

Single Board Computers

Raspberry Pi · SenseHAT

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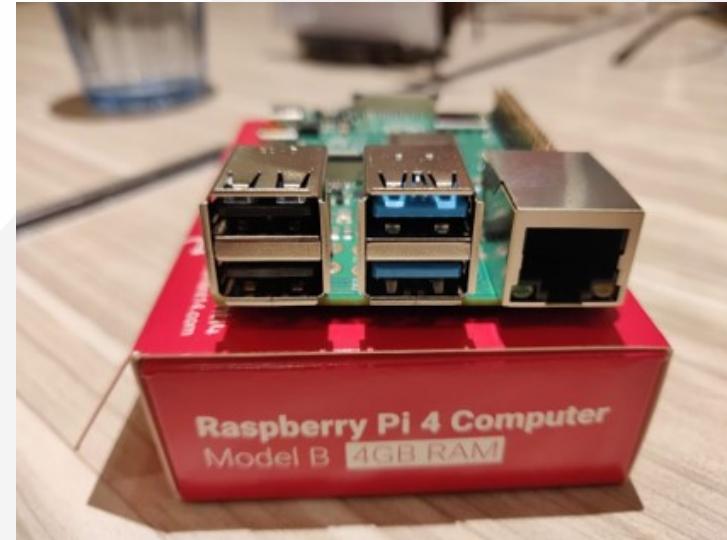
Agenda

- Single Board Computer (SBC)
 - Example: Raspberry Pi
- What are they?
- SBC vs Microcontrollers
- Raspberry Pi(RPi) Introduction
- Getting Started with the RPi
 - Conventional vs Headless
- Connecting Hardware
- SenseHAT



Single Board Computer(SBC)

- A complete computer on a single board CPU, RAM, storage, and I/O ports
- Runs a full-fledged operating system
 - Linux distributions
- Examples:
 - Raspberry Pi, Rock Pi 4, BeagleBone, Odroid
- Useful for embedded applications, prototyping, and as an affordable alternative to traditional PCs
- Raspberry Pi is one of the most recognized SBCs in the world



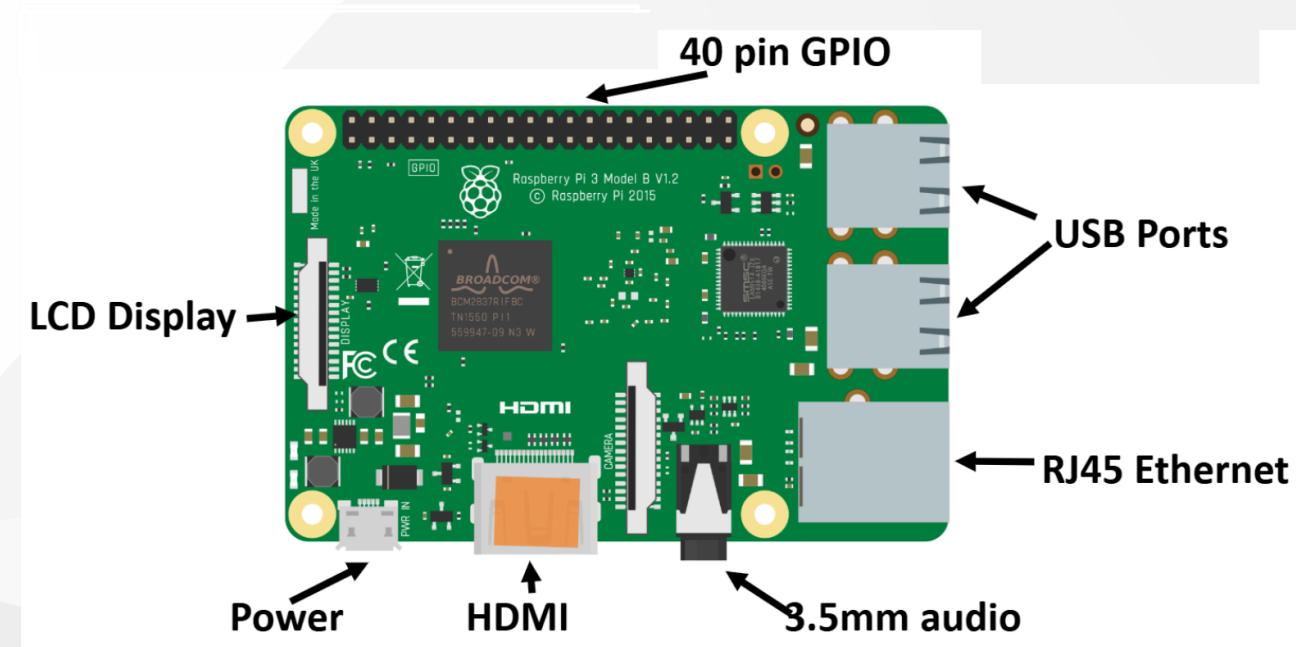
Aside: What is a Microcontroller?

