Real-Time Systems

Home Lab Introduction: Setting up your RT Embedded Linux – R Pi 3b+ or 4

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RT Embedded Linux – Raspberry Pi 3b+ or Better

Raspberry Pi 3b+ Meets Course (and Series) Requirements - $35

Recommend Canakit or similar with all components needed - $89
- Micro SD card, heat sinks, case, power cord with switch
- NOOB image on SD card – just enable wireless or wired
- Turn-key start-up

Quick start with Raspbian install (sufficient for course and series)

Simple UVC compatible USB-2 web camera

Set up with Keyboard, HDMI monitor and mouse one time!

Use with SSH Terminal like MobaXterm or Putty on home router

Alternatively access with VNC (higher overhead)

Alternatively use RT distribution or patch and re-build kernel

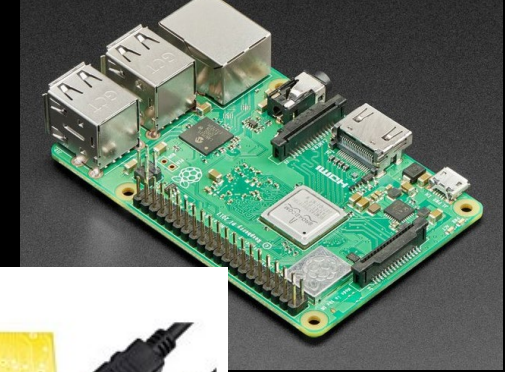Alternatively use R-Pi 4 or newer (gigabit ethernet, 2GB RAM, USB-3)

Alternatively use Jetson Nano, DE10-SoC, etc. that also boot Linux, but this is advanced, and you must self-support

All starter code tested on R-Pi 3b+ with Raspbian install

https://www.adafruit.com/product/3775

https://www.ideasonboard.org/uvc/

Catalog : Raspberry Pi : Pi 3 B+ Kits

https://www.canakit.com/raspberry-pi-3-model-b-plus-starter-kit.html

RT Embedded Linux – Physical Setup

Connections Required

1. Wall socket 100-240 VAC for AC/DC adapter, 5V, 2.5 amp out
2. Cat-6 Ethernet cable to home router (wired configuration)
3. Wireless home router (wireless use)
4. Terminal for bring-up only
   - USB keyboard
   - USB mouse
   - HDMI monitor
5. USB-2 Camera (UVC compliant)

The Raspberry Pi 3 Model B+ is the final revision in the Raspberry Pi 3 range.

- Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz
- 1GB LPDDR2 SDRAM
- 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE
- Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps)
- Extended 40-pin GPIO header
- Full-size HDMI
- 4 USB 2.0 ports
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- 4-pole stereo output and composite video port
- Micro SD port for loading your operating system and storing data
- 5V/2.5A DC power input

3b+ Bottlenecks

- SD card (Nand flash)
- USB-2 Camera I/O
- Ethernet (< 1 Gbps)
- Memory (1 GB)

