NanoPi NEO

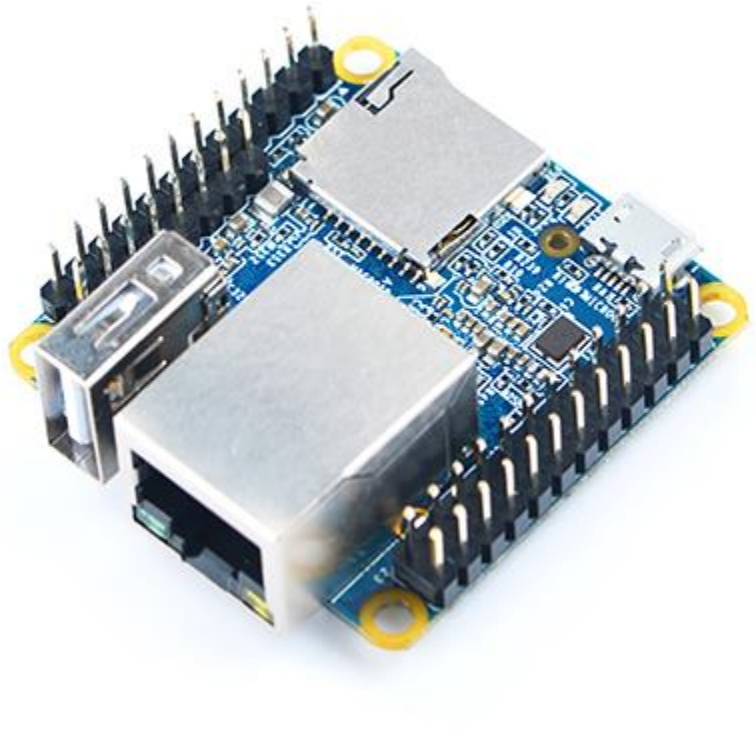
Download NanoPi NEO Files

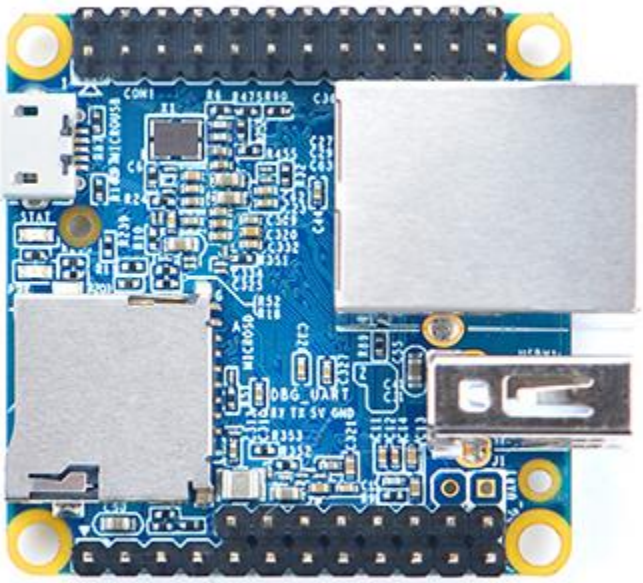
1 Introduction

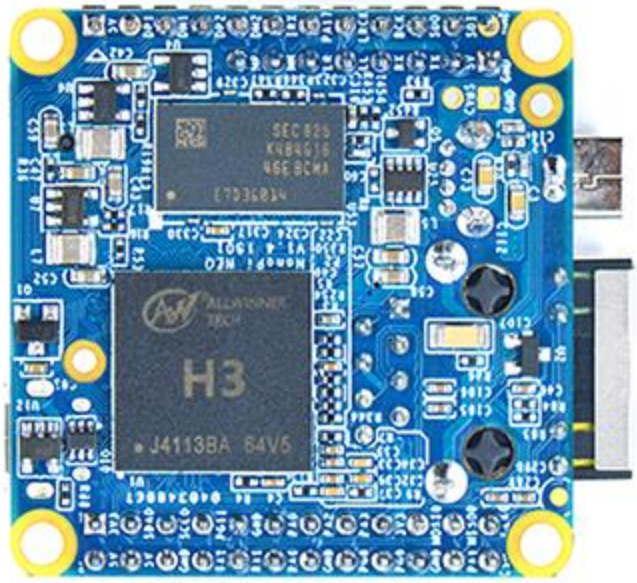
- The NanoPi NEO(abbreviated as NEO) is another fun board developed by FriendlyARM for makers, hobbyists and fans.

2 Hardware Spec

- CPU: Allwinner H3, Quad-core Cortex-A7 Up to 1.2GHz
- DDR3 RAM: 256MB/512MB
- Connectivity: 10/100M Ethernet
- USB Host: Type-A x 1, 2.54 mm pin x 2
- MicroSD Slot x 1
- MicroUSB: OTG, for power input
- Debug Serial Port: 4Pin, 2.54 mm pitch pin header
- Audio input/output Port: 5Pin, 2.0mm pitch pin header
- GPIO: 2.54mm pitch 36pin. It includes UART, SPI, I2C, IO etc
- Power Supply: DC 5V/2A
- PCB Dimension: 40 x 40 mm
- Working Temperature: -20℃ to 70℃
- Weight: 14g(WITHOUT Pin-headers)
- OS/Software: u-boot, UbuntuCore and Android




DBG_UART
RX TX 5V GND


H3
J4113BA 64V5

3.1 uboot

- mainline uboot released on May 2017
- supports fastboot to update uboot

3.2 UbuntuCore 16.04

- mainline kernel: Linux-4.14
- rpi-monitor: check system status and information
- npi-config: system configuration utility for setting passwords, language, timezone, hostname, SSH and auto-login,and enabling/disabling i2c, spi, serial and PWM
- software utility: wiringNP to access GPIO pins
- software utility: RPi.GPIO_NP to access GPIO pins
- networkmanager: manage network
- system log output from serial port
- nano editor
- welcome window with basic system information and status
- auto-login with user account "pi" with access to npi-config
- sudoers include "fa"
- on first system boot file system will be automatically extended.
- supports file system auto check and repair on system boot.
- supports FriendlyElec's NanoHat-PCM5102A
- supports USB WiFi module: refer to #Connect USB WiFi to NEO
- supports audio recording and playing with 3.5mm audio jack
- supports USB Host and 100M Ethernet
- supports FriendlyElec BakeBit modules
- supports dynamic frequency scaling and voltage regulation
- relieves overheat compared to kernel Linux-3.4
- fixed MAC address

3.3 Ubuntu OLED

- mainline kernel: Linux-4.14
- supports FriendlyElec's OLED module

3.4 Debian

- welcome window with basic system information and status

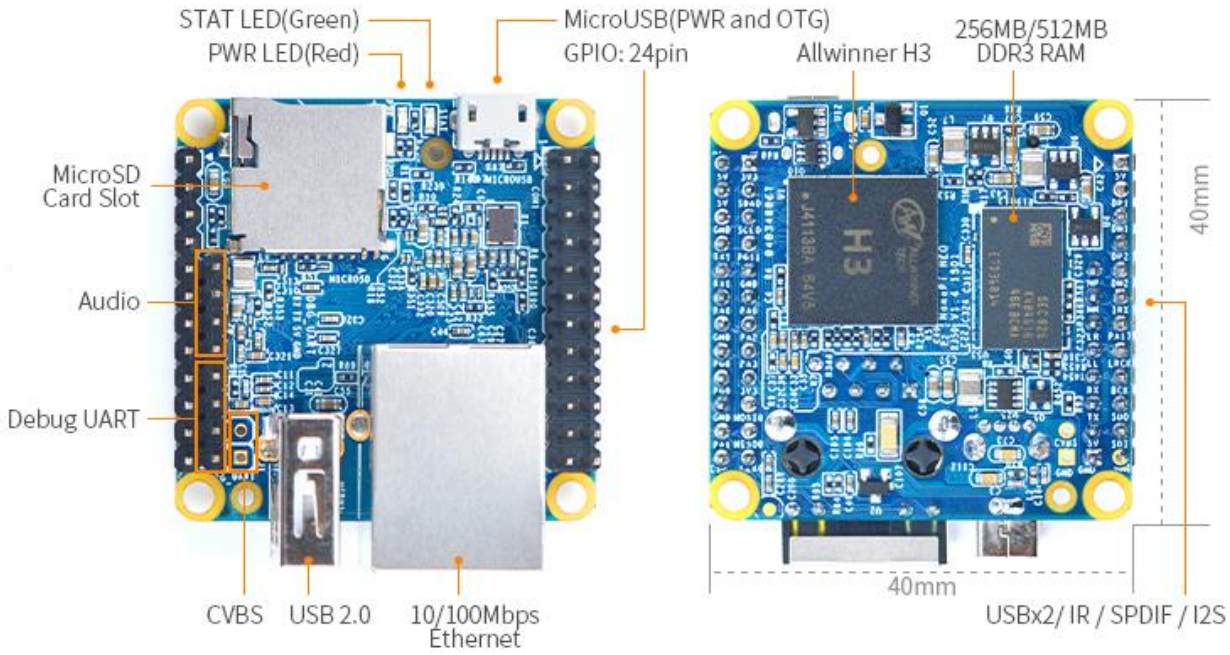
3.5 Debian for NAS Dock

- mainline kernel: Linux-4.14
- supports FriendlyElec's NAS Dock
- optimized OpenMediaVault configuration options
- allocated swap section