- A compact circuit designed for specific operations in embedded systems.
- Contains a CPU, small RAM, storage, and operates without a full OS.
- Executes pre-programmed tasks, ideal for hardware interactions.
- Real time/near Real time operation
 - process tasks within strict timing constraints, often for tasks where timing is critical
 - Example Application: **anti-lock braking system (ABS)**



Raspberry Pi

- Low cost, single board computer
- Linux OS
- Same features as most laptops/workstations
- Developed by the **Raspberry Pi Foundation** to promote computer science education.
- Popular for DIY, education, and professional projects.



Raspberry Pi History

- First launched in 2012 by the Raspberry Pi Foundation in the UK.
- Inspired by BBC Micro
- Aimed to make computing accessible to everyone.
- Evolved from the original Raspberry Pi Model B to the latest Raspberry Pi 4 and Raspberry Pi 400.

1981



2016



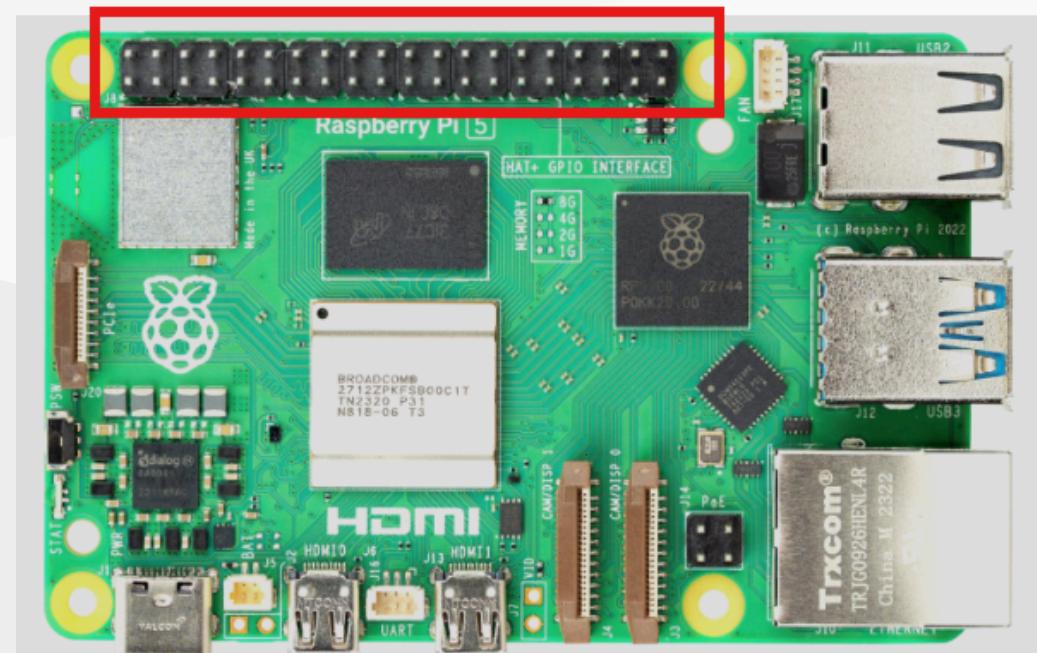
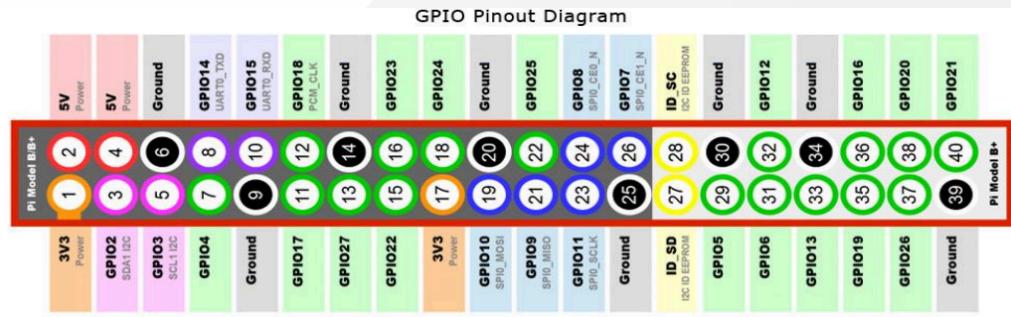
Raspberry Pi Models

