السلام عليكم

peace be upon you

Raspberry Pi for Noobs
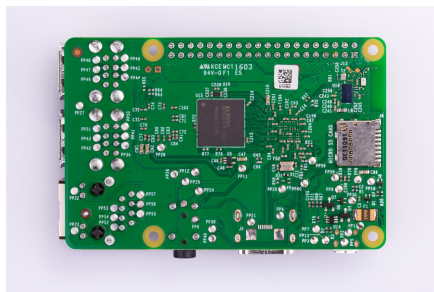## Riding Raspberry Pi 3 Model B

Abu Hasan 'ABDULLAH

February 2019

Outline

- The Raspberry Pi (RPi) is a series of small single-board computers developed in the United Kingdom by the **Raspberry Pi Foundation** to promote the teaching of basic computer science in schools and in developing countries.

(a) Top view

(b) Bottom view

Figure 1: Raspberry Pi 3 Model B board.

- This short workshop is designed for users with very little knowledge of Raspberry Pi to learn about different components on the Raspberry Pi 3 (RPi3) Model B board, to explore and try to figure out answers to the following questions:
  - What type of processor does RPi3 have?
  - How much RAM does the RPi3 have?
  - Does RPi3 have a WiFi interface? What about Bluetooth?
  - Where do you connect the power to?
  - Does the RPi3 have a MicroSD card? How much can data can it hold?
  - What operating system does it use?
  - Can it share data with my Windows and Linux machines?

Figure 2: Raspberry Pi 3 in a case.

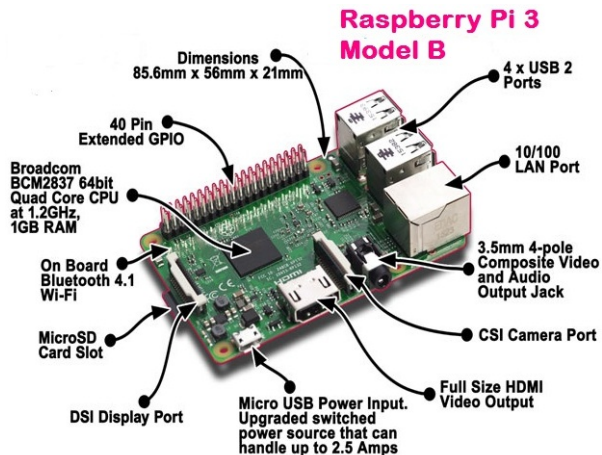|	**Raspberry Pi**	**Raspberry Pi 2**	**Raspberry Pi 3**
Released	2012-02	2015-02	2016-02
CPU	ARM1176JZF-S 700 MHz single core	ARM Cortex-A7 900 MHz quad core	ARM Cortex-A53 1,200 MHz quad core
RAM	512 MB	1 GB	1 GB
GPU	Broadcom Videocore IV 250 MHz	Broadcom Videocore IV 250 MHz	Broadcom Videocore IV 400 MHz
Storage	micro-SD	micro-SD	micro-SD
USB Ports	2 on Model B	4	4
WiFi	None	None	802.11n & Bluetooth 4.1
Video Output	HDMI/Composite	HDMI/Composite	HDMI/Composite
Audio Output	HDMI/Headphone	HDMI/Headphone	HDMI/Headphone

Figure 3: Raspberry Pi 3.

CPU: Broadcom BCM2837 SOC 64-bit quad-core ARM Cortex A53 (ARMv8 CPU) with 512KB shared L2 cache.

Memory: 1 GB of RAM on board.

Micro SD card slot: Used to hold the Micro SD Card holding the operating system which will boot when RPi3 is powered on.

Graphics Support: VideoCore IV @ 400 MHz 3D graphics core provides advance graphics capabilities.

Full HDMI Port: Support HDMI (High-Definition Multimedia Interface) port which can be used to quickly connect RPi to HDMI Monitor. With HDMI Cable and Monitor we can add Screen to RPi.

Audio/Video: Combined 3.5mm audio jack and composite video

Display interface (DSI): enables RPi3 to interface with Display Module

Camera interface (CSI): enables RPi3 to interface with Camera Module

Ethernet Port: Fast Ethernet (10/100 Mbit/s) port to access the Internet.

