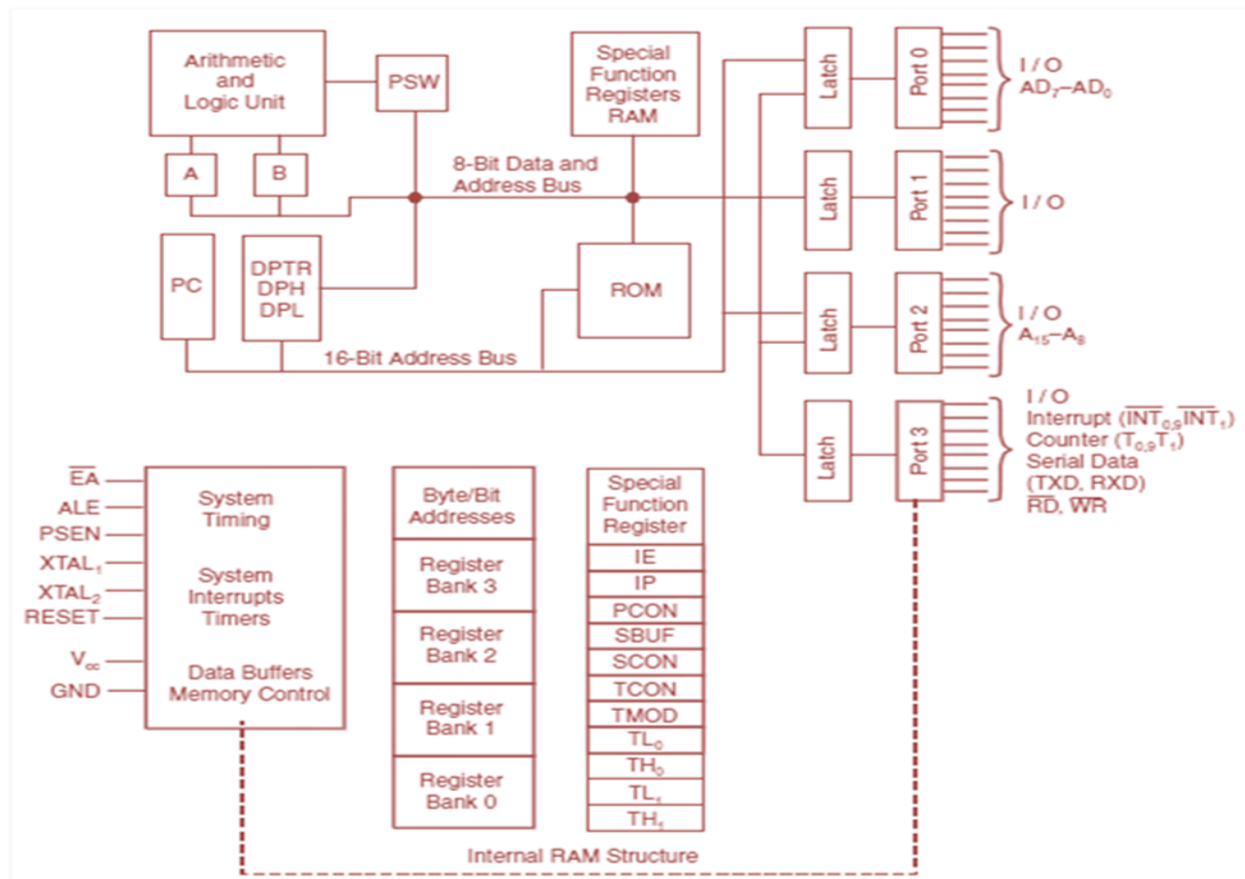# Architecture of 8051 microcontroller:

Description:

It is 8-bit microcontroller, means MC 8051 can Read, Write and Process 8 bit data. This is mostly used microcontroller in the robotics, home appliances like mp3 player, washing machines, electronic iron and industries. Mostly used blocks in the architecture of 8051 are as follows:

1. Oscillator and clock generator:

All operations in a microcontroller are synchronized by the help of an oscillator clock. The oscillator clock generates the clock pulses by which all internal operations are synchronized. A resonant network connected through pins XTAL1 and XTAL2 forms up an oscillator. For this purpose a quartz crystal and capacitors are employed. The crystal run at specified maximum and minimum frequencies typically at 1 MHz to 16 MHz.