Over-resourced

- CPU cores
- SMP OS
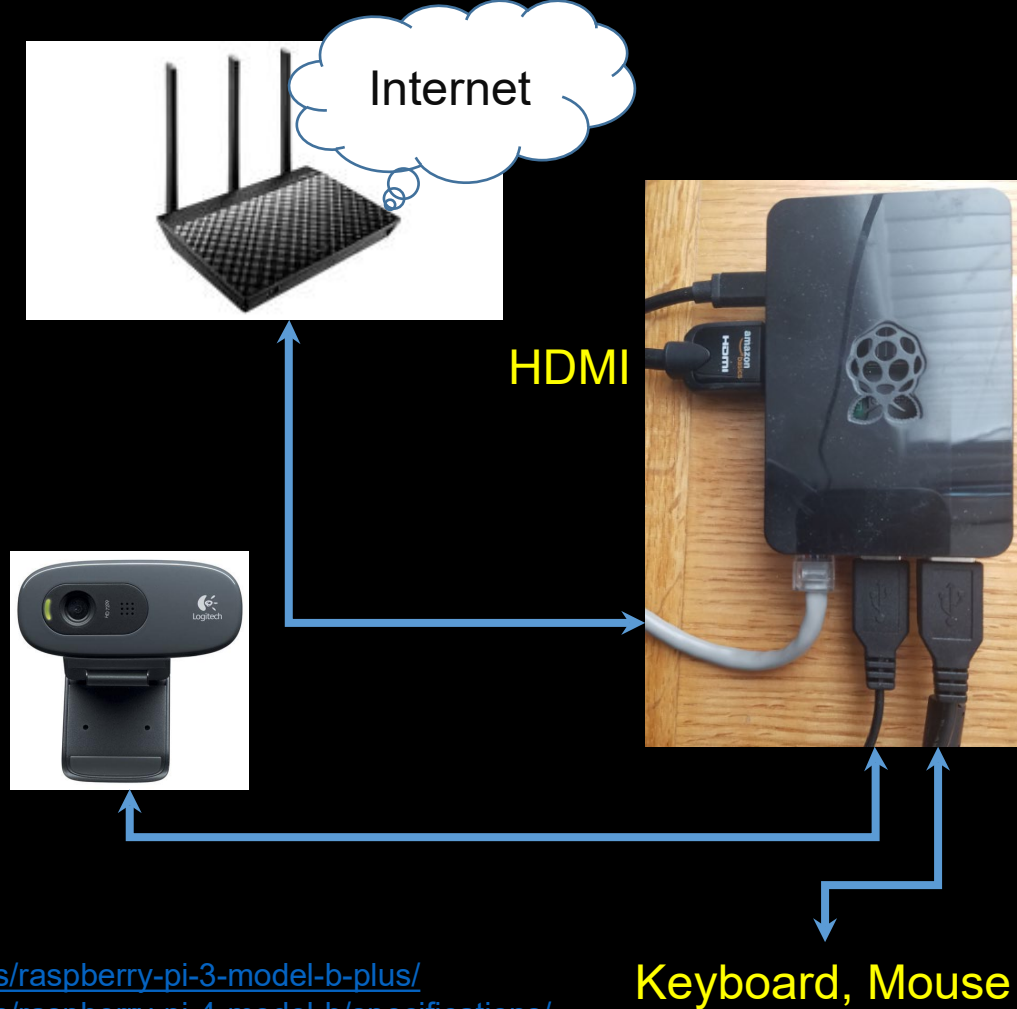
Current Options for Home Lab

https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/
https://www.raspberrypi.org/products/raspberry-pi-4-model-b/specifications/

Internet

HDMI

Keyboard, Mouse

Install Raspbian with NOOB SD card… Configure

Connect to HDMI Monitor and USB Keyboard and Mouse

Login as "pi", default password is "raspberry"

Change it!

Go to "Pi icon" and "Preferences"

