* MCU fundamentals lesson ① Report *

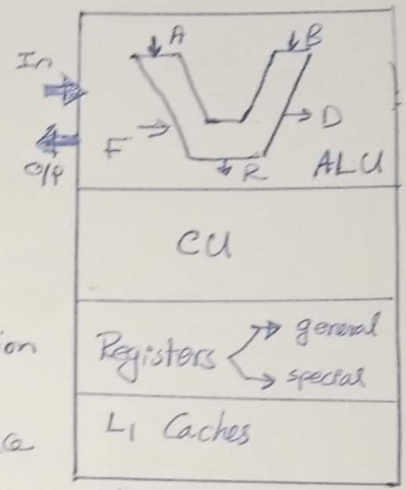
* Definations :-

① Microprocessor :-

A microprocessor is an integrated circuit (IC) which can perform arithmetic and logic operdtions.

→ microprocessor consist of :-

- Arithmetic and Logic unit (ALU)
  → perform logic and arithmetic operations
- Control unit (CU)
  → Control the flow of exection of instruction
- Registers
  → handle the results of Operations to reduce the execution time of instructions
- I/O ports
  → to interect with other modules like RAM, ROM and Buses
- Memory (optional)
  → L1 Cache to matches the processor speed with main memory speed

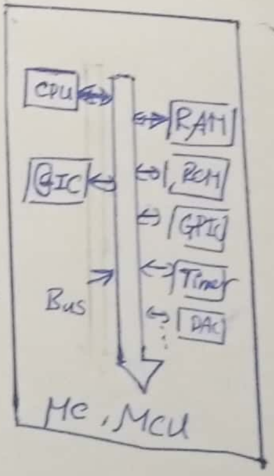


MP, CPU, MPU

② Micro Controller :-

A micro controller is an integrated circuit (IC) has an specific task consist of microprocessor (CPU), memory elements (RAM, ROM, L1, L2 Caches), peripherals and general interrupt controllers

- it can be a single chip or a multichip.

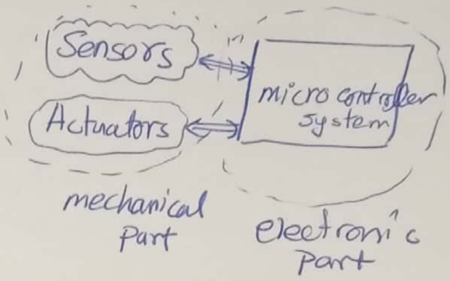


③ Embedded systems :-

a single purpose system designed to perform one or more dedicated function, Consist of hardware (MCU or SOC) and software (Bare metal or OS), with constrains like time, size and cost

④ Mechatronic Systems :-

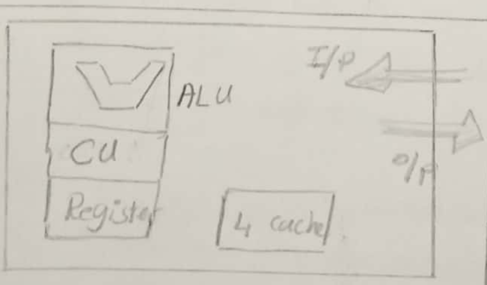
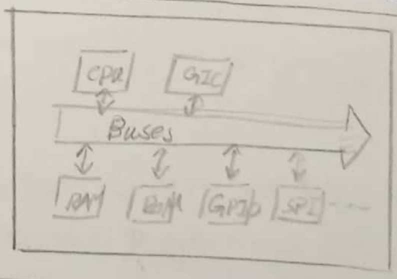
Systems mainly consist of two parts : electronic part (micro controllers) integrated within mechanical part (sensors and Actuators) to control it
. theses systems used in Robets



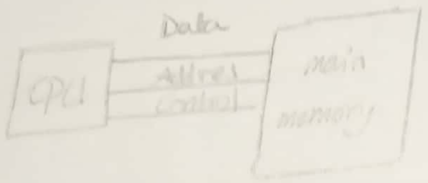
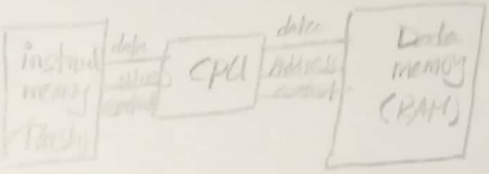
⑤ n-bit processor :

- processor works only on n-bit of data at time.
- Data larger than n-bit has to be broken into n-bits pieces to be processed .

⇒ Microprocessor vs. Micro controller

	Microprocessor	Micro controller
Operation	general purpose .	Special purpose
Architecture	Small scale processor perform arithmetic and logic operation consist of • ALU • CU • Registers • I/P ports • L_1 cache	integrated circuit perform specific task consist of • MPU • RAM • ROM .. • L_2 cache • GIC • peripherals (Timers, DAC, GPIO, --)
Digram		
Power	power Consumption high	power Consumption low
Architecture	Based on von-numann	Based on Harverd
Usage	Designed to perform Arithmetic and logic operations, and can't run without external module	Designed to perform few number of tasks , can work without extornl moduer. it is used in Embedded systemy