Wi-Fi Support: Built-in 802.11n Wireless LAN

Bluetooth: Built-in Bluetooth 4.1 Bluetooth Low Energy (BLE)

USB Ports: 4-USB ports which allow attaching four different USB devices like keyboard, mouse, etc.

GPIO Pins: supports 40 General Purpose Input Output (GPIO) pins. These digital input/output pins can be used to drive LED, switches, sensors, 'On the Go' (OTG) pendrives, etc.
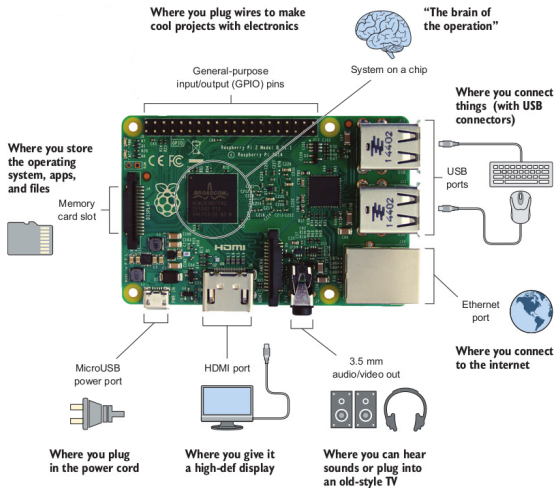
Figure 4: Stringing the Raspberry Pi (Heitz, 2016).

Raspberry Pi 3
Operating Systems

- Before you can use your RPi3, you must install an operating system (OS) on an SD card. There are many to choose from.
  See `https://www.raspberrypi.org/downloads/`
- The OS recommended by Raspberry Pi Foundation on the first two generations is their own version of Linux, called **Raspbian**. RPi3 brings new capabilities and runs other distributions of Linux.
- We shall be looking at four different flavours of Linux
  - **Raspbian**,
  - **Ubuntu MATE**,
  - **Lubuntu** and
  - **LibreELEC**,

  for three possible different needs:
  - desktop computing,
  - scientific computing and
  - media centre application.
- RPi3 also runs **Windows 10 IoT core** but it's primarily designed for developers and hardware hackers who want to prototype IoT appliances using RPi.

- **Raspbian** comes in two flavours: Raspbian with PIXEL desktop and the minimal Raspbian Lite. Raspbian with PIXEL comes with several SDK, hence a good programming environment. It also includes LibreOFFICE suite, a web browser and e-mail app.
  Raspbian Lite boots to a command line and is fully customizable; you can add your choice of GUI, languages, web browser, and so on.
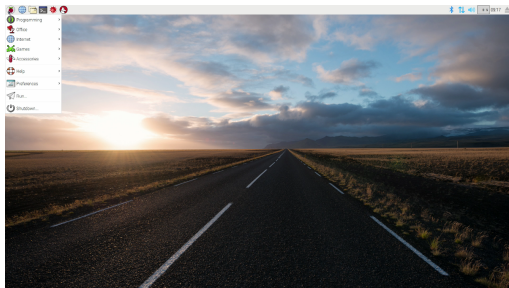

Figure 5: Raspbian desktop.

- https://www.raspberrypi.org/downloads/raspbian/

- **Ubuntu MATE** is a derivative of Ubuntu. It uses the MATE desktop environment as its default user interface.
- It comes as a ready-to-run image that fully supports the built-in Bluetooth and Wifi on RPi3. LibreOffice and Firefox are included, as does hardware accelerated video playback in VLC.
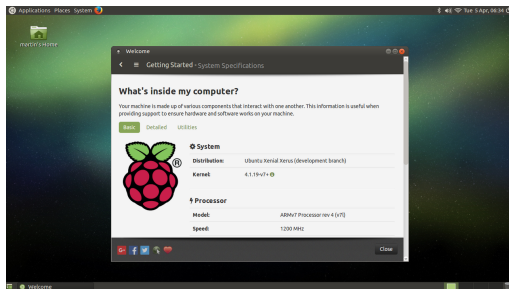

Figure 6: Ubuntu MATE desktop.

