Q.1 Explain the types of embedded system based on their classification.

Ans Embedded system can be classified based on their functionality and application:

(i) Real-time Embedded System:- These are of 2 types:

- **Hard Real-time System:-**
  Critical tasks must be completed within a guaranteed time-frame. Failure to meet deadline can have severe consequences in these systems.

- **Soft Real-time System:-**
  Here timeliness is important, but missing occasional deadlines may not result in system failure.

(ii) Networked Embedded System:- These are also of 2 types:

- **Wireless Embedded System:-** These systems utilize wireless communication for data transfer, often seen in applications like IOT devices.

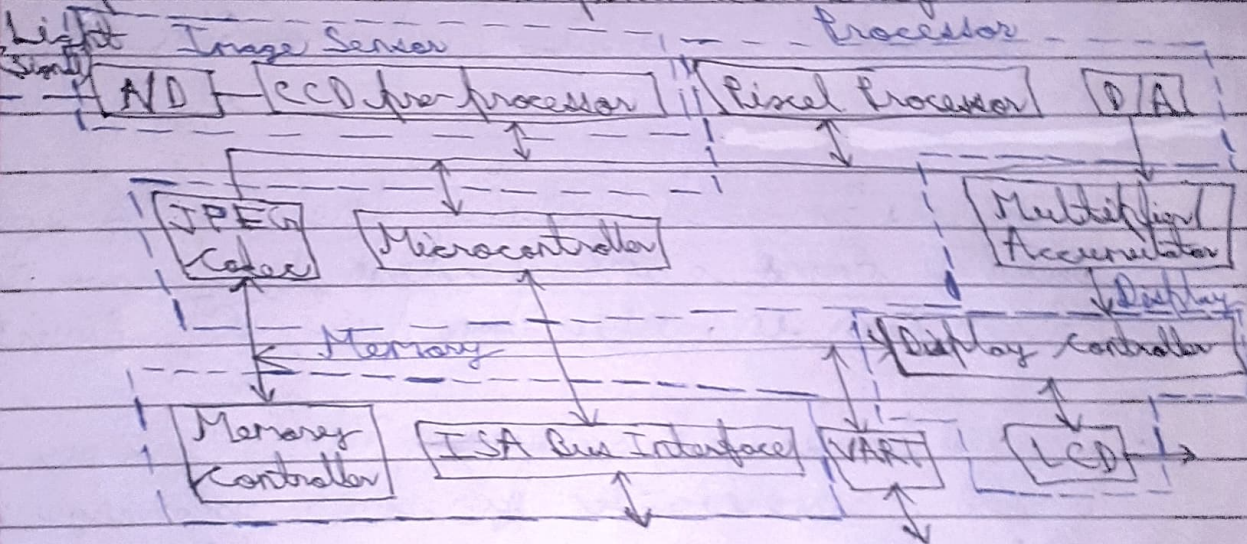- **Wired Embedded System:-** These systems utilize wired communication for data exchange such as ethernet.

Standalone Embedded system:- These system operate without connection to other system, independently handling specific tasks automatically.

Mobile Embedded System: These are also of 2 types:

Mobile Phones and Tablets:- Include embedded systems for communication, multimedia, and various applications.

Wearable Devices:- These embedded systems are used in devices like smartwatches & fitness trackers.

Design simple digital camera architecture and explain the basic components in brief.

Light
Signal

Image Sensor		Processor	
A/D	CCD pre processor	Pixel Processor	D/A
JPEG Codec	Microcontroller		Multiplier Accumulator
	Memory		Display Controller
Memory Controller	ISA Bus Interface	UART	LCD

Simple Digital Camera Architecture

(i) Image Sensor → It converts the lights entered in camera into electrical signals.

(ii) Processor → It manage image processing tasks, such as compression, color correction, and white white balance adjustments. It contains mainly a Pixel Processor and a Microcontroller along with

(iii) Memory → It contains multiplier / accumulator D/A convertor and JPEG codec, which is a widely used image compression standard.

(iii) Multiplier-Accumulator (MAC) unit → It is a hardware component that is used in digital signal processing & arithmetic to perform multiplication and accumulation operations. It also accelerates the image processing speed of the digital cam camera.

(iv) Memory → It consists mainly the memory controller and ISA Bus Interface. Industry Standard Architecture (ISA) Bus Interface is provided a way to connect the proces Processor unit with the Memory.

(v) NART → It is a tool for automatically revealing regression faults.