Von-Neumann Architecture Vs. Harvard Architecture

Von-Neumann Archit.	Harvard Architecture
Data memory and instruction memory are only two sections from the main memory, this means that there is only one bus for data & instruction, this bus can't access the two section at one time.	Data memory and instruction mem are sperated memory, this means the CPU can access the two mem at one time, there are two buses : Data bus, Address bus
low performance	High performance
Simple design	Complex design
Doesn't support pipleining	support pipLining
used in pc's and laptob's	in microcontrollers and SOC
	 instruct memory (Flash) data address control CPU data Address control Data memory (RAM)

Types of ROM :-

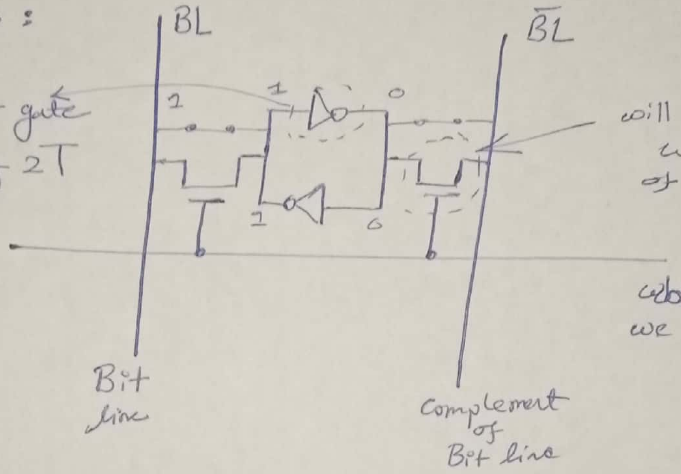
- PROM : programmable Read only memory
  - OTP (programmable one time) since we burn the program on it one time and can't erases this program
  - for each bit there is a fuse
- EPROM : Erasable programable Read only memory
  - can be reprogrammable for thousands of times
  - Can delete, its whole content using UV waves
  - to delete its content, memoy should be sperated from circuit
  - Can't be erasabled electrically
- Masked ROM : masked Read only memoy
  - Can be programmed only one time by manufacturer
  - it is not user programeable ROM
  - Used for Boot ROM code

⇒ Types of RAM :-

⇒ SRAM : static Random Acess Memory.

- Required 6 transistors for storing only one bit.
- Based on MOSFET technology.
- voltaile memory, if power off, all content of memory will be deleted
- High speed memory than DRAM - since doesn't need refreshing time.
- it is the building block for Caches memory.
- we can Read/write on it.
- it has Complex design since it uses 6 transistor for each bit.
- we can access each byte in memory for W/R.

Digram :



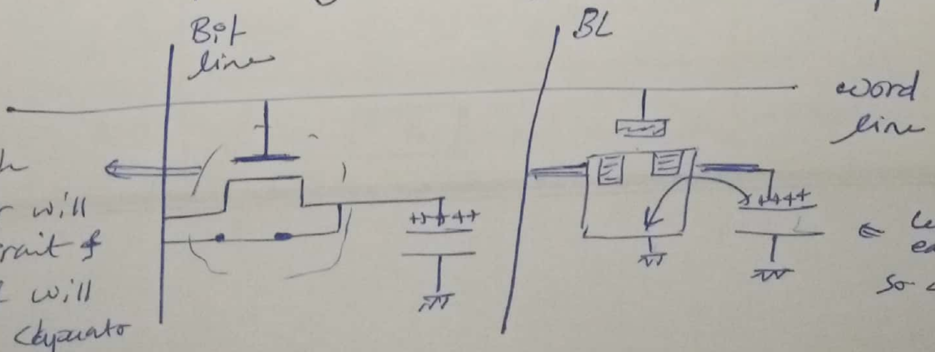
each not gate consist of 2T

will be short Circuit when WL = high and content of BL will transfer to feedback

WL
when WL = high we can W/R from byte

⇒ DRAM :- Dynamic Random Access Memory.

- Required 1 transistor and one capacitor for each bit
- Based on MOSFET technology
- Volatile memory
- It need almost >16 times refreshing, since the power leakage from Capacitor to substrate
- Can't access the memory during refreshing time, so it is slower SRAM
- used for main memory, since it is cheaper than SRAM
- it has simple design and high power consumption



if WL = high the transistor will be short circuit & content of BL will transfer to Capacitor

leakage due to earthy of substrate so we need refresh time

⇒ why ROM is only Read memory although we can write on it ?

- Because we can't write on it at Runtime, Since processor Can read instructions only from it.
  But we can write on it using the burner @ loading time

⇒ Comparison between Different types of memory :

Type	volatile?	writeable?	Erase size?	Max Erase size?	Cost	speed
SRAM	yes	yes	one byte	unlimited	Expensive	Fast
DRAM	yes	yes	one byte	unlimited	Moderate	Moderate
PROM	No	once, with a device programer	Not Appliable	not Appliable	Moderate	Fast
EPROM	No	thousands of times with device programer	whole memory	Limited	Moderate	Fast
EEPROM	No	yes	one Byte	limited	Expensive	Fast reading, slow writing
Flash	No	yes	Sector (section)	limited	moderate	Fast reading, slow writing
NVRAM	No	~~No~~ yes	Byte	unlimited	Expensive	Fast
Masked ROM	No	NO	not Appliable	Not Appliable	Inexpensive	fast