# Bella Hat Documentation

## version

**2024, Sunfounder**

■■ 12, 2024

# Contents

# Bella Hat documentation

## Hardware Introduction

### Pinout

### Features

## Bella Hat Library

## Install

1. Update your system.

   Make sure you are connected to the Internet and update your system:

   ```
   sudo apt update
   ```

   > **Note**
   >
   > Python3 related packages must be installed if you are installing the **Lite** version OS.
   >
   > sudo apt install git python3-pip python3-setuptools python3-smbus

2. Download the source code.

   ```
   git clone https://github.com/sunfounder/bella-hat.git
   ```

3. Install the package.

   It is recommended to install within a Python virtual environment.

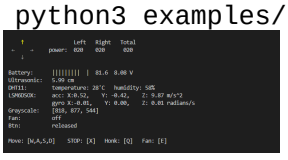
   ```
   cd bella-hat
   pip3 install ./
   ```

   > **Note**
   >
   > if you want to install in system environment. You need add parameter “–break-system-packages”
   >
   > ```
   > pip3 install ./ --break-system-packages
   > ```

## Examples

### Basic test

```
cd bella-hat
python3 examples/basic_test.py
```



## Reset MCU

Reset the MCU on the Bella HAT.

```
bella-hat reset_mcu
```

# Reference

## class Bella

The class Bella encapsulates the usage functions of all physical interfaces on the Bella HAT and presets the corresponding pin numbers. For a more detailed example, you can refer to the examples/basic_test.py file.

**Example**

```
from bella_hat.bella import Bella

bella = Bella()
bellas.et_motors_reverse(True, False)

bella.set_eyes_led(80, 80)
bella.set_motors(20, 20)
bella.fan_on()

batVolt = bella.get_battery_voltage()
batPerc = bella.get_battery_percentage()
distance = bella.get_ultrasonic_distance()
temp = bella.get_temperature()
hum = bella.get_humidity()
grayscale = bella.get_grayscales()
acc = bella.get_acc()
gyro = bella.get_gyro()
btn_state = bella.read_btn()
print(f'''
Battery:      {batPerc:.1f}  {batVolt:.2f} V
Ultrasonic:   {distance} cm
DHT11:        temperature: {temp}'C   humidity: {hum}%
LSM6DSOX:     acc: X:{acc[0]:.2f},    Y: {acc[1]:.2f},    Z: {acc[2]:.2f} m/s^2
              gyro X:{gyro[0]:.2f},    Y: {gyro[1]:.2f},    Z: {gyro[2]:.2f} radians/s
Grayscale:    {grayscale}
Fan:          {"on" if bella.fan_state else "off"}
Btn:          {"pressed" if btn_state else "released"}
''')
```

**API**

*class* bella_hat.bella.**Bella**(*args, **kwargs)

Bases: **_Basic_class**

**__init__(***args, **kwargs***)**

Initialize the basic class

**Parameters:** **debug_level** (*str/int*) – debug level, 0(critical), 1(error), 2(warning), 3(info) or 4(debug)

**get_battery_voltage()**

‘ Get the battery voltage.

return: float - Battery voltage in volts.

**get_battery_percentage()**

Get the battery percentage.

return: float - Battery percentage.

**get_ultrasonic_distance ()**
Get the distance from the ultrasonic sensor.

**return: float - Distance in cm.**

-1, timeout -2, distance limit exceeded

**get_temperature ()**
Get the temperature from the DHT11 sensor.
return: float - Temperature in Celsius.

**get_humidity ()**
Get the humidity from the DHT11 sensor.
return: float - Humidity in percentage.

**get_grayscales ()**
Get the grayscale sensor values.
return: list - Grayscale sensor values.

**set_motors (**`leftPercent`**,** `rightPercent`**)**
Set the motor percentage for left and right motors
leftPercent: int - Motor percentage for left motor, -100 to 100 rightPercent: int - Motor percentage for right motor, -100 to 100