3.6 Android

- basic system

4.1 Layout



GPIO Pin Description

Pin#	Name	Linux gpio	Pin#	Name	Linux gpio
1	SYS_3.3V		2	VDD_5V	
3	I2C0_SDA		4	VDD_5V	
5	I2C0_SCL		6	GND	
7	GPIOG11	203	8	UART1_TX/GPIOG6	198
9	GND		10	UART1_RX/GPIOG7	199
11	UART2_TX/GPIOA0	0	12	GPIOA6	6
13	UART2_RTS/GPIOA2	2	14	GND	
15	UART2_CTS/GPIOA3	3	16	UART1_RTS/GPIOG8	200

17	SYS_3.3V		18	UART1_CTS/GPIOG9	201
19	SPI0_MOSI/GPIOC0	64	20	GND	
21	SPI0_MISO/GPIOC1	65	22	UART2_RX/GPIOA1	1
23	SPI0_CLK/GPIOC2	66	24	SPI0_CS/GPIOC3	67

- **USB/Audio/IR Pin Description**

NanoPi NEO 1606			**NanoPi NEO V1.1/V1.2/V1.3/V1.31/V1.4**		
Pin#	Name	Description	Pin#	Name	Description
1	VDD_5V	5V Power Out	1	VDD_5V	5V Power Out
2	USB-DP1	USB1 DP Signal	2	USB-DP1	USB1 DP Signal
3	USB-DM1	USB1 DM Signal	3	USB-DM1	USB1 DM Signal
4	USB-DP2	USB2 DP Signal	4	USB-DP2	USB2 DP Signal
5	USB-DM2	USB2 DM Signal	5	USB-DM2	USB2 DM Signal
6	GPIOL11/IR-RX	GPIOL11 or IR Receive	6	GPIOL11/IR-RX	GPIOL11 or IR Receive
7	SPDIF-OUT/GPIOA17	GPIOA17 or SPDIF-OUT	7	SPDIF-OUT/GPIOA17	GPIOA17 or SPDIF-OUT
8	MICIN1P	Microphone Positive Input	8	PCM0_SYNC/I2S0_LRC	I2S/PCM Sample Rate Clock/Sync

9	MICIN1N	Microphone Negative Input	9	PCM0_CLK/I2S0_BCK	I2S/PCM Sample Rate Clock
10	LINEOUTR	LINE-OUT Right Channel Output	10	PCM0_DOUT/I2S0_SDOUT	I2S/PCM Serial Data Output
11	LINEOUTL	LINE-OUT Left Channel Output	11	PCM0_DIN/I2S0_SDIN	I2S/PCM Serial Data Input
12	GND	0V	12	GND	0V

- **Audio Port**

Pin#	Name	Description
1	LINEOUTL	LINE-OUT Left Channel Output
2	LINEOUTR	LINE-OUT Right Channel Output
3	MICIN1N	Microphone Negative Input
4	MICIN1P	Microphone Positive Input

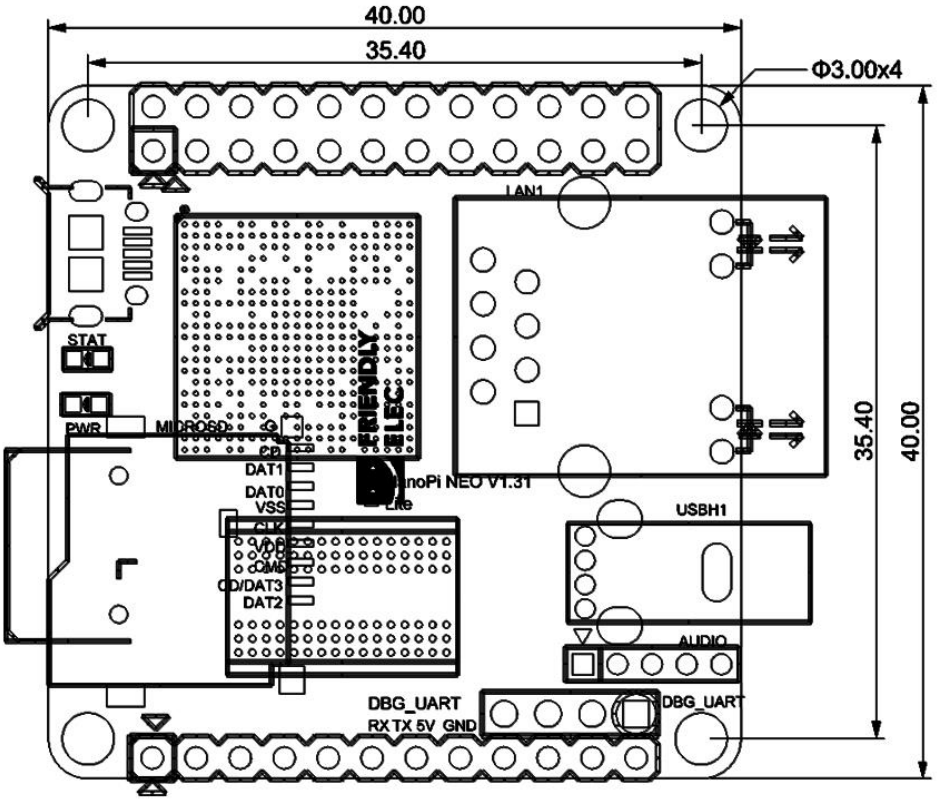
- **Debug Port（UART0）**

Pin#	Name
1	GND
2	VDD_5V
3	UART_TXD0
4	UART_RXD0

Note:

1. SYS_3.3V: 3.3V power output
2. VVDD_5V: 5V power input/output. When the external device's power is greater than the MicroUSB's the external device is charging the board otherwise the board powers the external device. The input range is 4.7V ~ 5.5V
3. All pins are 3.3V, output current is 5mA
4. For more details refer to the document: NanoPi-NEO-v1.4-1801-Schematic.pdf

4.2 Dimensional Diagram



For more details refer to the document: pcb file in dxf format

5 Get Started

5.1 Essentials You Need

Before starting to use your NanoPi NEO get the following items ready

- NanoPi NEO
- microSD Card/TFCard: Class 10 or Above, minimum 8GB SDHC
- microUSB power. A 5V/2A power is a must
- A Host computer running Ubuntu 16.04 64 bit system

5.2 TF Cards We Tested

To make your NanoPi NEO boot and run fast we highly recommend you use a Class10 8GB SDHC TF card or a better one. The following cards are what we used in all our test cases presented here:

- SanDisk TF 8G Class10 Micro/SD TF card:

- SanDisk TF128G MicroSDXC TF 128G Class10 48MB/S:

- 川宇 8G C10 High Speed class10 micro SD card:

5.3 Install OS

5.3.1 Get Image Files

Visit this link download link to download image files and the flashing utility:

Image Files:	
nanopi-neo_sd_friendlycore-xenial_3.4_armhf_YYYYMMDD.img.zip	Base on UbuntuCore, Kernel: Linux-3.4
nanopi-neo_sd_friendlycore-xenial_4.14_armhf_YYYYMMDD.img.zip	Base on UbuntuCore, Kernel: Linux-4.14
nanopi-neo_sd_friendlywrt_4.14_armhf_YYYYMMDD.img.zip	Base on OpenWrt, kernel:Linux-4.14
Flash Utility:	
win32diskimager.rar	Windows utility for flashing Debian image. Under Linux users can use "dd"

5.3.2 Comparison of Linux-3.4 and Linux-4.14

- Our Linux-3.4 is provided by Allwinner. Allwinner has done a lot of customization work which on one hand contains many features and functions but on the other

hand incurs overheat issues. If your application needs to use VPU or GPU you need to use the 3.4 kernel based ROM and use a heat sink together with your board.

- Our Linux-4.14 is based on the mainline kernel. We will keep this kernel with the latest one released by Linus Torvalds. This kernel is stable and doesn't generate heat that much. If your application doesn't need to use VPU or GPU we recommend you to use this kernel.
- For more details about the Linux-4.14 kernel refer to: Building U-boot and Linux for H5/H3/H2+

6 Work with FriendlyCore

6.1 Introduction

FriendlyCore is a light Linux system without X-windows, based on ubuntu core, It uses the Qt-Embedded's GUI and is popular in industrial and enterprise applications.

Besides the regular Ubuntu Core's features FriendlyCore has the following additional features:

- it integrates Qt4.8;
- it integrates NetworkManager;
- it has bluez and Bluetooth related packages;
- it has alsa packages;
- it has npi-config;
- it has RPiGPIO, a Python GPIO module;
- it has some Python/C demo in /root/ directory;
- it enables 512M-swap partition;

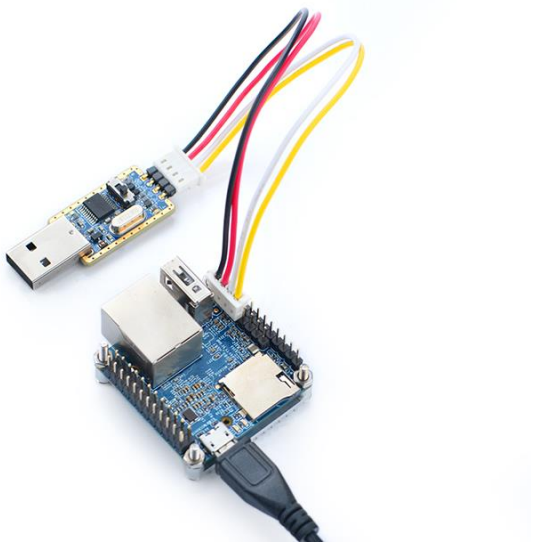
6.2 System Login

- If your board is connected to an HDMI monitor you need to use a USB mouse and keyboard.
- If you want to do kernel development you need to use a serial communication board, ie a PSU-ONECOM board, which will

allow you to operate the board via a serial terminal.Here is a setup where we connect a board to a PC via the PSU-ONECOM and you can power on your board from either the PSU-ONECOM or its

MicroUSB:

You can use a USB to Serial conversion board too.
Make sure you use a 5V/2A power to power your board from its MicroUSB port:



- FriendlyCore User Accounts:

Non-root User:

```
User Name: pi
Password: pi
```

Root:

```
User Name: root
Password: fa
```

The system is automatically logged in as "pi". You can do "sudo npi-config" to disable auto login.

