Single Board Computers

A single-board computer (SBC) is a complete computer built on a single circuit board, with microprocessor(s), memory, input/output (I/O) and other features required of a functional computer. Single-board computers are commonly made as demonstration or development systems, for educational systems, or for use as embedded computer controllers. Many types of home computers or portable computers integrate all their functions onto a single printed circuit board.

Unlike a desktop personal computer, single-board computers often do not rely on expansion slots for peripheral functions or expansion. Single-board computers have been built using a wide range of microprocessors. Simple designs, such as those built by computer hobbyists, often use static RAM and low-cost 32- or 64-bit processors like ARM. Other types, such as blade servers, would perform similar to a server computer, only in a more compact format.

A computer-on-module is a type of single-board computer made to plug into a carrier board, baseboard, or backplane for system expansion.

Examples of Single Board Computers

Raspberry Pi 4 Model B

- **Specs:** Quad-core ARM Cortex-A72 CPU, up to 8 GB RAM, USB 3.0, Gigabit Ethernet, HDMI.
- **Use Case:** General-purpose computing, IoT projects, media centers, education.

BeagleBone Black

- **Specs:** ARM Cortex-A8, 512 MB RAM, onboard storage, GPIO, PRUs (Programmable Real-time Units).
- **Use Case:** Embedded systems, industrial applications, robotics.

NVIDIA Jetson Nano

- **Specs:** Quad-core ARM Cortex-A57 CPU, 128-core Maxwell GPU, 4 GB RAM.
- **Use Case:** Edge AI, computer vision, deep learning inference.

Odroid XU4

- **Specs:** Samsung Exynos5422 octa-core CPU, 2 GB RAM, USB 3.0, eMMC support.

- **Use Case:** Gaming, server applications, high-performance tasks.

Banana Pi M64

- **Specs:** ARM Cortex-A53 64-bit quad-core CPU, 2 GB RAM, Wi-Fi, Bluetooth, SATA.

- **Use Case:** Networking, home automation, media servers.

Applications of single board computers

1. Home Automation

- **Use:** Control lights, fans, and appliances using sensors and relays.

- **Example:** Smart home systems using Raspberry Pi with Home Assistant.

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2. Media Center

- **Use:** Stream and play media files on a TV.

- **Example:** Use Raspberry Pi with Kodi (LibreELEC) for a DIY media center.

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3. IoT Projects

- **Use:** Collect and transmit data from sensors to the cloud.

- **Example:** Environmental monitoring using temperature, humidity, and air quality sensors.

4. Educational Tools

- **Use:** Teach students about programming, electronics, and robotics.

- **Example:** Scratch and Python-based coding on Raspberry Pi in schools.

5. Retro Gaming Console

- **Use:** Emulate classic game consoles.

- **Example:** Run RetroPie on Raspberry Pi to emulate NES, SNES, Sega Genesis, etc.

6. Robotics

- **Use:** Serve as the brain of robots to control movement and sensors.

- **Example:** Line-following or obstacle-avoiding robots using SBCs with motor drivers and sensors.

7. AI & Computer Vision

- **Use:** Perform edge computing tasks such as object detection and face recognition.

- **Example:** Use NVIDIA Jetson Nano for real-time object tracking with a camera.

8. Network Attached Storage (NAS)

- **Use:** Build a personal file server or backup system.

- **Example:** Use OpenMediaVault on Raspberry Pi with external hard drives.

9. Web Server Hosting

- **Use:** Host lightweight websites or REST APIs.

- **Example:** Flask/Django web applications deployed on Raspberry Pi for learning or local use.

10. Industrial Monitoring

- **Use:** Monitor parameters like temperature, vibration, or machine status in factories.

- **Example:** BeagleBone Black interfacing with industrial sensors for real-time monitoring.