**set_motors_reverse (**`left_reverse`**,** `right_reverse`**)**
Set the motors is reversed or not
left_reverse: bool - set left motor is reversed or not right_reverse: bool - set right motor is reversed or not

**get_acc ()**
Get acceleration data of lsm6dsox sensor.
return: list - [acc_x, acc_y, acc_z].

**get_gyro ()**
Get gyro data of lsm6dsox sensor.
return: list - [gyro_x, gyro_y, gyro_z].

**fan_on ()**
Open the fan on Bella HAT.

**fan_off ()**
Close the fan on Bella HAT.

**read_btn ()**
Read the state of btn on Bella HAT.

**set_eyes_led (**`left_brightness`**,** `right_brightness`**)**
Set the front board LEDs brightness.
left_brightness: int - brightness for left LEDs, 0 to 100 right_brightness: int - brightness for right LEDs, 0 to 100

## class Pin

**Example**

Simple read or control pin:

```
# Import Pin class
from robot_hat import Pin

# Create Pin object with numeric pin numbering and default input pullup enabled
d0 = Pin(16, Pin.IN, Pin.PULL_UP)
# Create Pin object with named pin numbering
d1 = Pin(25)
```

```
# read value
value0 = d0.value()
value1 = d1.value()
print(value0, value1)

# write value
d0.value(1) # force input to output
d1.value(0)

# set pin high/low
d0.high()
d1.off()
```

Interrupt:

```
# Import Pin class
from bella_hat.pin import Pin

# set interrupt
led = Pin(16, Pin.OUT)
switch = Pin(25, Pin.IN, Pin.PULL_DOWN)
def onPressed(chn):
    led.value(not switch.value())
switch.irq(handler=onPressed, trigger=Pin.IRQ_RISING_FALLING)

while True:
    pass
```

**API**

*class* `bella_hat.pin.`**`Pin`**(`pin`, `mode=None`, `pull=None`, `*args`, `**kwargs`)

Bases: **`_Basic_class`**

Pin manipulation class

**`OUT`** = *1*

Pin mode output

**`IN`** = *2*

Pin mode input

**`PULL_UP`** = *17*

Pin internal pull up

**`PULL_DOWN`** = *18*

Pin internal pull down

**`PULL_NONE`** = *None*

Pin internal pull none

**`IRQ_FALLING`** = *33*

Pin interrupt falling

**`IRQ_RISING`** = *34*

Pin interrupt falling

**`IRQ_RISING_FALLING`** = *35*

Pin interrupt both rising and falling

**`__init__`**(`pin`, `mode=None`, `pull=None`, `*args`, `**kwargs`)

Initialize a pin

**Parameters:**
- **pin** (*int/str*) – pin number of Raspberry Pi
- **mode** (*int*) – pin mode(IN/OUT)
- **pull** (*int*) – pin pull up/down(PUD_UP/PUD_DOWN/PUD_NONE)

**setup** (mode, pull=None)
Setup the pin

**Parameters:**
- **mode** (*int*) – pin mode(IN/OUT)
- **pull** (*int*) – pin pull up/down(PUD_UP/PUD_DOWN/PUD_NONE)

**dict** (_dict=None)
Set/get the pin dictionary

**Parameters:** **_dict** (*dict*) – pin dictionary, leave it empty to get the dictionary
**Returns:** pin dictionary
**Return type:** dict

**__call__** (value)
Set/get the pin value

**Parameters:** **value** (*int*) – pin value, leave it empty to get the value(0/1)
**Returns:** pin value(0/1)
**Return type:** int

**value** (value: bool = None)
Set/get the pin value

**Parameters:** **value** (*int*) – pin value, leave it empty to get the value(0/1)
**Returns:** pin value(0/1)
**Return type:** int