- Update packages

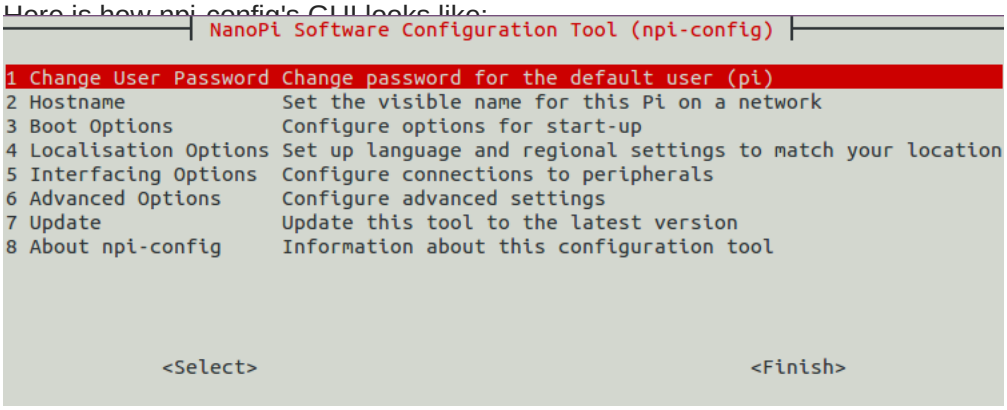
```
$ sudo apt-get update
```

6.3 Configure System with npi-config

The npi-config is a commandline utility which can be used to initialize system configurations such as user password, system language, time zone, Hostname, SSH switch , Auto login and etc. Type the following command to run this utility.

```
$ sudo npi-config
```

Here is how npi-config's GUI looks like:



6.4 Develop Qt Application

Please refer to: [How to Build and Install Qt Application for FriendlyELEC Boards]

6.5 Setup Program to AutoRun

You can setup a program to autorun on system boot with npi-config:

```
sudo npi-config
```

Go to Boot Options -> Autologin -> Qt/Embedded, select Enable and reboot.

6.6 Extend TF Card's Section

When FriendlyCore is loaded the TF card's section will be automatically extended.You can check the section's size by running the following command:

```
$ df -h
```

6.7 WiFi

For either an SD WiFi or a USB WiFi you can connect it to your board in the same way. The APXX series WiFi chips are SD WiFi chips. By default FriendlyElec's system supports most popular USB WiFi modules. Here is a list of the USB WiFi modules we tested:

Index	Model
1	RTL8188CUS/8188EU 802.11n WLAN Adapter
2	RT2070 Wireless Adapter
3	RT2870/RT3070 Wireless Adapter
4	RTL8192CU Wireless Adapter
5	mi WiFi mt7601

6	5G USB WiFi RTL8821CU
7	5G USB WiFi RTL8812AU

You can use the NetworkManager utility to manage network. You can run "nmcli" in the commandline utility to start it. Here are the commands to start a WiFi connection:

- Change to root

```
$ su root
```

- Check device list

```
$ nmcli dev
```

Note: if the status of a device is "unmanaged" it means that device cannot be accessed by NetworkManager. To make it accessed you need to clear the settings under "/etc/network/interfaces" and reboot your system.

- Start WiFi

```
$ nmcli r wifi on
```

- Scan Surrounding WiFi Sources

```
$ nmcli dev wifi
```

- Connect to a WiFi Source

```
$ nmcli dev wifi connect "SSID" password "PASSWORD" ifname wlan0
```

The "SSID" and "PASSWORD" need to be replaced with your actual SSID and password.If you have multiple WiFi devices you need to specify the one you want to connect to a WiFi source with iface
If a connection succeeds it will be automatically setup on next system reboot.

For more details about NetworkManager refer to this link: Use NetworkManager to configure network settings

If your USB WiFi module doesn't work most likely your system doesn't have its driver. For a Debian system you can get a driver from Debian-WiFi and install it on your system. For a Ubuntu system you can install a driver by running the following commands:

```
$ apt-get install linux-firmware
```

In general all WiFi drivers are located at the "/lib/firmware" directory.

6.8 Ethernet Connection

If a board is connected to a network via Ethernet before it is powered on it will automatically obtain an IP with DHCP activated after it is powered up. If you want to set up a static IP refer to: Use NetworkManager to configure network settings。

6.9 WiringPi and Python Wrapper

- WiringNP: NanoPi NEO/NEO2/Air GPIO Programming with C
- RPi.GPIO : NanoPi NEO/NEO2/Air GPIO Programming with Python

6.10 Set Audio Device

If your system has multiple audio devices such as HDMI-Audio, 3.5mm audio jack and I2S-Codec you can set system's default audio device by running the following commands.

- After your board is booted run the following commands to install alsa packages:

```
$ apt-get update
$ apt-get install libasound2
$ apt-get install alsa-base
$ apt-get install alsa-utils
```

- After installation is done you can list all the audio devices by running the following command. Here is a similar list you may see after you run the command:

```
$ aplay -l
card 0: HDMI
card 1: 3.5mm codec
card 2: I2S codec
```

"card 0" is HDMI-Audio, "card 1" is 3.5mm audio jack and "card 2" is I2S-Codec. You can set default audio device to HDMI-Audio by changing the "/etc/asound.conf" file as follows:

```
pcm.!default {
    type hw
    card 0
    device 0
}

ctl.!default {
    type hw
    card 0
}
```

If you change "card 0" to "card 1" the 3.5mm audio jack will be set to the default device.
Copy a .wav file to your board and test it by running the following command:

```
$ aplay /root/Music/test.wav
```

You will hear sounds from system's default audio device.
If you are using H3/H5/H2+ series board with mainline kernel, the easier way is using npi-config。

6.11 Connect to USB Camera(FA-CAM202)

The FA-CAM202 is a 200M USB camera. Connect your board to camera module. Then boot OS, connect your board to a network, log into the board as root and run "mjpg-streamer":

```
$ cd /root/C/mjpg-streamer
$ make
$ ./start.sh
```

You need to change the start.sh script and make sure it uses a correct /dev/videoX node. You can check your camera's node by running the following commands:

```
$ apt-get install v4l-utils
$ v4l2-ctl -d /dev/video0 -D
Driver Info (not using libv4l2):
        Driver name   : uvcvideo
        Card type     : HC 3358+2100: HC 3358+2100  / USB 2.0 Camera: USB 2.0
Camera
        Bus info      : usb-1c1b000.usb-1
    ...
```

The above messages indicate that "/dev/video0" is camera's device node.The mjpg-streamer application is an open source video steam server. After it is successfully started the following messages will be popped up:

```
$ ./start.sh
 i: Using V4L2 device.: /dev/video0
 i: Desired Resolution: 1280 x 720
 i: Frames Per Second.: 30
 i: Format............: YUV
 i: JPEG Quality......: 90
 o: www-folder-path...: ./www/
 o: HTTP TCP port.....: 8080
 o: username:password.: disabled
 o: commands..........: enabled
```

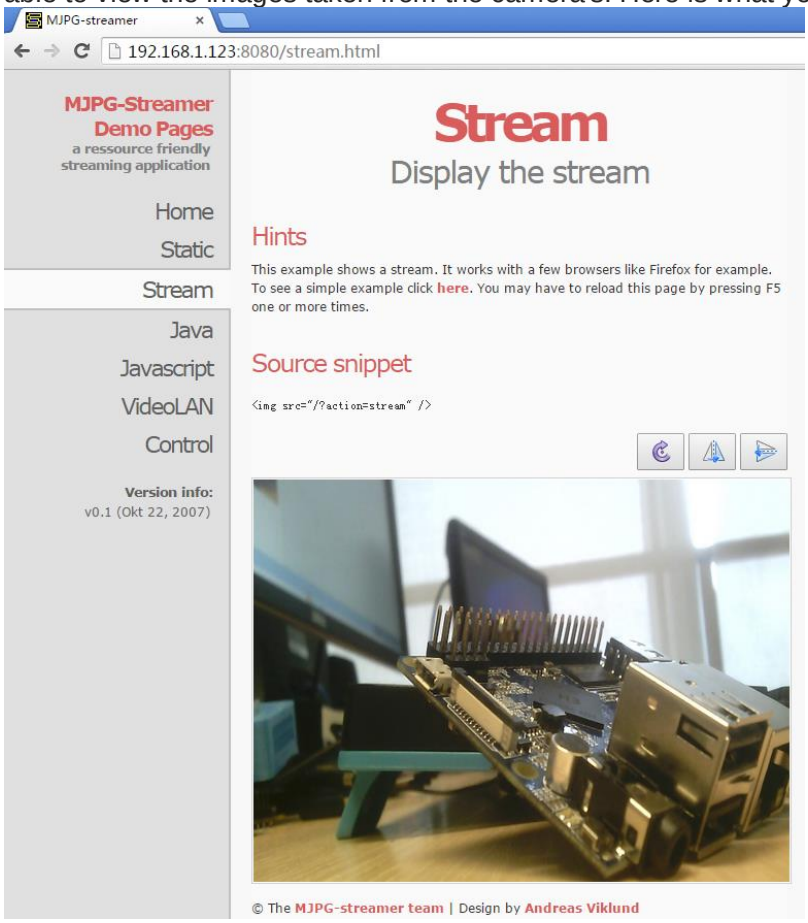
start.sh runs the following two commands:

```
export LD_LIBRARY_PATH="$(pwd)"
./mjpg_streamer -i "./input_uvc.so -d /dev/video0 -y 1 -r 1280x720 -f 30 -q 90 -n
-fb 0" -o "./output_http.so -w ./www"
```