- https://ubuntu-mate.org/raspberry-pi/

- **Lubuntu** is a faster, more lightweight and energy saving, official flavour of Ubuntu using LXDE, the Lightweight X11 Desktop Environment.
- It is designed to be fast and easy to use. It has lots of applications for every daily need, while keeping your system light and responsive—ideal not only for old computers and netbooks, but for newer computers too making them lightening fast.
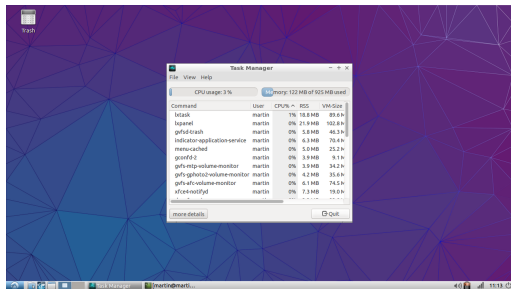

Figure 7: Lubuntu desktop.

- http://lubuntu.me/
  https://wiki.kubuntu.org/Lubuntu/RaspberryPi

- **LibreELEC** ("Libre Embedded Linux Entertainment Centre") is a fork of OpenELEC, a small and very fast booting, open source JeOS ("Just enough Operating System"), specifically designed to run pre-configured **Kodi** media centre and

- Optionally, it runs third-party Personal Video Recorder (PVR) backend software which allows one to watch live TV, listen to radio, schedule recordings, etc..

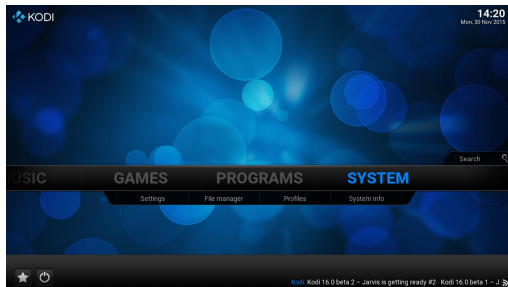Figure 8: LibreELEC Home window.

- https://libreelec.tv/about/
  https://seo-michael.co.uk/how-to-install-libreelec-on-rasbpery-pi/

- You will need to connect power, a mouse, a keyboard and a display. Specifically, you will need:
  1. Micro SD card preinstalled with **Ubuntu MATE** OS
  2. Micro USB power cable: RPi3 requires a 2.5A power supply.
  3. USB mouse
  4. USB keyboard
  5. Monitor or TV: If your monitor is DVI or VGA, you will need an adapter.
  6. HDMI cable

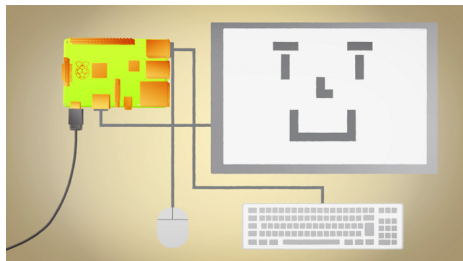Figure 9: Connecting Raspberry Pi.

RPi3 for Desktop Computing
Hardware & Operating System

- Optional extras:
  7. Ethernet cable: You may use an Ethernet cable for a more reliable wired network connection.
  8. Headphones or speakers
  9. USB device e.g. OTG pendrive

(a) Ethernet cable   (b) USB speaker   (c) OTG pendrive

Figure 10: Optional extras.

RPi3 for Desktop Computing

The standard **Ubuntu MATE** operating system for RPi3 comes with applications most commonly used for desktop computing which are grouped into:

- **Office suite**
  1. LibreOffice
  2. Abiword
  3. gnumeric
- **Graphics**
  1. Pinta
  2. Gimp
  3. Dia
  4. Inkscape
- **Internet**
  1. Firefox
  2. Transmission
  3. Pidgin
- **Audio & video**
  1. vlc
  2. Audacious
  3. omxplayer

- For scientific computing environment on RPi3, **Lubuntu** OS is recommended for being fast and lightweight, saving us the remaining CPU cycles for intensive computations. You will need:
  1. Micro SD card preinstalled with **Lubuntu** OS
  2. Micro USB power cable: RPi3 requires a 2.5A power supply.
  3. USB mouse
  4. USB keyboard
  5. HDMI cable
  6. Monitor or TV: If your monitor is DVI or VGA, you will need an adapter.