- **Raspberry Pi 4:** Available with 2GB, 4GB, or 8GB of RAM, and a quad-core CPU.
- **Raspberry Pi Zero:** Ultra-compact version for embedded and lightweight applications.
- **Raspberry Pi 400:** Keyboard-integrated model for an all-in-one computing experience.



GPIO Pins and Hardware Control

- **GPIO (General Purpose Input/Output)** pins allow control over electronic devices.
- Used for:
 - Sensors
 - LEDs
 - Motors
 - Cameras
- Makes Raspberry Pi ideal for robotics and IoT projects.



Popular Applications of Raspberry Pi

- **Education:** Teaching programming and computer science.
- **DIY Projects:** Smart home devices, weather stations, robots, etc.
- **Media Centers:** Turn your TV into a smart media center with software like Kodi.
- **Gaming:** Retro gaming consoles using RetroPie.

Warning - Don't fry your RPi

- RPis are fairly robust but...
- If using with keyboard/screen
 - Connect the USB keyboard and USB first
 - Connect the HDMI connector
 - Turn on the monitor
- Plug in the power cable
 - Do not plug in the SenseHat when the RPi is plugged in and booted into Raspian.
 - ALWAYS plug in the HAT before plugging in the power cable.



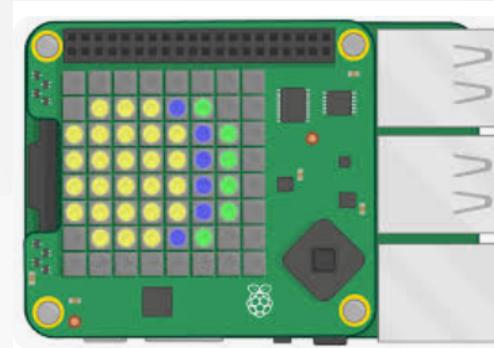
Pros and Cons of Raspberry Pi

- Pros:
 - Affordable
 - Versatile and customizable
 - Large community and resources
- Cons:
 - Limited processing power compared to full desktops and laptops
 - Usually need to get more stuff (enclosure, HATs, LCD Screens, cables)



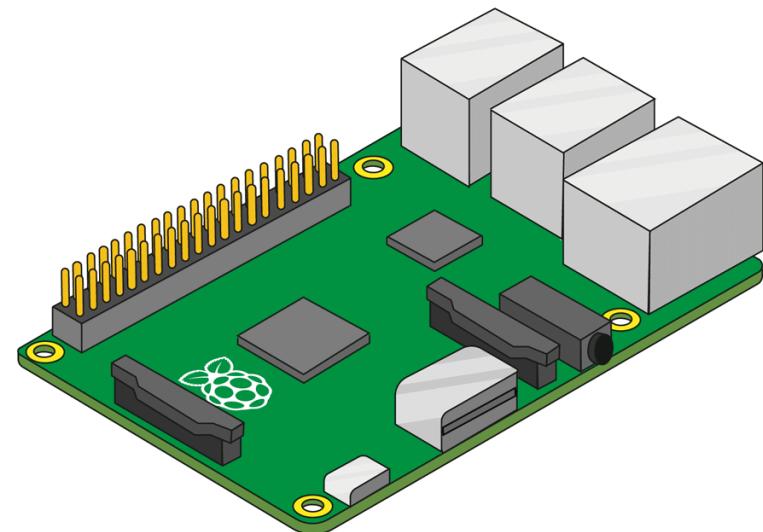
SenseHAT

- The Sense HAT (Hardware Attached on Top) is an add-on board for the Raspberry Pi featuring a collection of sensors and a programmable LED matrix
- **LED Matrix:** An 8x8 RGB LED matrix for display and visual output.
- **Sensors:**
 - Temperature
 - Humidity
 - Pressure
 - Gyroscope (orientation)
 - Accelerometer (movement)
 - Magnetometer (compass)
- **Joystick:** Mini-joystick for user input.



