

Types of microbrains

1. **Microprocessors** – single-chip processor. Not a complete computer!
 - Must surround a motherboard to implement the full computer ... things such as memory, busses, etc.
 - General purpose mathematical instructions
 - Silicon space is optimized for speed
2. **Microcontrollers** – single-chip computer
 - Silicon space is used to provide input and output devices

Computers consisting of microcontrollers can generally be smaller because they don't have to have all the additional hardware components that a microprocessor needs.

3. **Digital signal processors** – special purpose processors that include arithmetic circuitry for special mathematics, such as Laplace and Foyer transforms
 - Primary chip used in communication circuits
4. **Media processors**
 - Target system: one that works with audio / visual applications
 - Graphics cards, Tivo, MP3 players, computer-controlled home theater.
 - Vector mathematics for shading – for example, rotate – will be included as a processor instructions
 - Newest

Most modern embedded systems don't rely only on their microcontroller memory, but incorporate additional, off-chip memory to allow support for greater functionality.

Microprocessor Examples

First - Intel 4004 - Produced in 1971

Intel 8086, 8088, 80286, 80386, 80486, Pentium → Pentium D

AMD Athlon

Motorola MC68000, MC68020, MC68030, MC68040 // PowerPC →

Cyrix

Xbox uses a PowerPC processor with multimedia extensions

Microcontroller Examples

Motorola:

- MC68HC11, MC68HC12
 - MC:
 - 68: Implements 6800 architecture
 - HC: High-speed CMOS – very fast transitioning edges

11: Specific implementation

- MC68332
32-bit controller
Used heavily in the automotive and avionic industries
Numerical precision provided by the 32-bit
- PowerPC

Intel

- 8051*
8-bit microcontroller
In more products than anything else today. Licensed to 8 or 9 manufacturers.
Legacy product base – when things aren't broken, you don't fix them.

Instruction set is much harder to learn than the HC11. Half the world uses the HC11 and the other half uses the 8051.
- 80186
Implemented the 8086 instruction set as a microcontroller.
Never really took off.

Atmel

Produces very modern 32-bit microcontrollers

- ATMEGA32

Microchip PIC

Produces some of the cheapest microcontrollers.

One-time programmable chips that cost \$1. If your program is wrong, you throw it out and get another one. It only costs a buck.

Atmel and Microchip's IDE software rivals that of Visual Studio.

MC68HC11 A8 (Base Model)

48-pin DIP (dual-inline package) chip
52-pin PLCC

A PLCC Chip remover is used to remove a PLCC chip from its socket.

The 48-pin DIP chip only has 4 A/D channels available, as opposed to 8 in the PLCC chip.

8kb on-chip ROM
256 bytes RAM
512 bytes EEPROM

MC68HC11 E1

Also comes in 48-DIP and 52-pin PLCC configurations.

No on-chip ROM
512 bytes RAM
512 bytes EEPROM

Can run at 2, 3, 4, or 5 MHz and lower speeds, depending on the specific chip model.

EEPROM – Electronically erasable programmable read only memory