Figure 11: Connecting Raspberry Pi.

- Optional extras:
    7. Ethernet cable
    8. Headphones or speakers
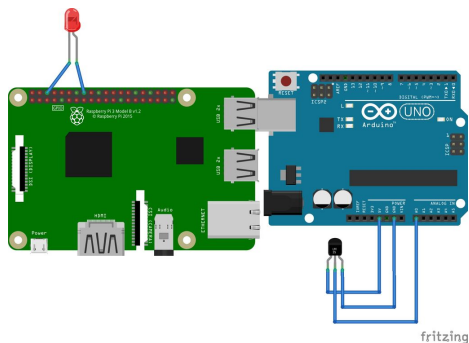   9. USB device e.g. OTG pendrive, Arduino microcontroller motherboard.

Figure 12: Connecting Raspberry Pi to Arduino microcontroller using USB ports.

On top of those software tools listed for desktop computing purposes, we add three more categories of software popular among users within the scientific & engineering communities

- **CAE & Scientific**
    1. LibreCAD & KiCAD
    2. gmsh & Netgen
    3. GNU Octave, Maxima (& Scilab)
    4. GNUplot & G3Data
    5. R & GNU PSPP
- **Programming & SDK**
    1. Scratch
    2. IDLE 3 & Python
    3. GNU SDK (C, C++, Fortran)
    4. Arduino
    5. CodeBlock, CodeLite, CMake & Geany
    6. Qt4 Designer
- **TeX/LaTeX-based typesetting tools**
    1. TeXLive
    2. TeXworks
    3. JabRef

RPi3 for Media Centre
LibreELEC: Embedded Linux Entertainment Centre OS

- **LibreELEC** is efficient with a tiny disk and memory footprint, and provides cutting edge hardware support to deliver a set-top box **Kodi** media centre experience. You will need:
  1. Micro SD card preinstalled with **LibreELEC** OS
  2. Micro USB power cable: RPi3 requires a 2.5A power supply.
  3. USB mouse
  4. USB keyboard
  5. HDMI cable
  6. Monitor or TV (preferably): If your monitor is DVI or VGA, you will need an adapter.

Figure 13: Building a media centre with Raspberry Pi 3.

- LibreELEC turns RPi3 into a media centre and includes software, Kodi, for playing, downloading, streaming, and managing graphics, audio and video files.
  - **Control:** You can use a keyboard and mouse with Kodi, buy a TV remote with a USB receiver, or even use a presentation clicker with directional buttons.
  - You can also use a Kodi app on your smartphone; search for Kodi in your phone's app store. Once configured to connect to your Kodi RPi's IP address, you can use the on-screen remote control or browse the files from your phone and select what to play.
  - **Playing video files:** You can copy video files onto your RPi's SD card, or put them on a USB stick or external hard drive and play these files.
  - **Connecting a network drive:** You can connect to a network device e.g. Network Attached Storage (NAS) or services (NFS or SMB) on your local network by using a wired connection to access videos.
  - **Settings:** Kodi has a host of configurable options. You can change the screen resolution, choose a different skin, set up a screensaver, configure the file view, set localisation options, configure subtitles, and much more.

- https://www.raspberrypi.org/documentation/usage/kodi/

Bibliography

1. HEITZ, R. (2016): *Hello Raspberry Pi!*, Manning (ISBN: 9781617292453)

2. RICHARDSON, M. & WALLACE, S. (2013): *Getting Started with Raspberry Pi*, O'Reilly (ISBN: 978-1-449-34421-4)

3. SOPER, M. E. (2017): *Expanding Your Raspberry Pi*, Apress (ISBN: 978-1-4842-2922-4)

- . . . and I end my presentation with two supplications

رَّبِّ زِدْنِي عِلْمًا

my Lord! increase me in knowledge

اَللّٰهُمَّ اِنَّا نَسْئَلُكَ عِلْمًا نَافِعًا

O Allah! We ask You for knowledge that is of benefit