.VONNEUMANN AND HARVARD ARCHITECTURE

Vonneumann (Princeton) and Harvard Architecture :

Intel’s 8051 employs Harvard architecture. A microcontroller has some embedded peripherals and Input/Output (I/O) devices. The data transfer to these devices takes place through I/O registers.

In a microprocessor, input /output (I/O) devices are externally interfaced and are mapped either to memory address (memory mapped I/O) or a separate I/O address space (I/O mapped I/O). There are two possible architectures one is Princeton (Von Neumann) and another is Harvard .I/O Registers space in Princeton architecture have only one memory interface for program memory (ROM) and data memory (RAM). One option is to map the I/O Register as a part of data memory or variable RAM area (memory mapped I/O). Alternatively a separate I/O register space can be assigned (I/O Mapped I/O) . Both the arrangements are shown in Fig.4.

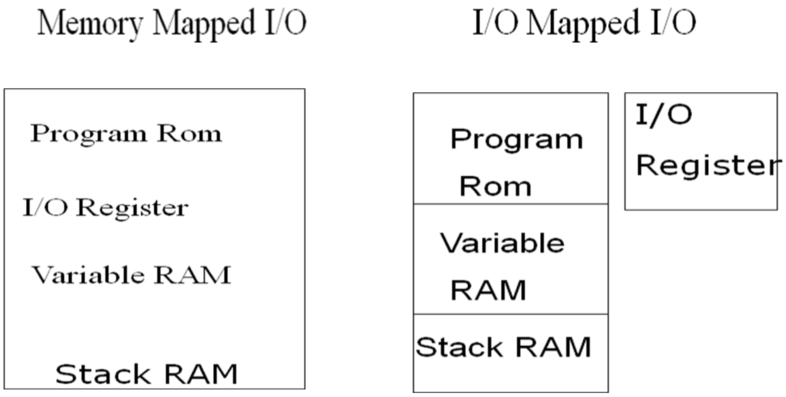

Fig 4. Input/Output Registers in Princeton Architecture

As shown in Fig 4. Program memory and Data memory are together in both the arrangements. The Princeton or Von neumann architecture one bus is used to carry the address and data with an appropriate multiplexing technique ,which in turn reduces the cost. But Harvard architecture which 8051 employs has separate Data memory and separate Code or Program memory . The Fig. 5 and Fig .6 show the need for separate address and data bus for each Program and Data memory in Harvard architecture. Since there are separate bus for access the operation of fetching the code and data can happen simultaneously which increases the speed of operation of execution inside CPU.

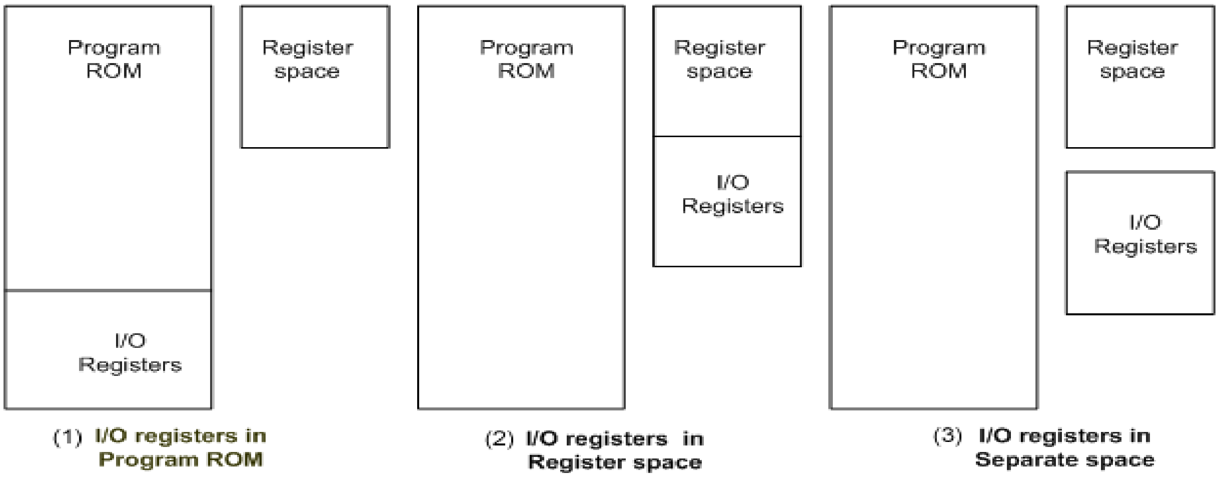

Fig. 5.Organization of I/O registers in Harvard Architecture

In Fig. 5**,** the first option is difficult to implement as there is no means to write to program ROM area. It is also complicated to have separate I/O space as shown in (3). Hence the second option where I/O registers are placed in the register space is widely used in Harvard architecture.

