Harvard Architecture is the computer architecture that contains separate storage and separate buses (signal path) for instruction and data. It was basically developed to overcome the bottleneck of Von Neumann Architecture. The main advantage of having separate buses for instruction and data is that the CPU can access instructions and read/write data at the same time.

Buses

Buses are used as signal pathways. In Harvard architecture, there are separate buses for both instruction and data. Types of Buses:

> **Data Bus:** It carries data among the main memory system, processor, and I/O devices.
>
> **Data Address Bus:** It carries the address of data from the processor to the main memory system.
>
> **Instruction Bus:** It carries instructions among the main memory system, processor, and I/O devices.
>
> **Instruction Address Bus:** It carries the address of instructions from the processor to the main memory system.

Operational Registers

There are different types of registers involved in it which are used for storing addresses of different types of instructions. For example, the Memory Address Register and Memory Data Register are operational registers.

Program Counter

It has the location of the next instruction to be executed. The program counter then passes this next address to the memory address register.

Arithmetic and Logic Unit

The arithmetic logic unit is that part of the CPU that operates all the calculations needed. It performs addition, subtraction, comparison, logical Operations, bit Shifting Operations, and various arithmetic operations.

Control Unit

The Control Unit is the part of the CPU that operates all processor control signals. It controls the input and output devices and controls the movement of instructions and data within the system.

Input/Output System

Input devices are used to read data into main memory with the help of CPU input instruction. The information from a computer as output is given through Output devices. The computer gives the results of computation with the help of output devices.

1. **Easy to manage.**

   Embedded systems meant for general use are easy to manage. Since the materials used to make these devices are cheap and long-lasting, they require less maintenance.

2. **Fast performance.**

   The performance of an embedded system depends on various factors. Developers must fulfil non-functional requirements like execution time, energy consumption, and memory capacity to optimize a system's performance.

3. **They are smaller in size.**

   Compared to traditional computers, embedded systems are smaller, meaning they take up little space and are easily portable. Due to their small size, embedded systems require less power compared to larger systems.

4. **Hardware benefits and cost-effectiveness.**

   The embedded system hardware comes with the advantage that it hardly requires any changes like additional memory or storage, making it ideal for any device, no matter the size.

5. **It can be used in mobile robots and military applications.**

   The interest in mobile robots has been rising, as they are a perfect tool that facilitates engineering education. This is because mobile robots were in the past controlled by large, expensive, and heavy non-portable computer systems that could only be linked via cables.

6. **Internet of things (IoT) and embedded systems.**

   With the IoT connectivity, the designing of embedded systems has become more advanced, allowing the dedicated embedded system to become a data source for an entire business process. Any updates on the data source reflect in real-time to keep the system running smoothly.

Latest Technologies

1. Real-Time Apple Detection System.

   Real-time apple detection is one of the most effective ways of estimating apple yields, which helps in managing apple supplies more effectively.

2. Injection Molding Machine.

   Injection moulding is used to make a range of widely used products, including common plastic items like bottle tops as well as remote control casings, syringes and more.

3. Anti-theft ATM Machine.

   An anti-theft device for Automated Teller Machines (ATMs) provides for the blurring or defacing of banknotes which are stored within ATM banknote cassettes/containers within the ATM upon a breach of security of the ATM.

4. Renewable Energy using smart Grid Embedded System.

   Smart grid is nothing but future vision of traditional electrical grid. Smart grid technology gives roadmap for efficient, reliable & clean future electric power delivery system.

5. 3D Object Detection.

   Compared with 2D object detection, 3D object detection provides more spatial information, such as location, direction, and object size, which makes it become more significant in autonomous driving.