How to enable SPI under BananaPi BPI-R4 v3.

1. Intro

All necessary files are located in my repo: https://github.com/drozdi70/bananapi_bpir4
Especially Adafruit_Blinka_SPI_Pack.tar used in point 5.

2. Image preparation.

Add in DTS file section related to enabling spi/spidev
(~/openwrt/target/linux/mediatek/files-6.6/arch/arm64/boot/dts/mediatek/mt7988a-bananapi-bpi-r4.dts):

```
&spi1 {
    #address-cells = <1>;
    #size-cells = <0>;
    pinctrl-names = "default";
    pinctrl-0 = <&spi1_pins>;
    status = "okay";

    spidev0: spidev@0 {
        compatible = "sitronix,st7789v";
        spi-max-frequency = <32000000>;
        #address-cells = <1>;
        #size-cells = <0>;
        reg = <0>;
        dc-gpios = <&pio 50 GPIO_ACTIVE_HIGH>;    //GPIO50/pin 15
        reset-gpios = <&pio 53 GPIO_ACTIVE_LOW>;  //pin 22 / GPIO53
        spi-cpol;
        spi-cpha;
        status = "okay";
    };
};
```

Install a patch for st7789v – 0004-spidev-lcd-6.6.patch in your directory where you compile openwrt:
cp 0004-spidev-lcd-6.6.patch ~/openwrt/target/linux/mediatek/patches-6.6/

In menuconfig → enable spi/spipdev to be sure all is installed as
kmod-spi-dev spi_tools spidev_test kmod-spi-gpio

Write image to SD and start router from SD card.
Make connection to internet working from your router.

apk update
apk upgrade

```
root@BPI-R4:~# ls -ltr /dev/spi*
crw-------    1 root     root      153,    0 Nov 23 20:27 /dev/spidev1.0
root@BPI-R4:~# lsmod | grep spi
crc_itu_t             12288  1 mmc_spi
crc7                  12288  1 mmc_spi
mmc_spi               16384  0
of_mmc_spi            12288  1 mmc_spi
spi_bitbang           12288  1 spi_gpio
spi_gpio              16384  0
spidev                20480  0
root@BPI-R4:~#
```

3. SPI bus check

If nothing is connected to the bus:

root@BPI-R4:~# spidev_test -D /dev/spidev1.0 -v
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |......@........................|
RX | 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 |..............................|

Next we short pin19 and pin21:

root@BPI-R4:~# spidev_test -D /dev/spidev1.0 -v
spi mode: 0x0
bits per word: 8
max speed: 500000 Hz (500 kHz)
TX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |......@........................|
RX | FF FF FF FF FF FF 40 00 00 00 00 95 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
FF FF F0 0D |......@........................|
root@BPI-R4:~#

root@BPI-R4:~# spi-config -d /dev/spidev1.0 -q
/dev/spidev1.0: mode=0, lsb=0, bits=8, speed=32000000, spiready=0

4. LCD screen wiring to the board

BPI-R4 GPIO pinout:
https://docs.banana-pi.org/en/BPI-R4/GettingStarted_BPI-R4#_gpio_define

SPI - 1.69inch LCD Module 240x280 pixels, ST7789V2
SPI - 1.54inch LCD module 240x240 pixels, ST7789

VCC   -> 3.3V (pin 17)
GND   -> GND (pin 20)
SCL   -> SPI1_CLK (pin 23)   GPIO31
SDA   -> SPI1_MOSI (pin 19)   GPIO30
RST   -> pin 22 / GPIO53
DC   -> pin 15 / GPIO50
CS   -> pin26 / GPIO52
BL   -> +VCC or not connected

SPI1_CSB (24)   GPIO28 -- not connected!
SPI1_MISO (21)   GPIO29 -- not connected!

How to check which GPIO line is free and can be used?

