receiving orientation.
- Buzzer: Active (using Arduino PWM pin **D5**)
- Reset button: Reset the NyBoard
- Battery voltage detector: can be programed to alarm when battery is low (using Arduino analog pin **ADC0**)
- PCB: double-layer, 65×56mm

  Note: NyBoard V0_1 can be reconfigured to allow better performance with kit servos. Check this post on OpenCat forum.

Ports and Specification

The tables are ordered as the squares on the board, from left to right, top to bottom:


16-channel PWM pin to servos
Version No.
Power input
5V supply for chips
6-axis motion sensor port
Additional D/A pins
Tunable servo Output voltage
LED power indicator
chips
servos
FTDI port
20MHz crystal
SPI port
ATmega328P
IR receiver
Reset button
I²C master jumper
Additional I²C ports for RasPi
NyBoard V0_1
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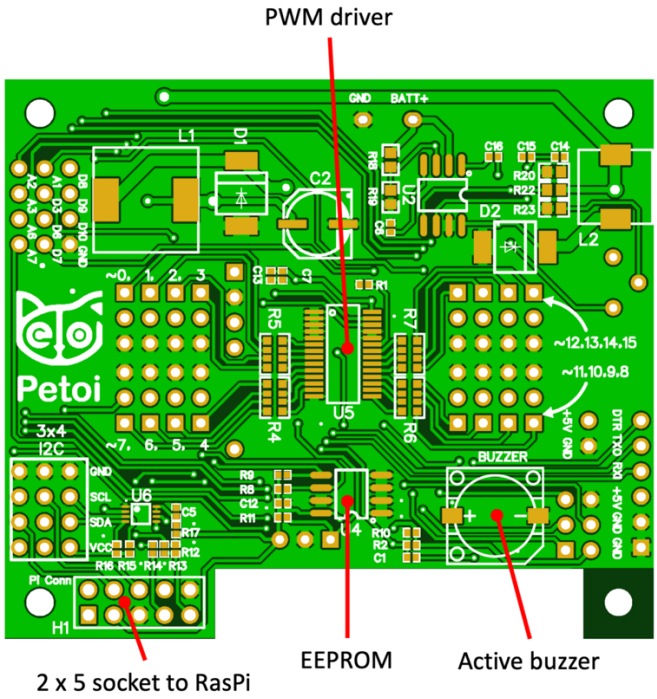
BATT
P3
C3
C4
U1
J2
X1
U3
P1
SPI
SW2
SW1
J1
R24
~15,14,13,12
~8,9,10,11
~3,2,1,0
~4,5,6,7
3x4 I2C


PWM driver
EEPROM
Active buzzer
2 x 5 socket to RasPi
Petoi
BUZZER
U5
U6
L1
L2
D1
D2
C2
~12,13,14,15
~11,10,9,8
~7, 6, 5, 4
~0, 1, 2, 3
3x4 I2C
P1 Conn
H1

- Power input

+	-

- 16 channel PWM pin to servos (NyBoard V0_1)

15	14	13	12		3	2	1	0
+					+			
GND					GND			
GND					GND			
+					+			
8	9	10	11		4	5	6	7

- FTDI port

DTR
TXO
RXI
+5V
GND
GND

- SPI port

GND	RST
MOSI	SCK
+5V	MISO

- IR receiver

OUT	GND	+5V

- 6-Axis motion sensor port

Mark on NyBoard	Corresponding pins on GY521
+5V	VCC
GND	GND
SCL	SCL
SDA	SDA
/	/
/	/
/	/
INT	INT

- I^2C jumper switch

Dial up to select ATmega328P, dial down to select Pi (or another AI chip)

- Pre-defined pins (~ supports PWM)

Interrupt	IR receiver	Buzzer	MOSI	MISO	SCK
D2	D4	D5 ~	D11 ~	D12	D13

- Additional D/A pins

D8	ADC1	ADC2
D9 ~	D3 ~	ADC3
D10 ~	D6 ~	ADC6
GND	D7	ADC7

Recommended usage is using (D8, D9, D10, GND) for the ultrasound sensor, and (A2, A3, A6, A7) for optional foot contact sensors. You can also find other combinations in one row/column for convenient interfacing (2 Digital + 1 Analog, 2 Analog + 1 Digital, GND + digital + Analog, etc.)

- Additional I^2C ports (the voltage of VCC is Equal to REF)

GND	GND	GND
SCL_P	SCL_P	SCL_P
SDA_P	SDA_P	SDA_P
VCC	VCC	VCC

- Socket to Pi

REF	SDA_P	SCL_P	RST	GND
+5V	+5V	GND	TXD	RXD

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