AI Pyramid EC Proxy 硬件控制

1. 简介

AI Pyramid 默认镜像中内置 EC Proxy 嵌入式控制器通信系统，用于实现主系统与嵌入式控制器（EC）之间的通信与管理。EC Proxy 为底层硬件提供统一的抽象层，封装具体硬件实现细节，对上层系统暴露标准化控制接口。AI Pyramid 上的 **RGB 灯、散热风扇、电源管理、按键等外设功能** 可通过 EC Proxy 进行控制。 AI Pyramid 开机后将自动启用 EC Proxy 服务，用户可通过 `ec_cli` 命令行工具对硬件资源进行操作，无需直接与底层硬件交互。

2. 硬件控制

输入 `ec_cli device` 可查看，硬件控制相关的指令。

```
root@m5stack-AI-Pyramid:~# ec_cli device
usage: ec_cli [options] ...
options:
  -r, --rgb                          Get or set RGB LED display mode
      --poweron_time                 Get or set the scheduled power-on time
      --poweroff_time                Get or set the scheduled power-off time
      --rgb_size                     Get or set the number of RGB LEDs in the array
      --rgb_get_color                Get the color value of a specific RGB LED
      --rgb_set_color                Set color for a specific RGB LED, example: cli --rgb_set_color -d '{
  -f, --fan                          Get or set the fan PWM duty cycle
  -F, --fanspeed                     Get the current fan rotation speed in RPM
      --pd_power_info                Get the USB PD power delivery information
  -B, --board                        Get the board power consumption information
      --ip_eth0                      Get or set the IP address for Ethernet interface eth0
      --ip_eth1                      Get or set the IP address for Ethernet interface eth1
      --ip_wlan                      Get or set the IP address for wireless LAN interface
  -l, --lcd                          Get or set the LCD display mode
      --lcd_ram                      Set the LCD RAM buffer data directly
  -c, --vddcpu                       Get or set the CPU core voltage (VDD)
      --modbus_speed                 Get or set the Modbus communication baud rate
  -p, --ext_power                    Control the external power supply output
  -b, --board_power                  Control the main board power switch
      --pcie0                        Set the PCIe slot 0 switch on/off state
      --pcie1                        Set the PCIe slot 1 switch on/off state
      --gl3510_reset                 Reset the GL3510 USB hub controller
      --usbds1_big                   Set the high-power mode for USB downstream port 1
      --usbds2_big                   Set the high-power mode for USB downstream port 2
      --usbds1                       Set the switch on/off state for USB downstream port 1
      --usbds2                       Set the switch on/off state for USB downstream port 2
      --usbds3                       Set the switch on/off state for USB downstream port 3
      --hdmi_loop_en                 Switch HDMI OUT port input source between IN and AX8850
      --grove_uart                   Set the switch on/off state for Grove UART interface
      --grove_iic                    Set the switch on/off state for Grove I2C interface
      --flash_switch                 Save switch configuration to flash memory (stores coil registers 4-1
      --flash_value                  Save value configuration to flash memory (stores holding registers 1
      --poweroff                     Trigger the system power-off sequence
      --lcd_brightness               Get or set the LCD backlight brightness level
  -P, --lcd_putc                     Output a character or string to the LCD display
      --i2c_set_reg                  Write a value to an I2C device register
      --i2c_get_reg                  Read a value from an I2C device register
      --ec_button_head_event         Get or set the event handler for EC head button press
      --soc_button_head_event        Get or set the event handler for SoC head button press
      --ec_button_lcd_event          Get or set the event handler for EC LCD button press
      --fun_auto                     Get or set the automatic control mode for the proxy service
      --ec_modbus_set_bit            Set a specific bit in the EC Modbus coil register
      --ec_modbus_get_bit            Get a specific bit value from the EC Modbus coil register
      --ec_modbus_input_bits         Read the EC Modbus discrete input bits status
      --ec_modbus_input_registers    Read the EC Modbus input registers values
      --ec_modbus_set_hold_registers Write values to the EC Modbus holding registers
      --ec_modbus_get_hold_registers Read values from the EC Modbus holding registers
      --pcie0_exists                 Check if a PCIe device is present in slot 0
      --pcie1_exists                 Check if a PCIe device is present in slot 1
      --V3_3_good                    Check if the 3.3V power rail is within normal operating range
      --V1_8_good                    Check if the 1.8V power rail is within normal operating range
      --head_button                  Get the current state of the head button (pressed/released)
```

```
      --lcd_button                  Get the current state of the LCD button (pressed/released)
      --version                     Get the EC firmware version information
  -d, --data                        call param (string [=])
  -D, --DataRaw                     call param raw (string [=])
  -?, --help                        print this message
```