**on** ()
Set pin on(high)

**Returns:** pin value(1)
**Return type:** int

**off** ()
Set pin off(low)

**Returns:** pin value(0)
**Return type:** int

**high** ()
Set pin high(1)

**Returns:** pin value(1)
**Return type:** int

**low** ()
Set pin low(0)

**Returns:** pin value(0)
**Return type:** int

**irq** (handler, trigger, bouncetime=200, pull=None)
Set the pin interrupt

**Parameters:**

- **handler** (*function*) – interrupt handler callback function
- **trigger** (*int*) – interrupt trigger(RISING, FALLING, RISING_FALLING)
- **bouncetime** (*int*) – interrupt bouncetime in miliseconds

**name ()**
Get the pin name

**Returns:** pin name
**Return type:** str

## class ADC

**Example**

```
# Import ADC class
from bella_hat.adc import ADC

# Create ADC object with numeric pin numbering
a0 = ADC(0)
# Create ADC object with named pin numbering
a1 = ADC('A1')

# Read ADC value
value0 = a0.read()
value1 = a1.read()
voltage0 = a0.read_voltage()
voltage1 = a1.read_voltage()
print(f"ADC 0 value: {value0}")
print(f"ADC 1 value: {value1}")
print(f"ADC 0 voltage: {voltage0}")
print(f"ADC 1 voltage: {voltage1}")
```

Read Battery voltage on Bella bella-hat:

The battery voltage measurement terminal is connected to ADC channel 4 and divided by 3 times

```
# Import ADC class
from bella_hat.adc import ADC

BAT_VOLT_GAIN = 3
bat = ADC('A4')

bat_value = bat.read()
bat_voltage = bat.read_voltage() * BAT_VOLT_GAIN
print(f"Battery adc value: {bat_value}, voltage: {bat_voltage:.2f} V")
```

**API**

*class* bella_hat.adc.**ADC** (chn, address=None, *args, **kwargs)
Bases: **I2C**
Analog to digital converter

**__init__ (**chn**,** address=None**,** *args**,** **kwargs**)**
Analog to digital converter

**Parameters:** **chn** (*int/str*) – channel number (0-7/A0-A7)

**read ()**
Read the ADC value

**Returns:** ADC value(0-4095)

**Return type:** int

**read_voltage ()**
Read the ADC value and convert to voltage

**Returns:** Voltage value(0-3.3(V))
**Return type:** float

## class PWM

**Example**

```
# Import PWM class
from bella_hat.pwm import PWM

# Create PWM object with numeric pin numbering and default input pullup enabled
p0 = PWM(0)
# Create PWM object with named pin numbering
p1 = PWM('P1')


# Set frequency will automatically set prescaller and period
# This is easy for device like Buzzer or LED, which you care
# about the frequency and pulse width percentage.
# this usually use with pulse_width_percent function.
# Set frequency to 1000Hz
p0.freq(1000)
print(f"Frequence: {p0.freq()} Hz")
print(f"Prescaler: {p0.prescaler()}")
print(f"Period: {p0.period()}")
# Set pulse width to 50%
p0.pulse_width_percent(50)

# Or set prescaller and period, will get a frequency from:
# frequency = PWM.CLOCK / prescaler / period
# With this setup you can tune the period as you wish.
# set prescaler to 64
p1.prescaler(64)
# set period to 4096 ticks
p1.period(4096)
print(f"Frequence: {p1.freq()} Hz")
print(f"Prescaler: {p1.prescaler()}")
print(f"Period: {p1.period()}")
# Set pulse width to 2048 which is also 50%
p1.pulse_width(2048)
```

**API**

*class* bella_hat.pwm.**PWM**(channel, address=None, *args, **kwargs)
Bases: **I2C**
Pulse width modulation (PWM)