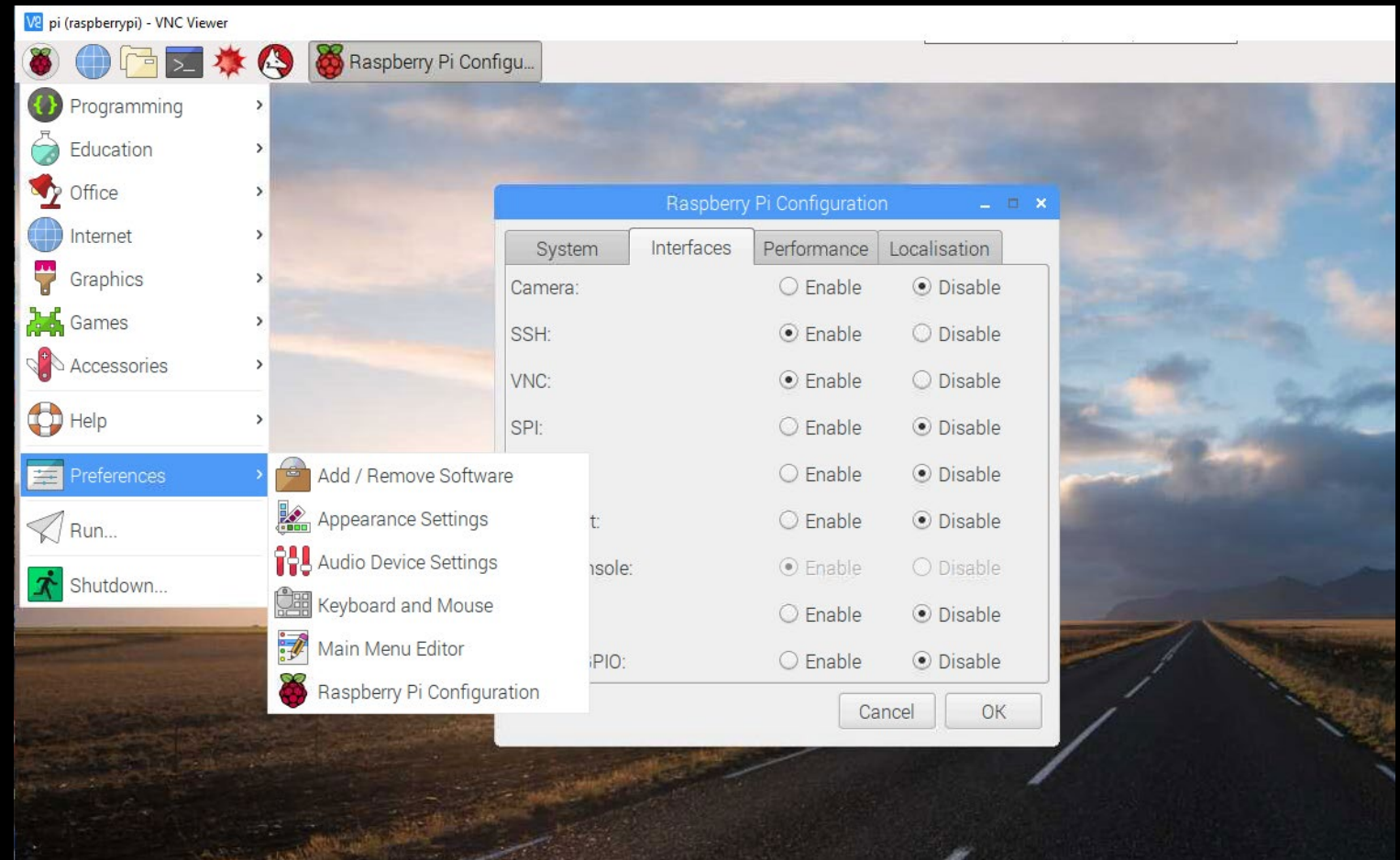Under Raspberry Pi Configuration

Enable:

1. SSH (required for MobaXterm or Putty)
2. VNC (if desired)

Configure any other Localization your might want

Keep physical monitor + keyboard + mouse

OR use VNC if you need a desktop

Typical MobaXterm Access from Win 10

Download and install MobaXterm for Windows 10
- Best option for Windows host
- Use VS code, geany, vim, vi, etc.
- Make sure you enabled SSH
- Note your IP address with "ifconfig –a"
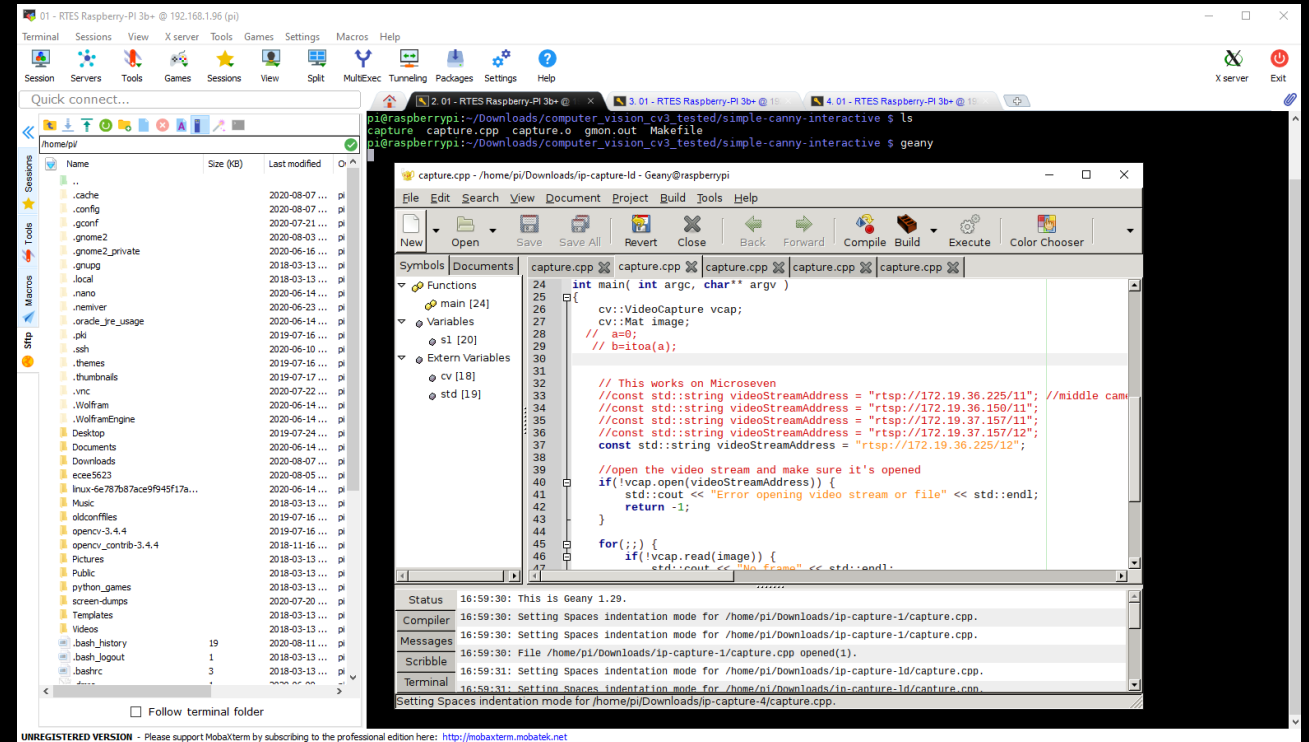- Set up MobaXterm SSH session