RGB LED 控制

配置 RGB LED 工作模式

```
ec_cli device --rgb -d 4
```

RGB LED Mode	描述
0	通过 rgb_set_color 指令控制
1	彩色渐变
2	呼吸灯效
3	流水灯效
4	分散灯效
5	聚合灯效

ai_pyramid_rgb_mode.mp4

通过 `rgb_set_color` 指令配置单个 RGB LED 颜色，该指令仅在模式 0 有效，注意：当前接口不支持范围设置灯光颜色。传入的 `rgb_color` 为十进制的 `RGB888` 编码。(eg: 0x00FF00 == 65280)

```
ec_cli device --rgb_set_color -d '{"rgb_index":0,"rgb_color": 65280}'
```

风扇控制

配置风扇 PWM 占空比为 80%

```
ec_cli device --fan -d 80
```


```
{
  "created": 1769747093,
  "data": "ok",
  "object": "",
  "request_id": "",
  "work_id": "fun_set_pwm"
}
```


读取风扇转速 RPM

```
ec_cli device --fanspeed
```

```
{
  "created": 1769753372,
  "data": 9060,
  "object": "",
  "request_id": "",
  "work_id": "get_input_registers"
}
```


网络信息

```
ec_cli device --ip_eth0
ec_cli device --ip_eth1
ec_cli device --ip_wlan
```

PD 电源信息

```
ec_cli device --pd_power_info
```


```
{
  "created": 1769753175,
  "data": { "voltage": "20 V", "current": "1.25 A" },
  "object": "",
  "request_id": "",
  "work_id": "pd_info"
}
```


电源管理

查看当前设备功耗信息

```
ec_cli device --board
```

```
{
  "created": 1769756427,
  "data": {
    "pcie0_mv": 3352,
    "pcie0_ma": 0,
    "pcie1_mv": 3328,
    "pcie1_ma": 0,
    "usb1_mv": 5040,
    "usb1_ma": 0,
    "usb2_mv": 5040,
    "usb2_ma": 0,
    "INVDD_mv": 20112,
    "INVDD_ma": 292,
    "EXTVDD_mv": 20112,
    "EXTVDD_ma": 28
  },
  "object": "",
  "request_id": "",
  "work_id": "board_get_power_info"
}
```


USB 接口供电

打开 USB 接口输出供电，设备内部的 USB 3.0 #4 接口为常开状态。

```
ec_cli device --usbds1 -d 1
ec_cli device --usbds2 -d 1
ec_cli device --usbds3 -d 1
```

关闭 USB 接口输出供电

```
ec_cli device --usbds1 -d 0
ec_cli device --usbds2 -d 0
ec_cli device --usbds3 -d 0
```

设置 USB 接口供电增强。接口默认输出能力可达 400mA，启用增强后可达 800mA。当前仅 USB #1 / #2 接口支持供电增强。

```
ec_cli device --usbds1_big -d 1
ec_cli device --usbds2_big -d 1
```

OLED

配置 OLED 显示模式

```
ec_cli device --lcd -d 4
```

RGB LED Mode	描述
0	M5Stack 字符
1	接口电压显示，每 3s 刷新数据
2	IP 显示，每 3s 刷新数据
3	ARM 映射
4	字符显示模式，通过 lcd_putc 指令控制