**REG_CHN** = *32*
Channel register prefix

**REG_PSC** = *64*
Prescaler register prefix

**REG_ARR** = *68*
Period registor prefix

**REG_PSC2** = *80*
Prescaler register prefix

**REG_ARR2** = *84*
Period registor prefix

**CLOCK** = *72000000.0*
Clock frequency

**__init__** (channel, address=None, *args, **kwargs)
Initialize PWM

**Parameters:** **channel** (*int/str*) – PWM channel number(0-13/P0-P13)

**freq** (freq=None)
Set/get frequency, leave blank to get frequency

**Parameters:** **freq** (*float*) – frequency(0-65535)(Hz)
**Returns:** frequency
**Return type:** float

**prescaler** (prescaler=None)
Set/get prescaler, leave blank to get prescaler

**Parameters:** **prescaler** (*int*) – prescaler(0-65535)
**Returns:** prescaler
**Return type:** int

**period** (arr=None)
Set/get period, leave blank to get period

**Parameters:** **arr** (*int*) – period(0-65535)
**Returns:** period
**Return type:** int

**pulse_width** (pulse_width=None)
Set/get pulse width, leave blank to get pulse width

**Parameters:** **pulse_width** (*float*) – pulse width(0-65535)
**Returns:** pulse width
**Return type:** float

**pulse_width_percent** (pulse_width_percent=None)
Set/get pulse width percentage, leave blank to get pulse width percentage

**Parameters:** **pulse_width_percent** (*float*) – pulse width percentage(0-100)
**Returns:** pulse width percentage
**Return type:** float

## module motor

## class Motors

**Example**

Initilize

```
# Import Motor class
from bella_hat.motor import Motors
```

```
# Create Motor object
motors = Motors()
# Create Motor object with setting motors direction
# motors = Motors(left_reversed=True, right_reversed=False)
```

Control motors power.

```
#
motors.speed([50, 50])
# stop
motors.stop()
```

Setup motor direction.

```
# Go forward and see if both motor directions are correct
motors.forward(100)
# if you found a motor is running in the wrong direction
# Use these function to correct it
motors.reverse(True, True) # [left_reverse, right_reverse]
# Run forward again and see if both motor directions are correct
motors.forward(100)
```

Move functions

```
import time

motors.forward(100)
time.sleep(1)
motors.backward(100)
time.sleep(1)
motors.turn_left(100)
time.sleep(1)
motors.turn_right(100)
time.sleep(1)
motors.stop()
```

**API**

*class* bella_hat.motor.**Motors**(left_motor_pwma=18, left_motor_pwmb=19, right_motor_pwma=16, right_motor_pwmb=17, left_reversed=False, right_reversed=False, *args, **kwargs)

Bases: **_Basic_class**

**__init__**(left_motor_pwma=18, left_motor_pwmb=19, right_motor_pwma=16, right_motor_pwmb=17, left_reversed=False, right_reversed=False, *args, **kwargs)

Initialize motors with bella_hat.motor.Motor

**Parameters:**

- **left_motor_pwma** (*int, pin number*) – pwma input for left motor
- **left_motor_pwmb** (*int, pin number*) – pwmb input for left motor
- **right_motor_pwma** (*int, pin number*) – pwma input for right motor
- **right_motor_pwmb** (*int, pin number*) – pwmb input for right motor
- **left_reversed** (*bool*) – whether to reverse left motor
- **right_reversed** (*bool*) – whether to reverse right motor

**stop**()

Stop all motors

**brake**()

Brake

**reverse**(reverse=None)

Get or set motors is reversed or not

**Parameters:** **reverse** (*[bool, bool]*) – [left_reverse, right_reverse]

**speed** (speed=None)
Get or Set motors speed

**Parameters:** **speed** (*[float/int, float/int]*) – [left_speed, right_speed] (-100.0~100.0)

**forward** (speed)
Forward

**Parameters:** **speed** (*float*) – Motor speed(-100.0~100.0)

**backward** (speed)
Backward

**Parameters:** **speed** (*float*) – Motor speed(-100.0~100.0)

**turn_left** (speed)
Left turn

**Parameters:** **speed** (*float*) – Motor speed(-100.0~100.0)

**turn_right** (speed)
Right turn

**Parameters:** **speed** (*float*) – Motor speed(-100.0~100.0)

## class Motor

**Example**

```
# Import Motor class
from bella_hat.motor import Motor, PWM, Pin

# Create Motor object
motor = Motor(18, 19) # pwma, pwmb

# Motor clockwise at 100% speed
motor.speed(100)
# Motor counter-clockwise at 100% speed
motor.speed(-100)

# If you like to reverse the motor direction
motor.reverse(True)
```