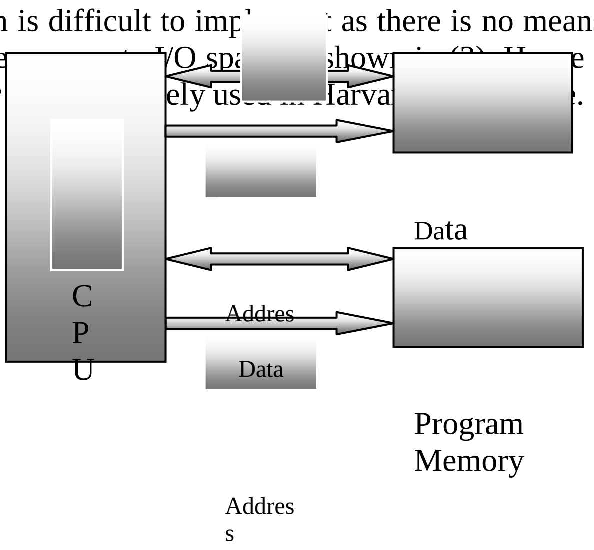

Fig6. Harvard Architecture

Computer Software: A set of instructions written in a specific sequence for computer to solve a specific task is called a program, and software is collection of programs. The program stored in the computer memory in the form of 0s and 1sand it is called as machine level instructions. Since it would be difficult to remember machine codes in the form of binary numbers an intermediate level of language for programming, between higher and machine level was developed and is known as assembly level language . Assembly language programs are written using assembly instructions known as mnemonics.

For example in CLR A, instruction CLR means clear and A means accumulator. The program mnemonics are converted to machine codes in the form of binary by a software called *Assembler*.

The Assembly language programming requires a detailed knowledge of the architecture with which the program is executed. In order to overcome the drawback of assembly language programming Higher level language like C,C++ are introduced where an interpreter or a compiler takes care of translating a higher level source code into machine codes.

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Development/Classification of microcontrollers : Microcontrollers have gone through a silent evolution (invisible). The evolution can be rightly termed as silent as the impact or application of a microcontroller is not well known to a common user, although microcontroller technology has undergone significant change since early 1970's. Development of some popular microcontrollers is given as follows.

Intel 4004	4 bit (2300 PMOS trans, 108 kHz)	1971
Intel 8048	8 bit	1976
Intel 8031	8 bit (ROM-less)	.
Intel 8051	8 bit (Mask ROM)	1980
Microchip PIC16C64	8 bit	1985
Motorola 68HC11	8 bit (on chip ADC)	.
Intel 80C196	16 bit	1982
Atmel AT89C51	8 bit (Flash memory)	.
Microchip PIC 16F877	8 bit (Flash memory + ADC)	.

We use more number of microcontrollers compared to microprocessors. Microprocessors are primarily used for computational purpose, whereas microcontrollers find wide application in devices needing real time processing and control. Application of microcontrollers are numerous. Starting from domestic applications such as in washing machines, TVs, air conditioners, microcontrollers are used in automobiles, process control industries , cell phones, electrical drives, robotics and in space applications.

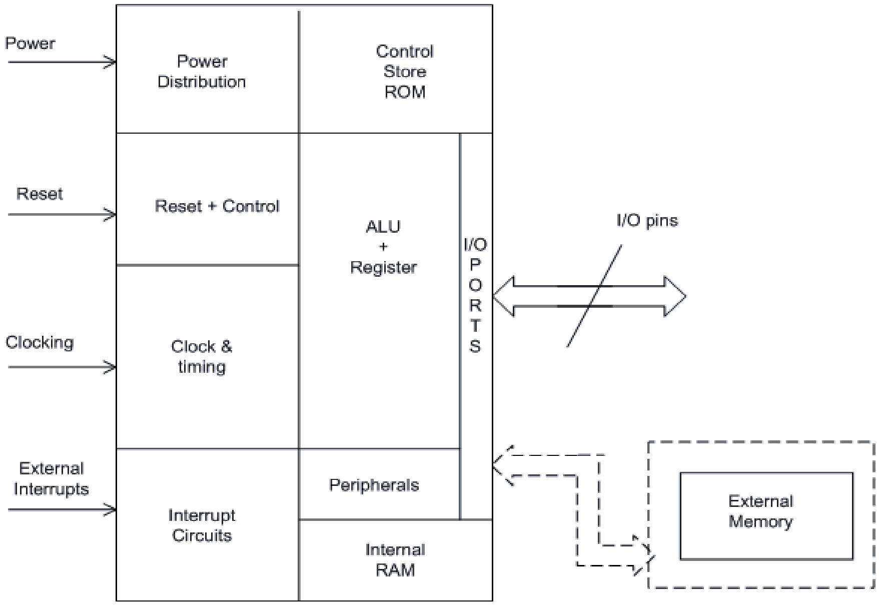

Fig. 7. Internal Structure of a typical Microcontroller

Source : http://elearningatria.files.wordpress.com/2013/10/ece-iv-microcontrollers-10es42-notes.pdf

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