通过 `lcd_putc` 指令打印字符到 OLED 屏上，该指令仅在模式 4 有效。

```
ec_cli device --lcd_putc  -d "Hello World!"
```

可通过写入空白字符进行清屏

```
ec_cli device --lcd_putc  -d "            "
```

3. 状态监控

输入 `ec_cli echo` 可查看，硬件控制相关的指令。当前版本仅支持读取顶部按键状态。

```
root@m5stack-AI-Pyramid:~# ec_cli echo
usage: ec_cli [options] ...
options:
  -b, --button    button event
  -?, --help      print this message
```

```
ec_cli echo --button
```

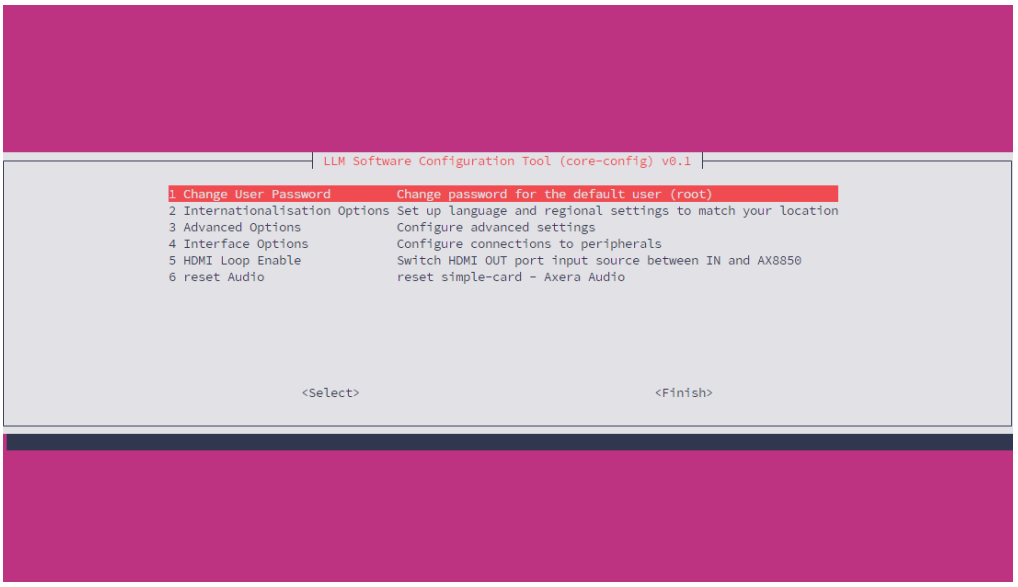
按下顶部按键

```
{ "created":1769747540,"data":{"code":0,"vale":204},"object":"","request_id":"","work_id":"buttons_thread" }
{ "created":1769747540,"data":{"code":1,"vale":204},"object":"","request_id":"","work_id":"buttons_thread" }
{ "created":1769747540,"data":{"code":0,"vale":204},"object":"","request_id":"","work_id":"buttons_thread" }
{ "created":1769747540,"data":{"code":1,"vale":204},"object":"","request_id":"","work_id":"buttons_thread" }
```