Here are some details for mjpg_streamer's major options:
-i: input device. For example "input_uvc.so" means it takes input from a camera;
-o: output device. For example "output_http.so" means the it transmits data via http;
-d: input device's subparameter. It defines a camera's device node;
-y: input device's subparameter. It defines a camera's data format: 1:yuyv, 2:yvyu, 3:uyvy 4:vyuy. If this option isn't defined MJPEG will be set as the data format;
-r: input device's subparameter. It defines a camera's resolution;
-f: input device's subparameter. It defines a camera's fps. But whether this fps is supported depends on its driver;
-q: input device's subparameter. It defines the quality of an image generated by libjpeg soft-encoding;
-n: input device's subparameter. It disables the dynctrls function;
-fb: input device's subparameter. It specifies whether an input image is displayed at "/dev/fbX";
-w: output device's subparameter. It defines a directory to hold web pages;

In our case the board's IP address was 192.168.1.230. We typed 192.168.1.230:8080 in a browser and were

able to view the images taken from the camera's. Here is what you would expect to observe:



6.12 Check CPU's Working Temperature

You can get CPU's working temperature by running the following command:

```
$ cpu_freq
Aavailable frequency(KHz):
        480000 624000 816000 1008000
Current frequency(KHz):
        CPU0 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU1 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU2 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU3 online=1 temp=26548C governor=ondemand freq=624000KHz
```

This message means there are currently four CPUs working. All of their working temperature is 26.5 degree in Celsius and each one's clock is 624MHz.
Set CPU frequency:

```
$ cpu_freq -s 1008000
Aavailable frequency(KHz):
        480000 624000 816000 1008000
Current frequency(KHz):
        CPU0 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU1 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU2 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU3 online=1 temp=36702C governor=userspace freq=1008000KHz
```

6.13 Test Infrared Receiver

Note: Please Check your board if IR receiver exist.
By default the infrared function is disabled you can enable it by using the npi-config utility:

```
$ npi-config
    6 Advanced Options     Configure advanced settings
        A8 IR              Enable/Disable IR
            ir Enable/Disable ir[enabled]
```

Reboot your system and test its infrared function by running the following commands:

```
$ apt-get install ir-keytable
$ echo "+rc-5 +nec +rc-6 +jvc +sony +rc-5-sz +sanyo +sharp +mce_kbd +xmp" >
/sys/class/rc/rc0/protocols   # Enable infrared
$ ir-keytable -t
Testing events. Please, press CTRL-C to abort.
```

"ir-keytable -t" is used to check whether the receiver receives infrared signals. You can use a remote control to send infrared signals to the receiver. If it works you will see similar messages as follows:

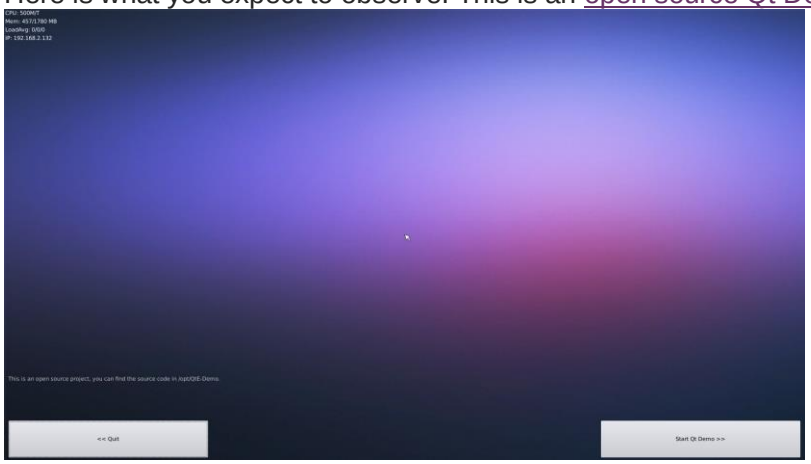
```
1522404275.767215: event type EV_MSC(0x04): scancode = 0xe0e43
1522404275.767215: event type EV_SYN(0x00).
1522404278.911267: event type EV_MSC(0x04): scancode = 0xe0e42
1522404278.911267: event type EV_SYN(0x00).
```

6.14 Run Qt Demo

Run the following command

```
$ sudo /opt/QtE-Demo/run.sh
```

Here is what you expect to observe. This is an open source Qt Demo:



6.15 How to install and use docker (for armhf system)

6.15.1 How to Install Docker

Run the following commands：

```
sudo apt-get update
sudo apt-get install docker.io
```

6.15.2 Test Docker installation

Test that your installation works by running the simple docker image:

```
git clone https://github.com/friendlyarm/debian-jessie-arm-docker
cd debian-jessie-arm-docker
```

```
./rebuild-image.sh
./run.sh
```

6.16 Using 4G Module EC20 on FriendlyCore

6.16.1 Step1：Compile the quectel-CM command line tool on the development board

Compile and install quectel-CM into the /usr/bin/ directory by entering the following command：

```
git clone https://github.com/friendlyarm/quectel-cm.git
cd quectel-cm/
make
cp quectel-CM /usr/bin/
```

6.16.2 Step2：Add udhcpc script

The quectel-CM tool will call the udhcpc script. we need to create a udhcpc script for it. Please create a new file with the editor you are familiar with. The file name is: /usr/share/udhcpc/default.script, the content is as follows：

```
#!/bin/sh

# udhcpc script edited by Tim Riker <Tim@Rikers.org>

[ -z "$1" ] && echo "Error: should be called from udhcpc" && exit 1

RESOLV_CONF="/etc/resolv.conf"
[ -n "$broadcast" ] && BROADCAST="broadcast $broadcast"
[ -n "$subnet" ] && NETMASK="netmask $subnet"

case "$1" in
  deconfig)
    /sbin/ifconfig $interface 0.0.0.0
    ;;

  renew|bound)
    /sbin/ifconfig $interface $ip $BROADCAST $NETMASK

    if [ -n "$router" ] ; then
      echo "deleting routers"
      while route del default gw 0.0.0.0 dev $interface ; do
        :
      done

      for i in $router ; do
        route add default gw $i dev $interface
      done
    fi

    echo -n > $RESOLV_CONF
    [ -n "$domain" ] && echo search $domain >> $RESOLV_CONF
    for i in $dns ; do
      echo adding dns $i
      echo nameserver $i >> $RESOLV_CONF
```

```
    done
    ;;
esac

exit 0
```

Assign executable permissions with the following command：

```
chmod 755 /usr/share/udhcpc/default.script
```

6.16.3 Step3：Start 4G dialing

Start the dialing by entering the following command:

```
quectel-CM &
```

If the dialing is successful, the screen will output information such as the IP address, as shown below:

```
root@NanoPC-T4:~# quectel-CM &
[1] 5364
root@NanoPC-T4:~# [05-15_08:23:13:719]
WCDMA&LTE_QConnectManager_Linux&Android_V1.1.34
[05-15_08:23:13:720] quectel-CM profile[1] = (null)/(null)/(null)/0, pincode =
(null)
[05-15_08:23:13:721] Find /sys/bus/usb/devices/3-1 idVendor=2c7c idProduct=0125
[05-15_08:23:13:722] Find /sys/bus/usb/devices/3-1:1.4/net/wwan0
[05-15_08:23:13:722] Find usbnet_adapter = wwan0
[05-15_08:23:13:723] Find /sys/bus/usb/devices/3-1:1.4/usbmisc/cdc-wdm0
[05-15_08:23:13:723] Find qmichannel = /dev/cdc-wdm0
[05-15_08:23:13:739] cdc_wdm_fd = 7
[05-15_08:23:13:819] Get clientWDS = 18
[05-15_08:23:13:851] Get clientDMS = 2
[05-15_08:23:13:884] Get clientNAS = 2
[05-15_08:23:13:915] Get clientUIM = 1
[05-15_08:23:13:947] Get clientWDA = 1
[05-15_08:23:13:979] requestBaseBandVersion EC20CEFHLGR06A01M1G_OCPU_BETA1210
[05-15_08:23:14:043] requestSetEthMode QMUXResult = 0x1, QMUXError = 0x46
[05-15_08:23:14:075] requestGetSIMStatus SIMStatus: SIM_READY
[05-15_08:23:14:107] requestGetProfile[1] cmnet///0
[05-15_08:23:14:139] requestRegistrationState2 MCC: 460, MNC: 0, PS: Attached,
DataCap: LTE
[05-15_08:23:14:171] requestQueryDataCall IPv4ConnectionStatus: DISCONNECTED
[05-15_08:23:14:235] requestRegistrationState2 MCC: 460, MNC: 0, PS: Attached,
DataCap: LTE
[05-15_08:23:14:938] requestSetupDataCall WdsConnectionIPv4Handle: 0xe16e4540
[05-15_08:23:15:002] requestQueryDataCall IPv4ConnectionStatus: CONNECTED
[05-15_08:23:15:036] ifconfig wwan0 up
[05-15_08:23:15:052] busybox udhcpc -f -n -q -t 5 -i wwan0
[05-15_08:23:15:062] udhcpc (v1.23.2) started
[05-15_08:23:15:077] Sending discover...
[05-15_08:23:15:093] Sending select for 10.22.195.252...
[05-15_08:23:15:105] Lease of 10.22.195.252 obtained, lease time 7200
[05-15_08:23:15:118] deleting routers
SIOCDELRT: No such process
```

```
[05-15_08:23:15:132] adding dns 221.179.38.7
[05-15_08:23:15:132] adding dns 120.196.165.7
```