**API**

*class* bella_hat.motor.**Motor** (pwma, pwmb, reversed=False)
Bases: **object**

**__init__** (pwma, pwmb, reversed=False)
Initialize a motor

**Parameters:**
- **pwma** (*pin number*) – Motor speed control pwm input A pin
- **pwmb** (*pin number*) – Motor speed control pwm input B pin

**Reversed:** Whether to reverse the direction of motor rotation

**speed** (speed=None)
Get or set motor speed

**Parameters:** **speed** (*int or float*) – Motor speed(-100.0~100.0)

**reverse (**reverse=None**)**
Get or set motor is reversed or not

**Parameters:** **reverse** (*bool*) – True or False

**brake ()**

**stop ()**

## class I2C

**Example**

```
# Import the I2C class
from bella_hat.i2c import I2C

# You can scan for available I2C devices
print([f"0x{addr:02X}" for addr in I2C().scan()])
# You should see at least one device address 0x14, which is the
# on board MCU for PWM and ADC

# Initialize a I2C object with device address, for example
# to communicate with on board MCU 0x14
mcu = I2C(0x14)
# Send ADC channel register to read ADC, 0x10 is Channel 0, 0x11 is Channel 1, etc.
mcu.write([0x10, 0x00, 0x00])
# Read 2 byte for MSB and LSB
msb, lsb = mcu.read(2)
# Convert to integer
value = (msb << 8) + lsb
# Print the value
print(value)
```

For more information on the I2C protocol, see checkout adc.py and pwm.py

**API**

*class* bella_hat.i2c.**I2C** (address=None, bus=1, *args, **kwargs)
Bases: **_Basic_class**
I2C bus read/write functions

**__init__ (**address=None**,** bus=1**,** *args**,** **kwargs**)**
Initialize the I2C bus

**Parameters:**
- **address** (*int*) – I2C device address
- **bus** (*int*) – I2C bus number

***static*** **scan (**busnum=1**,** force=False**)**
Scan the I2C bus for devices

**Returns:** List of I2C addresses of devices found
**Return type:** list

**write (**data**)**
Write data to the I2C device

**Parameters:** **data** (*int/list/bytearray*) – Data to write
**Raises:** ValueError if write is not an int, list or bytearray

**read** (length=1)
Read data from I2C device

**Parameters:** **length** (*int*) – Number of bytes to receive
**Returns:** Received data
**Return type:** list

**mem_write** (data, memaddr)
Send data to specific register address

**Parameters:**
- **data** (*int/list/bytearray*) – Data to send, int, list or bytearray
- **memaddr** (*int*) – Register address

**Raises:** **ValueError** – If data is not int, list, or bytearray

**mem_read** (length, memaddr)
Read data from specific register address

**Parameters:**
- **length** (*int*) – Number of bytes to receive
- **memaddr** (*int*) – Register address

**Returns:** Received bytearray data or False if error
**Return type:** list/False

**is_avaliable** ()
Check if the I2C device is avaliable

**Returns:** True if the I2C device is avaliable, False otherwise
**Return type:** bool

## module modules

## class Ultrasonic

**Example**

```
# Import Ultrasonic and Pin class
from bella_hat.modules import Ultrasonic, Pin

# Create Motor object
us = Ultrasonic(Pin(20), Pin(21))

# Read distance
distance = us.read()
print(f"Distance: {distance}cm")
```

**API**

*class* bella_hat.modules.**Ultrasonic** (trig, echo, timeout=0.02)

**__init__** (trig, echo, timeout=0.02)
Initialize an ultrasonic distance sensor

**Parameters:**
- **trig** (*pin number*) – tring pin
- **echo** (*pin number*) – echo pin
- **timeout** (*float, seconds*) – set the timeout for detecting the return of sound waves