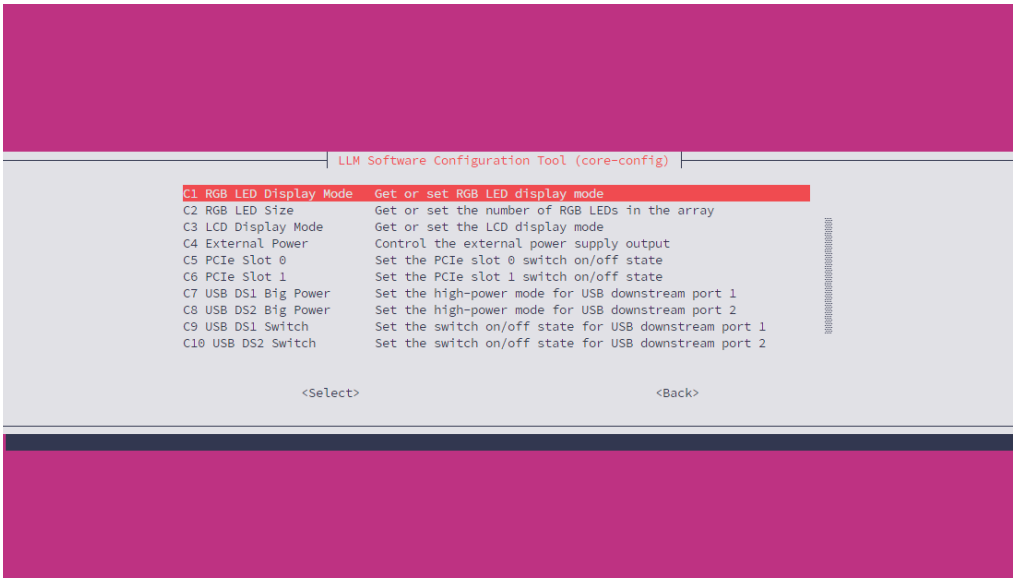
4. Core-Config

除了使用命令行，也可以使用 Core-Config 打开 GUI 界面进行配置。

```
core-config
```

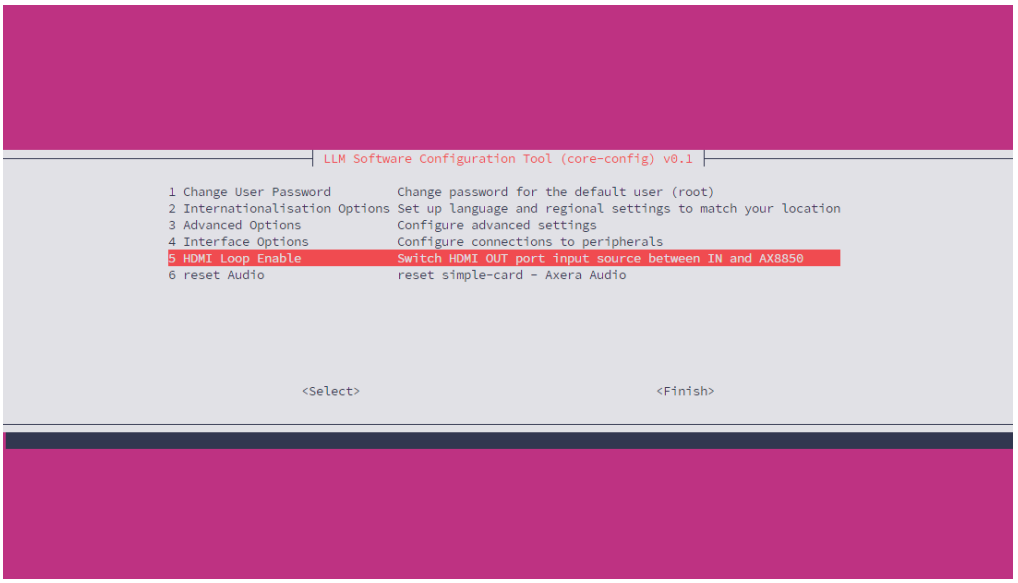


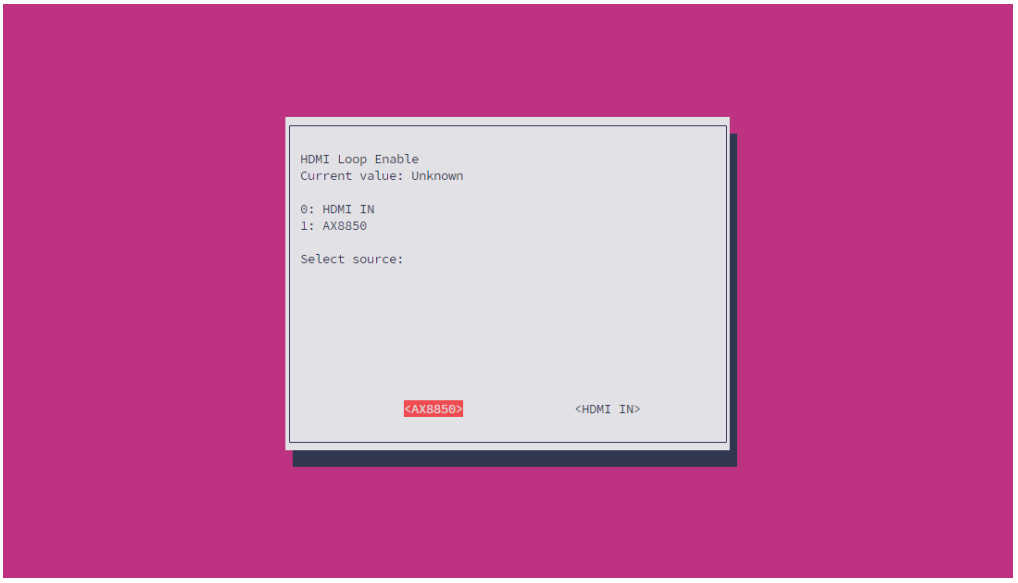
`Interface Option` 中包含了一些常用的硬件控制选项，如 USB 接口供电，风扇转速等。配置内容与 `ec_cli` 命令行工具功能一致。