6.16.4 Test 4G connection

Ping a domain name to see if DNS resolution is already working：

```
root@NanoPC-T4:~# ping www.baidu.com
PING www.a.shifen.com (183.232.231.174) 56(84) bytes of data.
64 bytes from 183.232.231.174 (183.232.231.174): icmp_seq=1 ttl=56 time=74.3 ms
64 bytes from 183.232.231.174 (183.232.231.174): icmp_seq=2 ttl=56 time=25.1 ms
64 bytes from 183.232.231.174 (183.232.231.174): icmp_seq=3 ttl=56 time=30.8 ms
64 bytes from 183.232.231.174 (183.232.231.174): icmp_seq=4 ttl=56 time=29.1 ms
64 bytes from 183.232.231.174 (183.232.231.174): icmp_seq=5 ttl=56 time=29.2 ms
```

6.16.5 Test the speed of 4G

```
wget -O - https://raw.githubusercontent.com/sivel/speedtest-
cli/master/speedtest.py | python
```

The test results obtained are as follows：

```
Retrieving speedtest.net configuration...
Testing from China Mobile Guangdong (117.136.40.167)...
Retrieving speedtest.net server list...
Selecting best server based on ping...
Hosted by ChinaTelecom-GZ (Guangzhou) [2.51 km]: 62.726 ms
Testing download
speed.....................................................................
...
Download: 32.93 Mbit/s
Testing upload
speed.....................................................................
...................
Upload: 5.58 Mbit/s
```

7 Work with OpenWrt

7.1 Introduction

OpenWrt is a highly extensible GNU/Linux distribution for embedded devices.Unlike many other distributions for routers, OpenWrt is built from the ground up to be a full-featured, easily modifiable operating system for embedded devices. In practice, this means that you can have all the features you need with none of the bloat, powered by a modern Linux kernel. For more details you can refer to:OpenWrt Website.

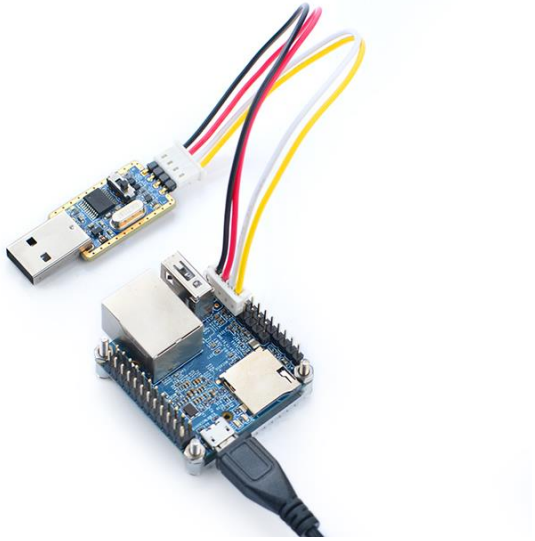
7.2 System Login

- **Login via Serial Port**

When you do kernel development you'd better get a serial communication board. After you connect your board to a serial communication board you will be able to do development work from a commandline utility.
Here is a hardware setup:
After you connect your board to a serial communication board (e.g. FriendlyElec's serial communication board) you can power the whole system from either the DC port on the serial communication board or the MicroUSB

port(if there is one) on your board:

or you can use a USB to serial board and power on the whole system at the MicroUSB port with a 5V/2A power:



By default you will login as root without a password. You can use "passwd" to set a password for root.

```
BusyBox v1.28.3 () built-in shell (ash)

 _______                     ________        __
|       |.-----.-----.-----.|  |  |  |.----.|  |_
|   -   ||  _  |  -__|     ||  |  |  ||   _||   _|
|_______||   __|_____|__|__||________||__|  |____|
         |__| W I R E L E S S   F R E E D O M
 -----------------------------------------------------
 OpenWrt 18.06.1, r7258-5eb055306f
 -----------------------------------------------------
=== WARNING! =====================================
There is no root password defined on this device!
Use the "passwd" command to set up a new password
in order to prevent unauthorized SSH logins.
--------------------------------------------------
root@OpenWrt:/#
```

On first boot the system will automatically extend the file system on the TF card to the max capacity:

```
Begin: Resizing ext4 file system on /dev/mmcblk0p3 ... Model: SD SR64G (sd/mmc)
Disk /dev/mmcblk0: 100%
Sector size (logical/physical): 512B/512B
Partition Table: msdos
Disk Flags:

Number  Start  End    Size   Type     File system  Flags
 1      0.04%  0.11%  0.07%  primary  fat16
 2      0.11%  0.53%  0.42%  primary  ext4
 3      0.53%  100%   99.5%  primary  ext4

resize2fs 1.44.1 (24-Mar-2018)
[   29.750417] random: crng init done
Resizing the filesystem on /dev/mmcblk0p3 to 62040064 (1k) blocks.
The filesystem on /dev/mmcblk0p3 is now 62040064 (1k) blocks long.
```

Please wait for this to be done.

- **Login via SSH**

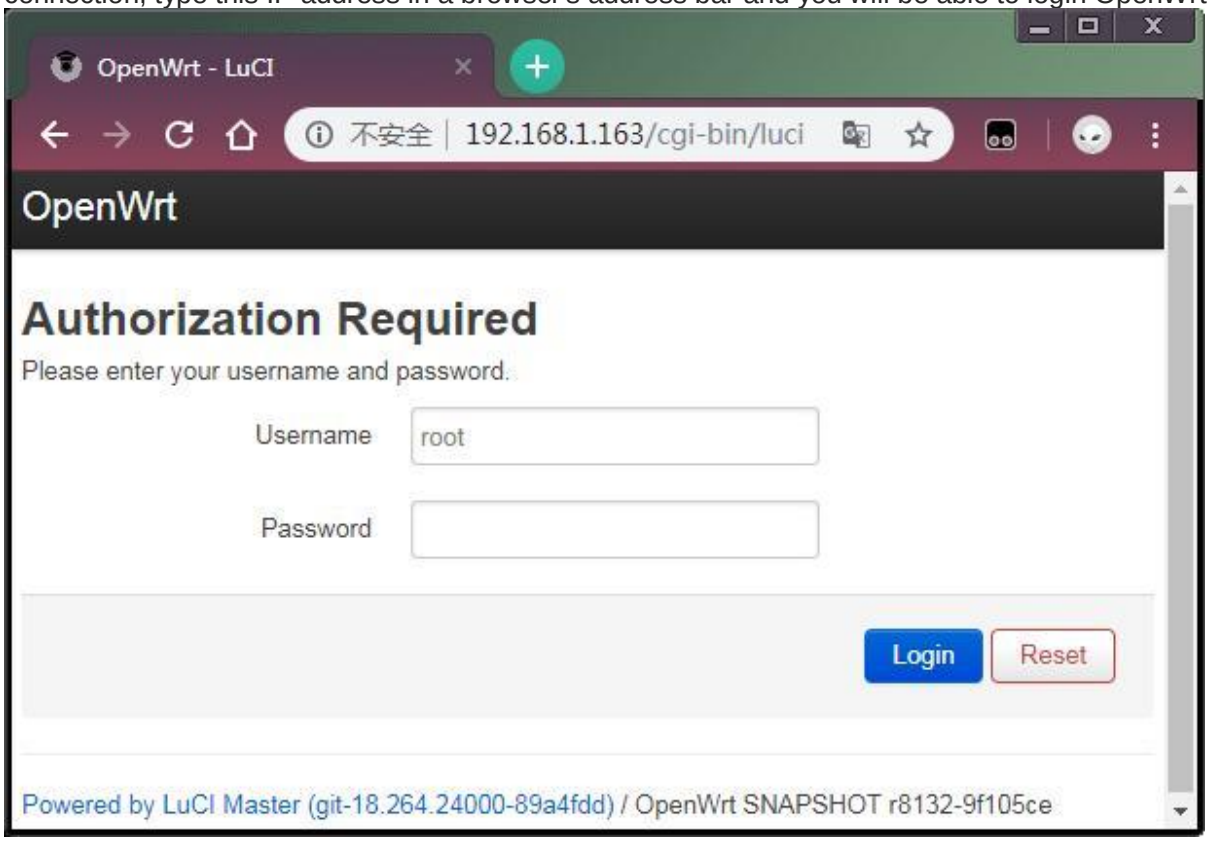
In FriendlyElec's OpenWrt system the Ethernet(eth0) is configured as WAN.
Before power on your board make sure your board is connected to a master router's LAN with an Ethernet cable and the eth0 will be assigned an IP address by DHCP.
For example, if your eth0 is assigned an IP address 192.168.1.163 you can login with SSH by running the following command:

```
$ ssh root@192.168.1.163
```

You can login without a password.