**read** (times=10)
Read the distance

**Parameters:** **times** (*int*) – retry times
**Returns:** float, distance in centimeter 1, timeout or error

## class Grayscale_Module

**Example**

```
# Import Grayscale_Module and ADC class
from bella_hat.modules import Grayscale_Module, ADC

# Create Grayscale_Module object, reference should be calculate from the value reads on w
# and black ground, then take the middle as reference
gs = Grayscale_Module(ADC(0), ADC(1), ADC(2), reference=[1000, 900, 1000])

# Read Grayscale_Module datas
datas = gs.read()
print(f"Grayscale Module datas: {datas}")
# or read a specific channel
l = gs.read(gs.LEFT)
m = gs.read(gs.MIDDLE)
r = gs.read(gs.RIGHT)
print(f"Grayscale Module left channel: {l}")
print(f"Grayscale Module middle channel: {m}")
print(f"Grayscale Module right channel: {r}")

# Read Grayscale_Module simple states
state = gs.read_status()
print(f"Grayscale_Module state: {state}")
```

**API**

*class* bella_hat.modules.**Grayscale_Module** (pin0: ADC, pin1: ADC, pin2: ADC, reference: int = None)
3 channel Grayscale Module

**LEFT** = *2*
Left Channel

**MIDDLE** = *1*
Middle Channel

**RIGHT** = *1*
Right Channel

**__init__** (pin0: ADC, pin1: ADC, pin2: ADC, reference: int = None)
Initialize Grayscale Module

**Parameters:**
- **pin0** (*bella_hat.ADC/int*) – ADC object or int for channel 0
- **pin1** (*bella_hat.ADC/int*) – ADC object or int for channel 1
- **pin2** (*bella_hat.ADC/int*) – ADC object or int for channel 2
- **reference** (*1*3 list, [int, int, int]*) – reference voltage

**reference** (ref: list = None) → list
Get Set reference value

**Parameters:** **ref** (*list*) – reference value, None to get reference value

**Returns:** reference value
**Return type:** list

**read_status** (datas: list = None) → list
Read line status

**Parameters:** **datas** (*list*) – list of grayscale datas, if None, read from sensor
**Returns:** list of line status, 0 for white, 1 for black
**Return type:** list

**read** (channel: int = None) → list
read a channel or all datas

**Parameters:** **channel** (*int/None*) – channel to read, leave empty to read all. 0, 1, 2 or Grayscale_Module.LEFT, Grayscale_Module.CENTER, Grayscale_Module.RIGHT
**Returns:** list of grayscale data
**Return type:** list

## class DHT11

**Example**

```
# Import DHT11 class
from bella_hat.modules import DHT11

# Create DHT11 object
dht11 = DHT11(19)

# Read DHT11 datas
temperature = dht11.temperature
humidity = dht11.humidity
print(f"Temperature: {temperature}'C, Humidity: {humidity}%")
```

**API**

*class* bella_hat.modules.**DHT11** (pin)

**__init__** (pin)
Initialize DHT11 Module

**Parameters:** **pin** (*pin number*) – DHT11 data pin

*property* **temperature**
Temperature

*property* **humidity**
Humidity

## class LSM6DSOX

**Example**

```
# Import LSM6DSOX class
from bella_hat.modules import LSM6DSOX

# Create LSM6DSOX object
lsm6dsox = LSM6DSOX()

# Read LSM6DSOX datas
acc = lsm6dsox.acc
```

```
gyro = lsm6dsox.gyro
print(f"acc: X:{acc[0]:.2f},    Y: {acc[1]:.2f},    Z: {acc[2]:.2f} m/s^2")
print(f"gyro X:{gyro[0]:.2f},    Y: {gyro[1]:.2f},    Z: {gyro[2]:.2f} radians/s")
```