2. ALU:

It is 8 bit unit. It performs arithmetic operation as addition, subtraction, multiplication, division, increment and decrement. It performs logical operations like AND, OR and EX-OR. It manipulates 8 bit and 16 bit data. It calculates address of jump locations in relative branch instruction. It performs compare, rotate

and compliment operations. It consists of Boolean processor which performs bit, set, test, clear and compliment. 8051 micro controller contains 34 general purpose registers or working registers.2 of them are called math registers A & B and 32 are bank of registers.

a. Accumulator (A-reg): It is 8 bit register. Its address is E0H and it is bit and byte accessible. Result of arithmetic & logic operations performed by ALU is accumulated by this register. Therefore it is called accumulator register. It is used to store 8 bit data and to hold one of operand of ALU units during arithmetical and logical operations. Most of the instructions are carried out on accumulator data. It is most versatile of 2 CPU registers.

b. B-register: It is special 8 bit math register. It is bit and byte accessible. It is used in conjunction with A register as I/P operand for ALU. It is used as general purpose register to store 8 bit data.

c. PSW: It is 8 bit register. Its address is D0H and It is bit and byte accessible. It has 4 conditional flags or math flags which sets or resets according to condition of result. It has 3 control flags, by setting or resetting bit required operation or function can be achieved. We will study the function of all PSW register bits in detail later.

3. Program counter (PC): The Program Counter (PC) is a 2-byte address which tells the 8051 where the next instruction to execute is found in memory. It is used to hold 16 bit address of internal RAM, external RAM or external ROM locations. When the 8051 is initialized PC always starts at 0000h and is incremented each time an instruction is executed. It is important to note that PC isnt always incremented by one and never decremented.

4. Data pointer register (DTPR): It is a 16 bit register used to hold address of external or internal RAM where data is stored or result is to be stored. It is used to store 16 bit data. It is divided into2- 8bit registers, DPH-data pointer higher order (83H) and DPL-data pointer lower order (82H). Each register can be used as general purpose register to store 8 bit data and can also be used as memory location. DPTR does not have single internal address. It functions as Base register in base relative addressing mode and in-direct jump.

5. Stack pointer (SP): It is 8-bit register. It is byte addressable. Its address is 81H. It is used to hold the internal RAM memory location addresses which are used as stack memory. When the data is to be placed on stack by push instruction, the content of stack pointer is incremented by 1, and when data is retrieved from stack, content of stack of stack pointer is decremented by 1.

Special function Registers(SFR):

The 8051 microcontroller has 11 SFR divided in 4 groups:

A. Timer/Counter register: 8051 microcontroller has 2-16 bit Timer/counter registers called Timer-reg-T0 And Timer/counter Reg-T1.Each register is 16 bit register divide into lower and higher byte register as shown below: These register are used to hold initial no. of count. All of the 4 register are byte addressable.

1. Timer control register: 8051 microcontroller has two 8-bit timer control register i.e. TMOD and TCON register. TMOD Register: it is 8-bit register. Its address is 89H. It is byte addressable. It used to select mode and control operation of time by writing control word.

2. TCON register: It is 8-bit register. Its address is 88H. It is byte addressable. Its MSB 4- bit are used to control operation of timer/ counter and LSB 4-bit are used for external interrupt control.

B. Serial data register: 8051 micro controller has 2 serial data register viz. SBUF and SCON.

1. Serial buffer register (SBUF): it is 8-bit register. It is byte addressable .Its address is 99H. It is used to hold data which is to be transferred serially.

2. Serial control register (SCON): it is 8-bit register. It is bit/byte addressable. Its address is 98H. The 8-bit loaded into this register controls the operation of serial communication.

C. Interrupt register: 8051 µC has 2 8-bit interrupt register.

1. Interrupt enable register (IE): it is 8-bit register. It is bit/byte addressable. Its address is A8H.it is used to enable and disable function of interrupt.

2. Interrupt priority register (IP): It is 8-bit register. It is bit/byte addressable. Its address is B8H. it is used to select low or high level priority of each individual interrupts.

D. Power control register (PCON): it is 8-bit register. It is byte addressable .Its address is 87H. Its bits are used to control mode of power saving circuit, either idle or power down mode and also one bit is used to modify baud rate of serial communication.

Internal RAM:

Internal RAM has memory 128-byte. See 8051 hardware for further internal RAM design. Internal RAM is organized into three distinct areas: 32 bytes working registers from address 00h to 1Fh 16 bytes bit addressable occupies RAM byte address 20h to 2Fh, altogether 128 addressable bits General purpose RAM from 30h to 7Fh.

Internal ROM:

Data memory and program code memory both are in different physical memory but both have the same addresses. An internal ROM occupied addresses from 0000h to 0FFFh. PC addresses program codes from 0000h to 0FFFh. Program addresses higher than 0FFFh that exceed the internal ROM capacity will cause 8051 architecture to fetch codes bytes from external program memory.