- **Login via Web**

You can login OpenWrt via a LuCI Web page.
After you go through all the steps in <Login via SSH> and get an IP address e.g. 192.168.1.163 for the Ethernet connection, type this IP address in a browser's address bar and you will be able to login OpenWrt-LuCI:



By default you will login as root without a password, just click on "Login" to login.

7.3 Manage Software Packages

OpenWrt has a package management utility: opkg. You can get its details by running the following command:

```
$ opkg
Package Manipulation:
        update                  Update list of available packages
        upgrade <pkgs>          Upgrade packages
        install <pkgs>          Install package(s)
        configure <pkgs>        Configure unpacked package(s)
        remove <pkgs|regexp>    Remove package(s)
        flag <flag> <pkgs>      Flag package(s)
         <flag>=hold|noprune|user|ok|installed|unpacked (one per invocation)

Informational Commands:
        list                    List available packages
        list-installed          List installed packages
        list-upgradable         List installed and upgradable packages
        list-changed-conffiles  List user modified configuration files
        files <pkg>             List files belonging to <pkg>
        search <file|regexp>    List package providing <file>
        find <regexp>           List packages whose name or description matches
<regexp>
        info [pkg|regexp]       Display all info for <pkg>
        status [pkg|regexp]     Display all status for <pkg>
        download <pkg>          Download <pkg> to current directory
...
```

These are just part of the manual. Here are some popular opkg commands.

- Update Package List

Before you install a package you'd better update the package list:

```
$ opkg update
```

- Check Available Packages

```
$ opkg list
```

At the time of writing there are 3241 packages available.

- Check Installed Packages:

```
$ opkg list-installed
```

At the time of writing 124 packages have been installed.

- Install/Delete Packages:

```
$ opkg install <pkgs>
$ opkg remove <pkgs>
```

- Check Files Contained in Installed Packages:

```
$ opkg files <pkg>
```

- Install Chinese Language Package for LuCI

```
$ opkg install luci-i18n-base-zh-cn
```

- Check Changed Files:

```
$ opkg list-changed-conffiles
```

- Reference Links:
  - openwrt opkg

7.4 Check System Status

- **Check CPU Temperature & Frequency via Commandline**

```
$ cpu_freq
Aavailable frequency(KHz):
        480000 624000 816000 1008000
Current frequency(KHz):
        CPU0 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU1 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU2 online=1 temp=26548C governor=ondemand freq=624000KHz
        CPU3 online=1 temp=26548C governor=ondemand freq=624000KHz
```

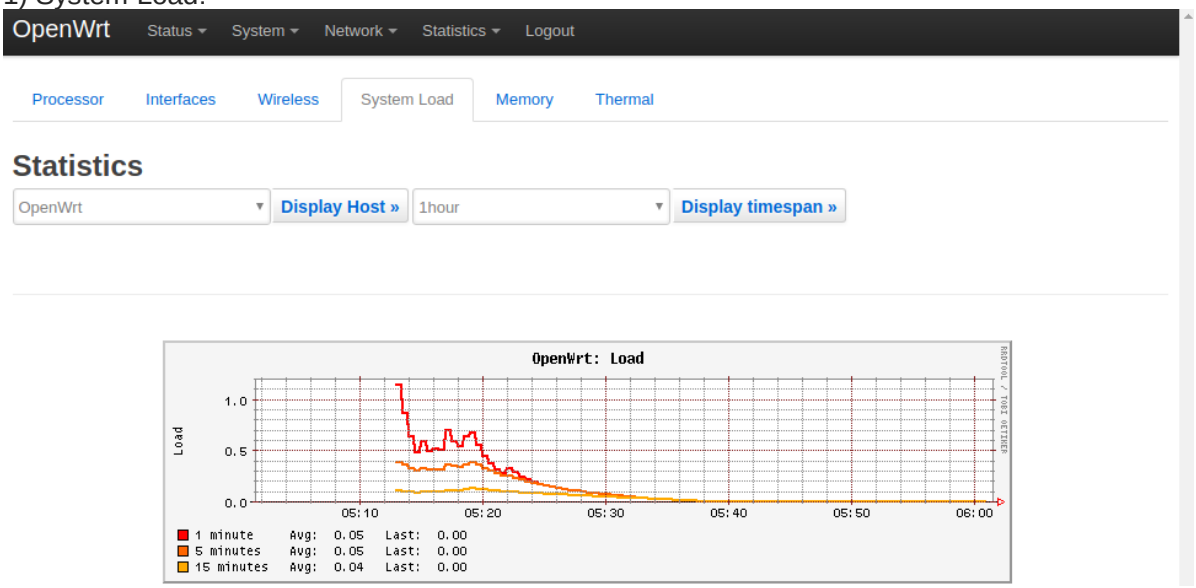
These messages mean that there are four CPU cores working online simultaneously. Each core's temperature is 26.5 degrees in Celsius, the scheduling policy is on-demand and the working frequency is 624MHz. You can set the frequency by running the following command:

```
$ cpu_freq -s 1008000
Aavailable frequency(KHz):
        480000 624000 816000 1008000
Current frequency(KHz):
        CPU0 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU1 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU2 online=1 temp=36702C governor=userspace freq=1008000KHz
        CPU3 online=1 temp=36702C governor=userspace freq=1008000KHz
```

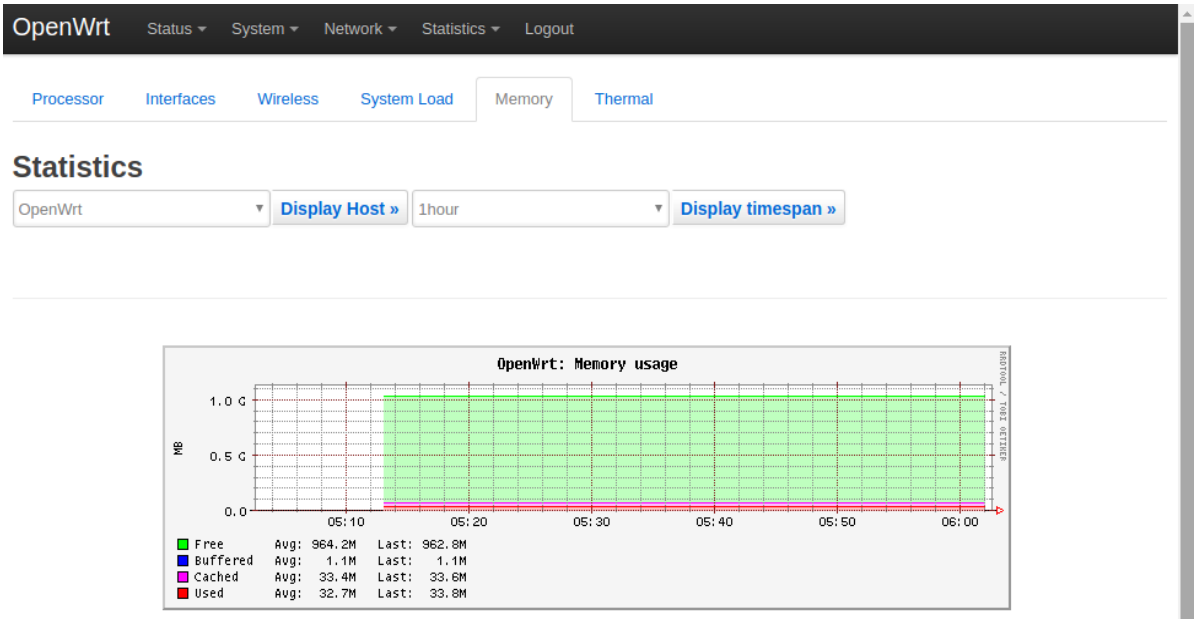
These messages mean four CPU cores are working online. Each core's temperature is 26.5 degrees. Each core's governor is on demand and the frequency is 480 MHz.

- **Check System Status on OpenWrt-LuCI Web Page**

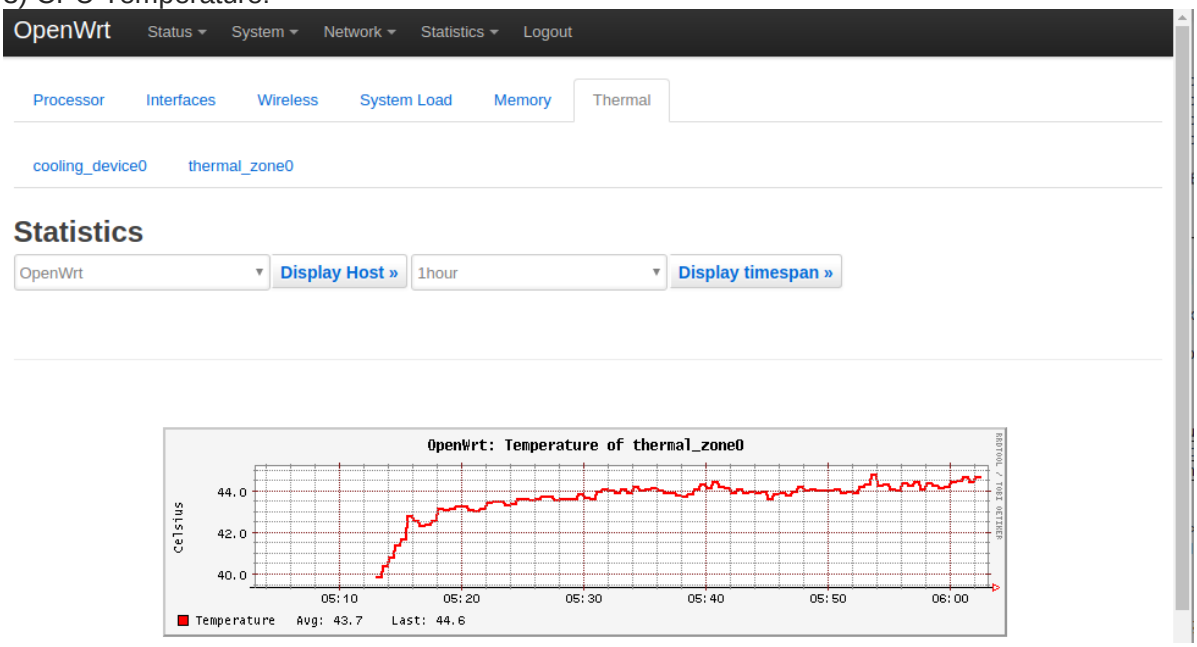
After open the OpenWrt-LuCI page, go to "Statistics ---> Graphs" and you will see various system statistics e.g.:
1) System Load:



2) RAM:



3) CPU Temperature:

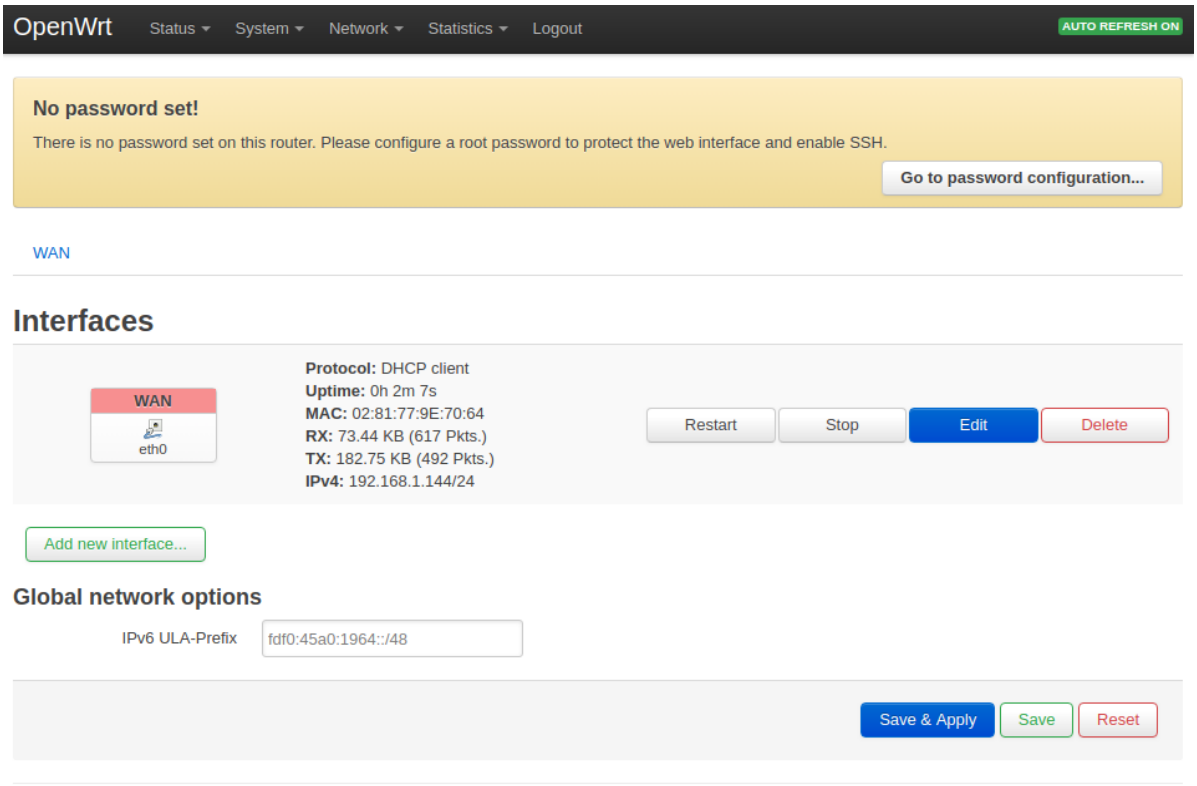


All the statistics listed on the Statistics page are presented by the luci-app-statistics package which uses the Collectd utility to collect data and presents them with the RRDtool utility.
If you want to get more statistics you can install other collectd-mod-* packages. All collectd-mod-* packages use the same configuration file: /etc/config/luci_statistics.

- Reference Links:
  - openwrt luci_app_statistics
  - openwrt statistics.chart.public
  - openwrt statistic.custom

7.5 Check Network->Interfaces Configurations

- After open the OpenWrt-LuCI page, go to "Network" ---> "Interfaces" and you will see the current network's configurations:



- All the configurations listed on the Network->Interfaces page are stored in the "/etc/config/network" file.

7.6 USB WiFi

Currently the NanoPi NEO2 Black only works with a RTL8821CU USB WiFi dongle, plug and play. After this module is connected to the board it will by default work under AP mode and the hotspot's name is "rtl8821cu-mac address" and the password is "password";

7.7 Huawei's WiFi 2 mini(E8372H-155) Module

After this module is connected to the board it will be plug and play. The hotspot's name is "HUAWEI-8DA5". You can connect a device to the internet by connecting to this hotspot.

8 Make Your Own FriendlyCore

8.1 Use Mainline BSP

The NanoPi NEO has gotten support for kernel Linux-4.14 with Ubuntu Core 16.04. For more details about how to use mainline u-boot and Linux-4.14 refer to :Building U-boot and Linux for H5/H3/H2+

8.2 Use Allwinner's BSP

8.2.1 Preparations

Visit this link download link and enter the "sources/nanopi-H3-bsp" directory and download all the source code.Use the 7-zip utility to extract it and a lichee directory and an Android directory will be generated.You can check that by running the following command:

```
$ ls ./
android lichee
```

Or you can get it from our github:

```
$ git clone https://github.com/friendlyarm/h3_lichee.git lichee
```

Note: "lichee" is the project name named by Allwinner for its CPU's source code which contains the source code of U-boot, Linux kernel and various scripts.

8.2.2 Install Cross Compiler

- Visit this site download link, enter the "toolchain" directory, download the cross compiler "gcc-linaro-arm.tar.xz" and copy it to the "lichee/brandy/toochain/" directory.

8.2.3 Compile lichee Source Code

Compilation of the H3's BSP source code must be done under a PC running a 64-bit Linux.The following cases were tested on Ubuntu-14.04 LTS-64bit:

```
$ sudo apt-get install gawk git gnupg flex bison gperf build-essential \
zip curl libc6-dev libncurses5-dev:i386 x11proto-core-dev \
libx11-dev:i386 libreadline6-dev:i386 libgl1-mesa-glx:i386 \
libgl1-mesa-dev g++-multilib mingw32 tofrodos \
python-markdown libxml2-utils xsltproc zlib1g-dev:i386 u-boot-tools
```

Run the following command to compile lichee:

```
$ cd lichee/fa_tools
$ ./build.sh -b nanopi-neo -p linux -t all
```

After this compilation succeeds a u-boot, Linux kernel and kernel modules will be generated.
Note: the lichee directory contains a cross-compiler we have setup. When the build.sh script runs it will automatically call this cross-compiler. Type the following command to update the U-boot on the MicroSD card:

```
$ ./fuse_uboot.sh /dev/sdx
```

Note: you need to replace "/dev/sdx" with the device name in your system.
The boot.img and kernel modules are under the "linux-3.4/output" directory. You can copy the new boot.img file to your MicroSD card's boot partition.

8.2.4 Compile U-boot

Note:you need to compile the whole lichee directory before you can compile U-boot individually.

```
$ cd lichee/fa_tools/
$ ./build.sh -b nanopi-neo -p linux -t u-boot
```

Type the following command to update the U-boot on the MicroSD card:

```
$ cd lichee/fa_tools/
$ ./fuse.sh -d /dev/sdX -p linux -t u-boot
```

Note: you need to replace "/dev/sdx" with the device name in your system.

8.2.5 Compile Linux Kernel

Note:you need to compile the whole lichee directory before you can compile Linux kernel individually.
If you want to compile the Linux kernel run the following command:

```
$ cd lichee/fa_tools/
$ ./build.sh -b nanopi-neo -p linux -t kernel
```

After the compilation is done a boot.img and its kernel modules will be generated under "linux-3.4/output".

8.2.6 Clean Source Code

```
$ cd lichee/fa_tools/
$ ./build.sh -b nanopi-neo -p linux -t clean
```

Link to 3D Printing Files

10 Other OS Support

10.1 Armbian

Armbian releases Armbian_5.20_Nanopineo_Debian_jessie_3.4.112 and Armbian_5.20_Nanopineo_Ubuntu_xenial_3.4.112 for the NanoPi NEO. You can refer to its home page for more details.
home page: http://www.armbian.com/nanopi-neo/

10.2 Android

This Android system is an Android4.4.2 variant.
FriendlyARM doesn't provide technical support for it.

- Download image files and utilities

Visit this download link and enter the "unofficail-ROMs" to download the nanopi-neo-android.img.zip image file, HDDLLF.4.40 and HDDLLF(under the "tools" directory).

- Make Android Installation Card

1. On a Windows PC run the HDDLLF.4.40 utility as administrator. Insert a TF card(at least 4G) into this PC and format it. After formatting is done take out the TF card;
2. Insert it into the PC again and format it with Windows internal format utility to format it to FAT32. After this formatting is done take out the card;
3. Insert the TF card you made in the previous step into a Windows PC and run the PhoenixCard utility as administrator. On the utility's main window select your TF card's drive, the wanted image file and click on "write" to start flashing the TF card.
Note: none of the above steps should be missed otherwise the TF card you made may not work.