root@BPI-R4:~# apk add gpiod-tools

root@BPI-R4:~# gpioinfo
gpiochip0 - 84 lines:
        line   0:   unnamed   output consumer=tx-disable
        line   1:   unnamed   input consumer=tx-fault
        line   2:   unnamed   input consumer=los
        line   3:   unnamed   input active-low consumer=rate-select0
        line   4:   unnamed   input
        line   5:   unnamed   output active-low consumer=reset
        line   6:   unnamed   input
        line   7:   unnamed   input
        line   8:   unnamed   input
        line   9:   unnamed   input consumer=kernel
        line 10:   unnamed   input consumer=kernel
        line 11:   unnamed   input
        line 12:   unnamed   input active-low consumer=cd
        line 13:   unnamed   input
        line 14:   unnamed   input active-low consumer=WPS
        line 15:   unnamed   input consumer=kernel
        line 16:   unnamed   input consumer=kernel
        line 17:   unnamed   input
        line 18:   unnamed   input
        line 19:   unnamed   input
        line 20:   unnamed   input consumer=kernel
        line 21:   unnamed   input active-low consumer=rate-select0
        line 22:   unnamed   input consumer=kernel

```
line  23:      unnamed          input consumer=kernel
line  24:      unnamed          input consumer=kernel
line  25:      unnamed          input consumer=kernel
line  26:      unnamed          input consumer=kernel
line  27:      unnamed          input consumer=kernel
line  28:      unnamed          input consumer=kernel
line  29:      unnamed          input consumer=kernel
line  30:      unnamed          input consumer=kernel
line  31:      unnamed          input consumer=kernel
line  32:      unnamed          input consumer=kernel
line  33:      unnamed          input consumer=kernel
line  34:      unnamed          input consumer=kernel
line  35:      unnamed          input consumer=kernel
line  36:      unnamed          input consumer=kernel
line  37:      unnamed          input consumer=kernel
line  38:      unnamed          input
line  39:      unnamed          input
line  40:      unnamed          input
line  41:      unnamed          input
line  42:      unnamed          input
line  43:      unnamed          input
line  44:      unnamed          input
line  45:      unnamed          input
line  46:      unnamed          input
line  47:      unnamed          input
line  48:      unnamed          input
line  49:      unnamed          input
line  50:      unnamed          input
line  51:      unnamed          input
line  52:      unnamed          input
line  53:      unnamed          input
line  54:      unnamed          input consumer=los
line  55:      unnamed          input consumer=kernel
line  56:      unnamed          input consumer=kernel
line  57:      unnamed          input consumer=kernel
line  58:      unnamed          input consumer=kernel
line  59:      unnamed          input consumer=kernel
line  60:      unnamed          input consumer=kernel
line  61:      unnamed          input consumer=kernel
line  62:      unnamed          input
line  63:      unnamed          output consumer=blue:wps
line  64:      unnamed          input consumer=kernel
line  65:      unnamed          input consumer=kernel
line  66:      unnamed          input consumer=kernel
line  67:      unnamed          input consumer=kernel
line  68:      unnamed          input
line  69:      unnamed          input consumer=tx-fault
line  70:      unnamed          output consumer=tx-disable
line  71:      unnamed          input consumer=kernel
line  72:      unnamed          input consumer=kernel
line  73:      unnamed          input
line  74:      unnamed          input consumer=kernel
```

line 75:	unnamed	input
line 76:	unnamed	input
line 77:	unnamed	input consumer=kernel
line 78:	unnamed	input consumer=kernel
line 79:	unnamed	output consumer=green:status
line 80:	unnamed	input consumer=kernel
line 81:	unnamed	input consumer=kernel
line 82:	unnamed	input active-low consumer=mod-def0
line 83:	unnamed	input active-low consumer=mod-def0

All lines consumer=kernel cannot be used as already reserved.
We check lines (GPIO) 50,52,53

```
root@BPI-R4:~# gpioinfo |grep -e "50:"  -e "52:" -e "53:"
        line  50:       unnamed                     input
        line  52:       unnamed                     input
        line  53:       unnamed                     input
root@BPI-R4:~#
```

We also check base numer for gpiochip → in our case is 512 (needed for pin mapping).

```
root@BPI-R4:~# ls -ltr /sys/class/gpio/
--w-------    1 root     root          4096 Jan  1 1970 unexport
lrwxrwxrwx    1 root     root             0 Jan  1 1970 gpiochip512 -> ../../devices/platform/soc/1001f000.pinctrl/gpio/gpiochip512
--w-------    1 root     root          4096 Jan  1 1970 export
root@BPI-R4:~#
```

5. SPI configuration

SPI can work programmed in different ways, I decided to use Adafruit-Blinka package and adopt it a little bit as per now our board is not supported offcially there.
Please remember one fact that in the case of any possible upgrade of the package Adafruit_Blinka you need to repeat whole process as probably some files will be replaced by new ones from new release.