**API**

*class* bella_hat.modules.**LSM6DSOX**

**__init__ ()**
Initialize LSM6DSOX Module

*property* **acc**
Acceleration

*property* **gyro**
Gyro

## class Music

**Example**

Initialize

```
# Import Music class
from bella_hat.music import Music

# Create a new Music object
music = Music()
```

Play sound

```
# Play a sound
music.sound_play("file.wav", volume=50)
# Play a sound in the background
music.sound_play_threading("file.wav", volume=80)
# Get sound length
music.sound_length("file.wav")
```

Play Music

```
# Play music
music.music_play("file.mp3")
# Play music in loop
music.music_play("file.mp3", loop=0)
# Play music in 3 times
music.music_play("file.mp3", loop=3)
# Play music in starts from 2 second
music.music_play("file.mp3", start=2)
# Set music volume
music.music_set_volume(50)
# Stop music
music.music_stop()
# Pause music
music.music_pause()
# Resume music
music.music_resume()
```

**API**

*class* bella_hat.music.**Music**
Bases: **_Basic_class**
Play music, sound affect and note control

**NOTE_BASE_FREQ** = *440*

Base note frequency for calculation (A4)

**NOTE_BASE_INDEX** = *69*
Base note index for calculation (A4) MIDI compatible

**NOTES** = *[None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, None, 'A0', 'A#0', 'B0', 'C1', 'C#1', 'D1', 'D#1', 'E1', 'F1', 'F#1', 'G1', 'G#1', 'A1', 'A#1', 'B1', 'C2', 'C#2', 'D2', 'D#2', 'E2', 'F2', 'F#2', 'G2', 'G#2', 'A2', 'A#2', 'B2', 'C3', 'C#3', 'D3', 'D#3', 'E3', 'F3', 'F#3', 'G3', 'G#3', 'A3', 'A#3', 'B3', 'C4', 'C#4', 'D4', 'D#4', 'E4', 'F4', 'F#4', 'G4', 'G#4', 'A4', 'A#4', 'B4', 'C5', 'C#5', 'D5', 'D#5', 'E5', 'F5', 'F#5', 'G5', 'G#5', 'A5', 'A#5', 'B5', 'C6', 'C#6', 'D6', 'D#6', 'E6', 'F6', 'F#6', 'G6', 'G#6', 'A6', 'A#6', 'B6', 'C7', 'C#7', 'D7', 'D#7', 'E7', 'F7', 'F#7', 'G7', 'G#7', 'A7', 'A#7', 'B7', 'C8']*
Notes name, MIDI compatible

**__init__ ()**
Initialize music

**time_signature (**`top: int = None`**,** `bottom: int = None`**)**
Set/get time signature

**Parameters:**
- **top** (*int*) – top number of time signature
- **bottom** (*int*) – bottom number of time signature

**Returns:** time signature

**Return type:** tuple

**key_signature (**`key: int = None`**)**
Set/get key signature

**Parameters:** **key** (*int/str*) – key signature use KEY_XX_MAJOR or String “#”, “##”, or “bbb”, “bbbb”

**Returns:** key signature

**Return type:** int

**tempo (**`tempo=None`**,** `note_value=0.25`**)**
Set/get tempo beat per minute(bpm)

**Parameters:**
- **tempo** (*float*) – tempo
- **note_value** – note value(1, 1/2, Music.HALF_NOTE, etc)

**Returns:** tempo

**Return type:** int

**beat (**`beat`**)**
Calculate beat delay in seconds from tempo

**Parameters:** **beat** (*float*) – beat index

**Returns:** beat delay

**Return type:** float

**note (**`note`**,** `natural=False`**)**
Get frequency of a note

**Parameters:**
- **note_name** (*string*) – note name(See NOTES)
- **natural** (*bool*) – if natural note

**Returns:** frequency of note

**Return type:** float

**sound_play (**`filename`**,** `volume=None`**)**
Play sound effect file

**Parameters:** **filename** (*str*) – sound effect file name

**sound_play_threading (**`filename`**,** `volume`=None**)**
Play sound effect in thread(in the background)

**Parameters:**
- **filename** (*str*) – sound effect file name
- **volume** (*int*) – volume 0-100, leave empty will not change volume