- Boot Android

Insert this installation card into your NanoPi NEO, power on the board and you will be able to work with it
The password for "root" or "fa" is "fa"

- This Android supports these WiFi cards: rtl8188etv and rt8188eus.

10.3 DietPi

DietPi is an extremely lightweight Debian Jessie OS. Its image file starts at 400MB and nearly 3x lighter than 'Raspbian Lite'.It is pre-installed with DietPi-RAMLog. These features enable users to get the best performance of a device.
The following steps are for reference only. FriendlyElec doesn't provide technical support for them.
Installation guide:

- Download the image file from DietPi
- Extract the package and use the win32diskimager to write it to a MicroSD card under Windows.
- Insert this MicroSD card to your NanoPi NEO and power up.

Username:root , Password: dietpi

11 Connect External Modules to NEO

11.1 DIY NAS Server with 1-bay NAS Dock & NEO

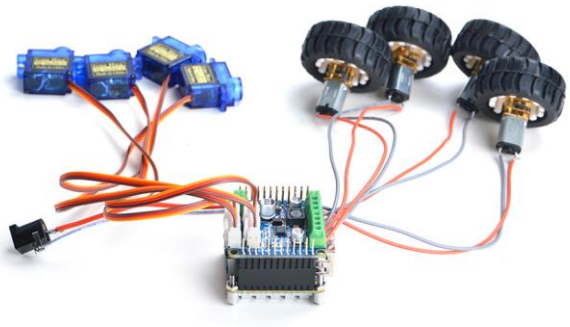
The 1-bay NAS Dock is an expansion board which can be used to connect an external hard disk to a NanoPi NEO.It uses JSM568 USB3.0 to SATA IC and communicates with a NanoPi NEO via USB interface. It works with a 2.5" SATA hard disk.It uses TI's DC-DC chipset to convert a 12V input to 5V. It has a power switch for users to turn on/off the device.It supports an onboard RTC battery. FriendlyElec migrated mainline Linux-4.14 kernel and Debian-Jessie with OpenMediaVault. Together with FriendlyElec's customized aluminum case you can quickly assemble a storage server. Here is a hardware setup :1-bay_NAS_Dock

11.2 Connect Python Programmable NanoHat OLED to NEO

The NanoHat OLED module is a small and cute monochrome OLED module with low power consumption. It has three user buttons. We provide its driver's source code and a user friendly shell interface on which you can check system information and status.A customized aluminum case is made for it. You cannot miss this lovely utility! Here is a hardware setup:NanoHat OLED

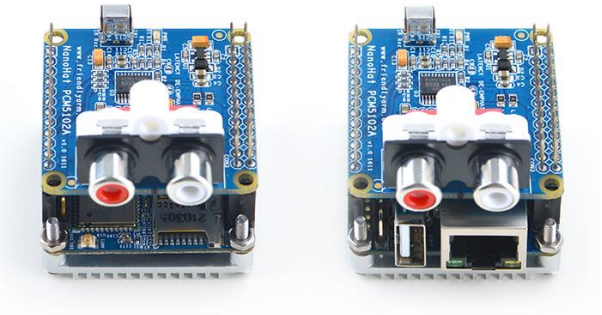
11.3 Connect Python Programmable NanoHat Motor to NEO

The NanoHat Motor module can drive four 5V PWM steering motors and four 12V DC motors or four 5V PWM steering motors and two 12V four-wire step motors.Here is a hardware setup: NanoHat Motor



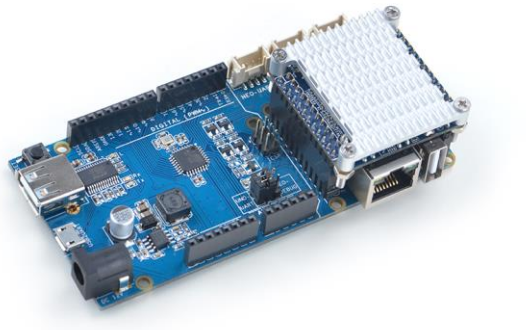
11.4 Connect NanoHat PCM5102A to NEO

The NanoHat PCM5102A module uses TI's DAC audio chip PCM5102A, a convenient and easy-to-use audio module for hobbyists. Here is a hardware setup:NanoHat PCM5102A



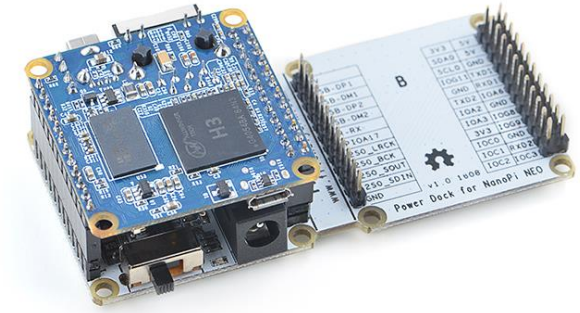
11.5 Connect Arduino Compatible UNO Dock to NEO

The UNO Dock module is an Arduino board compatible with Arduino UNO and works with Arduino programs.You can use Arduino IDE to run all Arduino programs on the Dock.It also exposes the NanoPi NEO's pins.It converts 12V power input to 5V/2A output.You can search for various code samples from Ubuntu's ecosystem and run on the Dock. These features make it a powerful platform for IOT projects and cloud related applications. Here is a hardware setup:UNO Dock for NanoPi NEO v1.0



11.6 Connect Power Dock to NEO

The Power Dock for NanoPi NEO is a high efficiency power conversion module. It provides stable and reliable power source. Here is a hardware setup:Power Dock for NanoPi NEO



11.7 Connect NanoHat Proto to NEO

The NanoHat Proto is an expansion board which exposes NEO's various pins.It has an onboard EEPROM for data storage.Here is a hardware setup:NanoHat Proto

11.8 Connect Matrix - 2'8 SPI Key TFT to NanoPi NEO

The Matrix-2'8_SPI_Key_TFT module is a 2.8" TFT LCD with resistive touch. It uses the ST7789S IC and XPT2046 resistive touch IC. It has SPI interface and three configurable user keys.Here is its wiki page Matrix - 2'8 SPI Key TFT

12 Developer's Guide

- System Development
  - Building U-boot and Linux for H5/H3/H2+
  - How to Build FriendlyWrt
  - Qt dev: How to Build, Install and Setting Qt Application

- Image Utilities
  - How to make your own SD-bootable ROM
  - How to use overlayfs on Linux
  - EFlasher

- System Configurations
  - npi-config
  - Use NetworkManager to configure network settings

- Hardware Access
  - WiringNP: NanoPi NEO/NEO2/Air GPIO Programming with C
  - RPi.GPIO : NanoPi NEO/NEO2/Air GPIO Programming with Python
  - Hardware Misc
  - Matrix
  - BakeBit
  - HATs&Docks

13 Resources

- Schematics
  - NanoPi-NEO-1606-Schematic.pdf
  - NanoPi-NEO-V1.1-1607-Schematic.pdf
  - NanoPi-NEO-V1.2-1608-Schematic.pdf
  - NanoPi-NEO-V1.3-1702-Schematic.pdf
  - NanoPi-NEO-V1.31-1703-Schematic.pdf
  - NanoPi-NEO-V1.4-1801-Schematic.pdf
- Dimensional Diagram
  - NanoPi-NEO-1606 pcb file in dxf format
  - NanoPi-NEO-V1.1-1608 pcb file in dxf format
  - NanoPi-NEO-V1.3-1702 pcb file in dxf format
  - NanoPi-NEO-V1.31-1703 pcb file in dxf format
  - NanoPi-NEO-V1.4-1801 pcb file in dxf format
  - NanoPi-NEO Heat sink file in pdf format
- H3 Datesheet Allwinner_H3_Datasheet_V1.2.pdf

13.1 Development Guide & Tutorials

13.1.1 Access Hardware in Python

- Programming Python on NanoPi NEO:

The following BakeBit modules can work with BakeBit - NanoHat Hub:

- 1.Button
- 2.Buzzer
- 3.Green LED
- 4.JoyStick
- 5.LED Bar
- 6.Light Sensor
- 7.OLED
- 8.Red LED
- 9.Rotary Angle Sensor
- 10.Servo
- 11.Sound Sendor
- 12.Ultrasonic Ranger

13.1.2 Access Hardware in C

- Matrix Modules & Wiki Sites:
  - Button
  - LED
  - A/D Converter
  - Relay
  - 3-Axis Digital Accelerometer
  - 3-Axis Digital Compass
  - Temperature Sensor
  - Temperature & Humidity Sensor
  - Buzzer
  - Joystick
  - I2C(PCF8574)+LCD1602
  - Sound Sensor
  - Ultrasonic Ranger
  - GPS
  - Matrix - Compact Kit
  - Fire Sensor
  - CAM500A Camera
  - BAll Rolling Switch
  - 2'8 SPI Key TFT 2.8" SPI LCD
  - IR Counter
  - IR Receiver
  - L298N Motor Driver
  - MQ-2 Gas Sensor
  - MQ-3 Gas Sensor
  - One_Touch_Sensor
  - _Photoresistor
  - _Potentiometer
  - Pressure & Temperature Sensor
  - RGB LED
  - RTC
  - Rotary Encoder
  - Soil Moisture Sensor
  - Thermistor
  - USB WiFi
  - Water Sensor