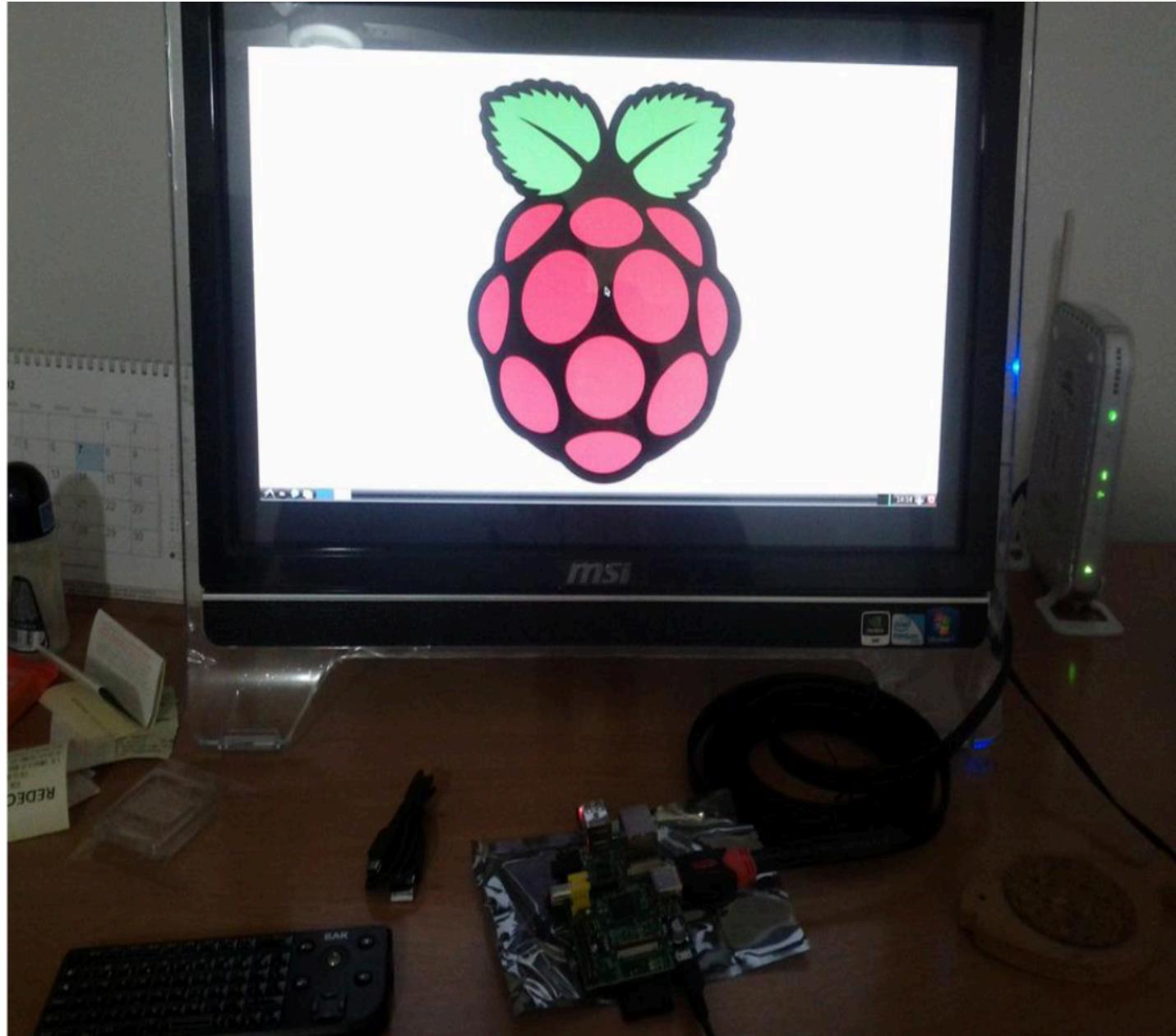
Attaching the SenseHAT

See the [Lab](#)



Getting Started - Conventional

- Raspberry Pi 3 B
- Keyboard and mouse
- HDMI display monitor
- SD Card (8 GB+ recommended)
- SD Card Reader (usually a laptop)



Getting Started –Headless

- Raspberry Pi 3 B or higher
- ~~Keyboard and mouse~~
- ~~HDMI display monitor~~
- SD Card (8 GB+ recommended)
- SD Card Reader (usually a laptop)
- Accessible WiFi network