Advantages of MobaXterm
- Simple X-windows display on your host
- Lower overhead than VNC
- Easy to use

Disadvantages of MobaXterm
- Not available for Macintosh Host
- Must be downloaded and installed

Alternatives to MobaXterm
- Putty – simple download for Windows or Mac
- VNC – full desktop display from R-Pi
- Must enable VNC on R-Pi for VNC

MobaXterm to my R-Pi 3b+ on home router
- Geany editor pop-up shown for coding
- "sudo apt-get install geany"
- VS code is another option
- Built in "vi" or install "vim" – vi improved

Typical VNC Access from Win 10

Download and install VNC client for Win 10 or Mac
* https://www.realvnc.com/en/connect/download/viewer/windows/

Numerous options exist, so choose best for your Host

VNC is simple and nice, but consumes resources and bandwidth for full desktop

X window apps can be displayed on your host one at a time instead

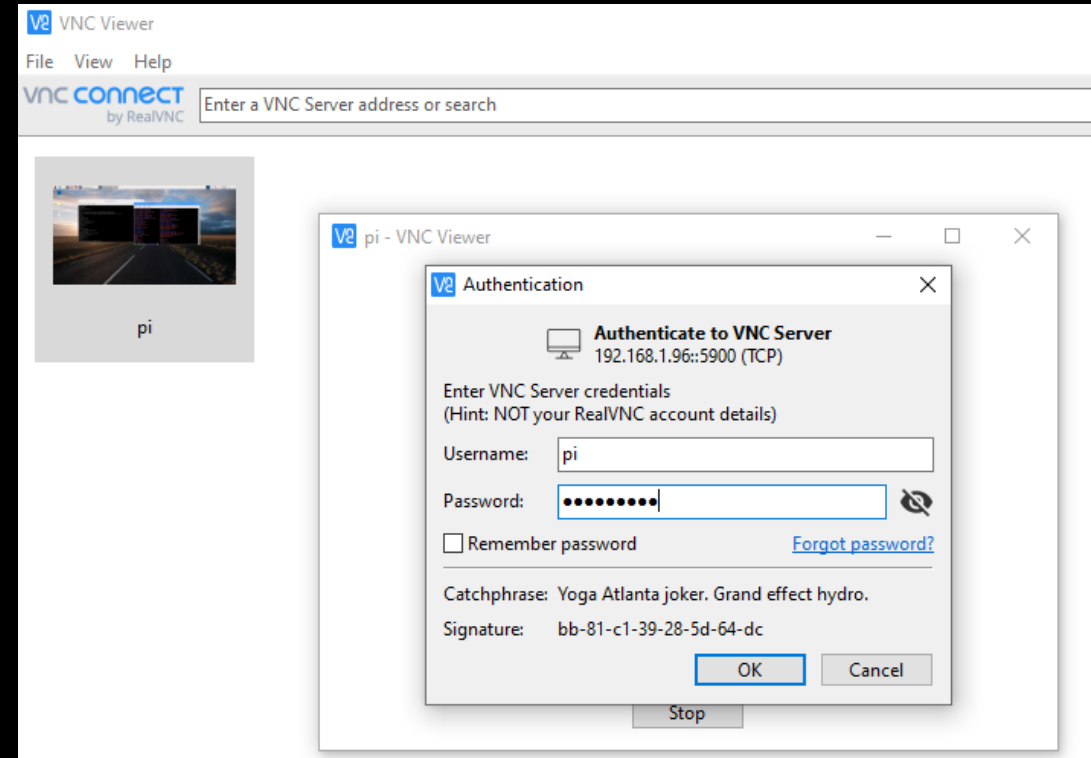For real-time, unless an RT HCI (user interface) is part of you project or design, consider not running graphics

Test your camera with camorama
* **sudo apt install camorama**

OpenCV has graphics and required for some examples

OpenCV install must be done if used
* sudo apt install libopencv-dev opencv-doc
* install-opencv-3- 4- 4- on-raspberry-pi/

VNC is much higher overhead than SSH

Xorg uses significant memory for desktop

Consider SSH and no graphics, but start simple

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