配置显示输出

该配置适用于 AI Pyramid-Pro，可配置 Display 输出接口的信号源来自 Display Input 接口，或是直接使用 AX8850 内部默认输出

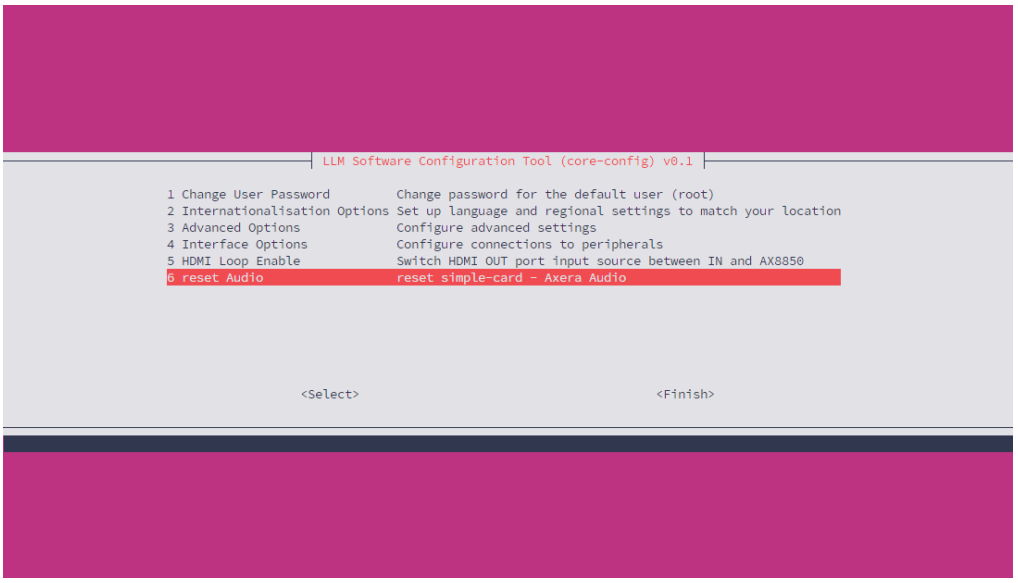




Reset Audio

重置声卡

设备音频输出存在杂音，或其他异常情况时，可执行 Reset Audio 选项重置声卡。



5. 更多内容

- AI-Pyramid-EC-Proxy Github