**music_play (**`filename`**,** `loops`=1**,** `start`=0.0**,** `volume`=None**)**
Play music file

**Parameters:**
- **filename** (*str*) – sound file name
- **loops** (*int*) – number of loops, 0:loop forever, 1:play once, 2:play twice, …
- **start** (*float*) – start time in seconds
- **volume** (*int*) – volume 0-100, leave empty will not change volume

**music_set_volume (**`value`**)**
Set music volume

**Parameters:** **value** (*int*) – volume 0-100

**music_stop ()**
Stop music

**music_pause ()**
Pause music

**music_resume ()**
Resume music

**music_unpause ()**
Unpause music(resume music)

**sound_length (**`filename`**)**
Get sound effect length in seconds

**Parameters:** **filename** (*str*) – sound effect file name
**Returns:** length in seconds
**Return type:** float

**get_tone_data (**`freq: float`**,** `duration: float`**)**
Get tone data for playing

**Parameters:**
- **freq** (*float*) – frequency
- **duration** (*float*) – duration in seconds

**Returns:** tone data
**Return type:** list

**play_tone_for (**`freq`**,** `duration`**)**
Play tone for duration seconds

**Parameters:**
- **freq** (*float*) – frequency, you can use NOTES to get frequency
- **duration** (*float*) – duration in seconds

## module utils

bella_hat.utils.**set_volume**(value)
Set volume

**Parameters:** **value** (*int*) – volume(0~100)

bella_hat.utils.**run_command**(cmd)
Run command and return status and output

**Parameters:** **cmd** (*str*) – command to run
**Returns:** status, output
**Return type:** tuple

bella_hat.utils.**is_installed**(cmd)
Check if command is installed

**Parameters:** **cmd** (*str*) – command to check
**Returns:** True if installed
**Return type:** bool

bella_hat.utils.**mapping**(x, in_min, in_max, out_min, out_max)
Map value from one range to another range

**Parameters:**
- **x** (*float/int*) – value to map
- **in_min** (*float/int*) – input minimum
- **in_max** (*float/int*) – input maximum
- **out_min** (*float/int*) – output minimum
- **out_max** (*float/int*) – output maximum

**Returns:** mapped value
**Return type:** float/int

bella_hat.utils.**get_ip**(ifaces=['wlan0', 'eth0'])
Get IP address

**Parameters:** **ifaces** (*list*) – interfaces to check
**Returns:** IP address or False if not found
**Return type:** str/False

bella_hat.utils.**reset_mcu**()
Reset mcu on BL100 Hat.
This is helpful if the mcu somehow stuck in a I2C data transfer loop, and Raspberry Pi getting IOError while Reading ADC, manipulating PWM, etc.

bella_hat.utils.**get_battery_voltage**()
Get battery voltage

**Returns:** battery voltage(V)
**Return type:** float

## class _Basic_class

_Basic_class is a logger class for all class to log, so if you want to see logs of a class, just add a debug argument to it.

**Example**

```
# See PWM log
from bella_hat.pwm import PWM

# init the class with a debug argument
```

```
pwm = PWM(0, debug_level="debug")

# run some functions and see logs
pwm.freq(1000)
pwm.pulse_width_percent(100)
```

**API**

*class* bella_hat.basic.**_Basic_class**(debug_level='warning')
Basic Class for all classes
with debug function

**DEBUG_LEVELS** = *{'critical': 50, 'debug': 10, 'error': 40, 'info': 20, 'warning': 30}*
Debug level

**DEBUG_NAMES** = *['critical', 'error', 'warning', 'info', 'debug']*
Debug level names

**__init__**(debug_level='warning')
Initialize the basic class

**Parameters:** **debug_level** (*str/int*) – debug level, 0(critical), 1(error), 2(warning), 3(info) or 4(debug)

*property* **debug_level**
Debug level

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