Adafruit-Blinka version: 8.50.0
Adafruit-platformdetect version: 3.75.0

apk update
apk upgrade
apk add python3 curl git git-http
apk add python3-dev make
apk add python3-setuptools
apk add python3-pip sudo coreutils
apk add python3-pillow
apk add python3-gpiod

pip3 install Adafruit-Blinka

pip3 install adafruit-platformdetect
pip3 install --upgrade adafruit-python-shell click
pip3 install adafruit-circuitpython-st7789
pip install adafruit-circuitpython-display-text
pip install Adafruit-GPIO

Some Hocus-Pocus (based on https://github.com/Dangku/Adafruit_Python_PlatformDetect)

cd /usr/lib/python3.11/site-packages
mv adafruit_platformdetect adafruit_platformdetect.ORIG
copy adafruit_platformdetect.tar here and extract
tar xvf adafruit_platformdetect.tar
mv board.py board.py.ORIG
copy board.py here
copy bananapi.tar to /usr/lib/python3.11/site-packages/adafruit_blinka/board
mv bananapi bananapi.ORIG
tar xvf bananapi.tar
copy mt7988a.tar to /usr/lib/python3.11/site-packages/adafruit_blinka/microcontroller
tar xvf mt7988a.tar
in /usr/lib/python3.11/site-packages/
mv digitalio.py digitalio.py.ORIG
in /usr/lib/python3.11/site-packages/
mv microcontroller microcontroller.ORIG
copy microcontroller.tar here and extract
tar xvf microcontroller.tar

Tests:

root@BPI-R4:~# python3 detect.py
Board Detection Test

Check that the Chip and Board IDs match your board and that this it is
correctly detecting whether or not it is a Linux board.

Board deteted:

Chip id: MT7988A
Board id: BANANA_PI_BPI_R4

Linux Detection

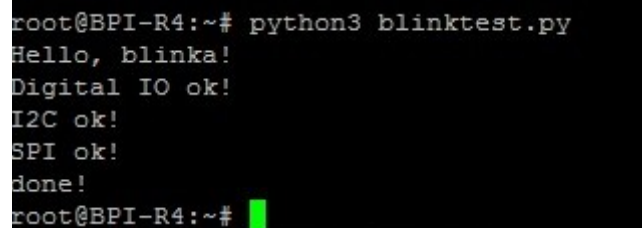Is this an embedded Linux system? True

Raspberry Pi Boards

Is this a Pi 3B+? False
Is this a Pi 4B? False
Is this a 40-pin Raspberry Pi? False
Is this a Raspberry Pi Compute Module? False

Other Boards

Is this a Siemens Simatic IOT2000 Gateway? False
Is this a BananaPi board? True
Is this a 96boards board? False
Is this a BeagleBone board? False
Is this a Giant board? False
Is this a Coral Dev board? False
Is this a MaaXBoard? False
Is this a SiFive board? False
Is this a PYNQ board? False
Is this a Rock Pi board? False
Is this a NanoPi board? False
Is this a Khadas VIM3 board? False
Is this a Clockwork Pi board? False
Is this a Seeed Board? False
Is this a UDOO board? False
Is this an ASUS Tinker board? False
Is this an STM32MP1 board? False
Is this a MilkV board? False
Is this a Luckfox Pico board? False
Is this a generic Linux PC? False
Is this an OS environment variable special case? False

BananaPi board detected.

```
root@BPI-R4:~# python3 blinktest.py
Hello, blinka!
Digital IO ok!
I2C ok!
SPI ok!
done!
root@BPI-R4:~#
```

Remark:
Adafruit-Blinka package could be probably pinned / hold to the current version/state as below by runnig:
```
# pip3 freeze > requirements.txt
```

and revert operation:
```
# pip3 install -r requirements.txt
```

Ref. https://builtin.com/software-engineering-perspectives/pip-freeze

6. Examples

git clone https://github.com/adafruit/Adafruit_CircuitPython_ST7789

cd Adafruit_CircuitPython_ST7789/examples/

edit a file and adjust SPI lines parameteres as below:

```
spi = busio.SPI(board.D23, MOSI=board.D19)
tft_cs = board.D26
tft_dc = board.D15
tft_backlight = None
```

or

```
tft_dc = board.D15
tft_cs = board.D26
spi_clk = board.D23
spi_mosi = board.D19
tft_rst = board.D22
backlight = None
spi = busio.SPI(spi_clk, spi_mosi)
```

or

```
spi = board.SPI()
tft_cs = board.D26
tft_dc = board.D15

display_bus = FourWire(spi, command=tft_dc, chip_select=tft_cs, reset=board.D22)
```