(vi) Display → It allows users to frame and preview shots with the help of LCD screen.

(vii) Memory →

(a) Name all Special function (SFR) along with the direct internal RAM address

Ans The SFR's of 8051 MC are:-

(i) A (Accumulator) + E0H - Direct RAM address

(ii) B (Arithmetic) + F0H - Direct RAM address

(iii) DPL + 82H - Direct RAM address

(iv) DPH + 83H - Direct RAM address

(v) SP (Stack Pointer) + 81H

(vi) P0 + 80H   (viii) P2 + A0H ⎫ I/O

(vii) P1 + 90H   (ix) P3 + B0H ⎭ Latch Port

(x) Serial Control Port (SCON) + 98H

(xi) Serial Port Data Buffer + 99H (SBUF)

(xii) Timer/Counter Control (TCON) + 88H

(xiii) TMOD + 89H   (xiv) TL0 + 8AH

(xv) TL1 + 8BH   (xvi) Program Status Word (PSW) + D0H

(xvii) TH0 + 8CH   (xviii) TH1 + 8DH
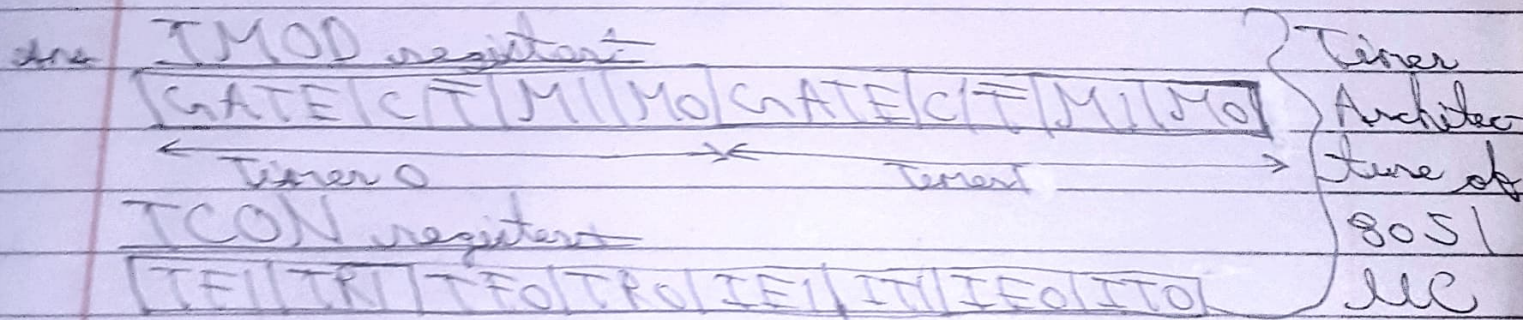
(xix) IE (Interrupt enable) + A8H

(x) IP (Interrupt Priority) = B8H

(xi) TCON (Timer control) = 97H

(b) Draw the timer architecture of 8051 MC, showing the relevant fns and signal flow of Oscillator frequency, T0/T1, Gate, TR1/0, External interrupt to Timer & explain the following:

(i) What should be the data bits of Gate, $C/\overline{T}$, M1 and M0 in order to make it a 16-bit timer?

(ii) What is the clock frequency of timer?

(iii) What if GATE=1, and GATE=0 and TR first is set?

(iv) $C/\overline{T}=0$, $C/\overline{T}=1$ along with the status of T1/T0 pins.

Ans. TMOD register

GATE	$C/\overline{T}$	M1	M0	GATE	$C/\overline{T}$	M1	M0

←——— Timer 0 ———×——— Timer1 ———→

TCON register

TF1	TR1	TF0	TR0	IE1	IT1	IE0	IT0

{ Timer Architecture of 8051 MC

(i) GATE=0, $C/\overline{T}=0$, M1=0 & M0=1 in order to make a 16-bit timer.

(ii) The clock frequency of timer is 16 MHz.
$$= 11.0592 \times \frac{1}{12} \text{ MHz}$$

$$= 0.92 \text{ MHz}$$

(iii) If the TR pins are set, ie, TR=1, & initially, it means that 16-bit timer will start counting and it will be hardware controlled (i.e directly a pins) & if GATE=0 & TR=1, it means that the 16-bit timer will be controlled by software instructions.

(iv) If C/T=0, then 8051 MC

(iv) If C/T=0, then 8051 μController will act as a timer then T1/T0 pins will be enabled & if C/T=1, then 8051 μController will act as a counter, then T1/T0 pins will be disabled.