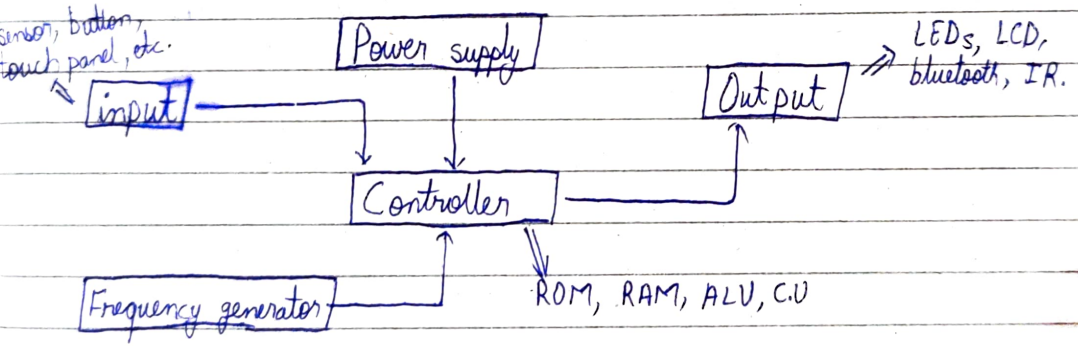
Embedded System

It is an arrangement in which all its components assembled work together a/c to set of rules.

Embedded System : It is a combination of software & hardware which is designed to perform a particular task that has to be completed in a given time.

E.g. - mobile, washing machine, micro oven, etc.

- **Building Blocks**



- **Applications :**

(i) Medical systems - pace maker, patient monitoring system, ICU
(ii) Office Equipment - Printer, copier, fax.
(iii) Tools - multimeter, oscilloscope, GPS
(iv) Banking - ATM's, statement printers
(v) Transportation - Planes, trains, automobiles

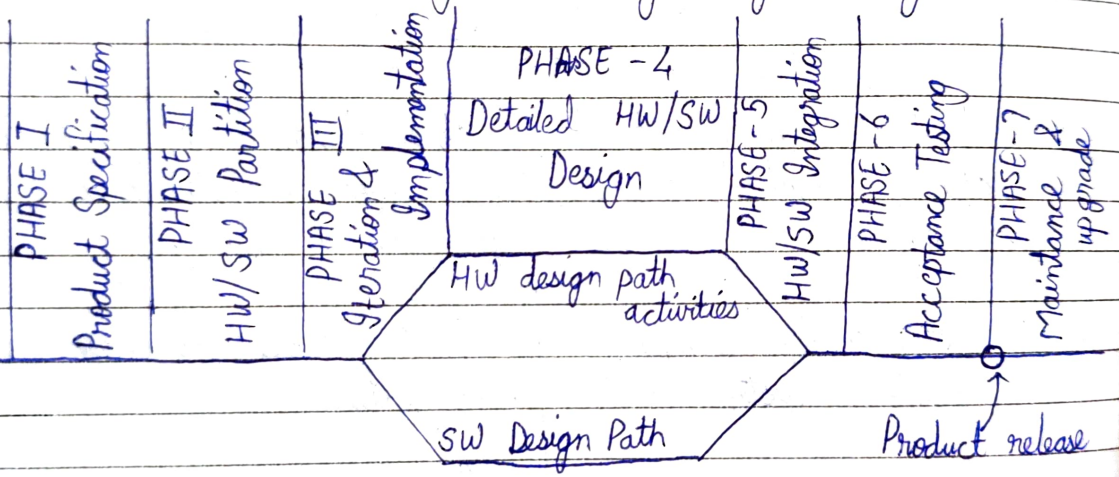
Q. What is the difference b/w an Embedded system & a computer system?

Ans-

Computer System	Embedded System
(i) It is designed using microprocess as the main processing unit	(i) It is mostly designed using a microcontroller as main processing unit.
(ii) It is designed such that it can cater to multiple tasks as per requirement.	(ii) It is designed such that it can cater to a particular predefined task.
(iii) It is mostly costlier compared to the embedded systems	(iii) It is cheaper compared to a computer.
(iv) It contains a large memory semiconductor memories like cache & RAM.	(iv) It uses semiconductor memories, but does not require secondary memory like HDD.
(v) It requires huge number of peripheral devices & their controller	(v) It requires less devices & their controller are micro controller chip itself.
(vi) The OS & other softwares are normally complicated & occupy more memory space.	(vi) The OS (RTOS) & other software occupy less memory space.
(vii) It needs human interaction to perform task.	(vii) It doesn't need human interaction

Q. Discuss the design life cycle of an embedded system?

Ans- Unlike the design of a software application on a standard platform, the design of an embedded system implies that both software & hardware are being designed in parallel. Although this isn't always the case, it is a reality for many designs today.



(i) Product specification
(ii) Partitioning of the design into its software & hardware components.
(iii) Iteration & refinement of the partitioning
(iv) Independent hardware & software design tasks.
(v) Integration of the hardware & software components.
(vi) Product testing & release
(vii) On-going maintenance & upgrading.

Q. Discuss some practical examples of embedded systems.

Ans- Examples of Embedded systems are :

(i) Digital camera – A digital camera has basically three functions, to capture an image which we call data, to store image data & to represent this data. No need for the film for storing images, these features has increased because of embedded system present in it.

(ii) ATM (Automated Teller Machine) – An ATM is an embedded system which utilizes a crowded computer to set up a network b/w a bank computer & an ATM itself. It also has a microcontroller to bear both input & output operations.

(iii) Automatic washing machine – It is an example of an embedded system. It can enclose an easy user interface, microcontroller & different sensors.

(iv) Air Bag Control System – All modern cars have airbags to create driving safer. It detects a crash using a crash sensor (embedded) & sends an authorization to the explosion system to make airbags blow up.

(v) Industrial robots – We use these robots with embedded system, to enhance the productivity. These robots are controlled by various programs which are coded in memory inside the robot.

Q. What do you mean by RTOS ? Discuss any three RTOS in details.

Ans- RTOS refers to Real Time Operating System used in computers & embedded systems that has strict time constraint for any job to be performed.

It provides a mechanism to let the processor run each process as per scheduling & to do context-switching b/w the various processes (threads & tasks).

They are commonly used in flight control, telephone switching equipment, Robot, Network multimedia.

Advantages –

① Maximum CPU consumption
② Task shifting
③ Error free
④ Memory allocation

Some of the RTOS are –

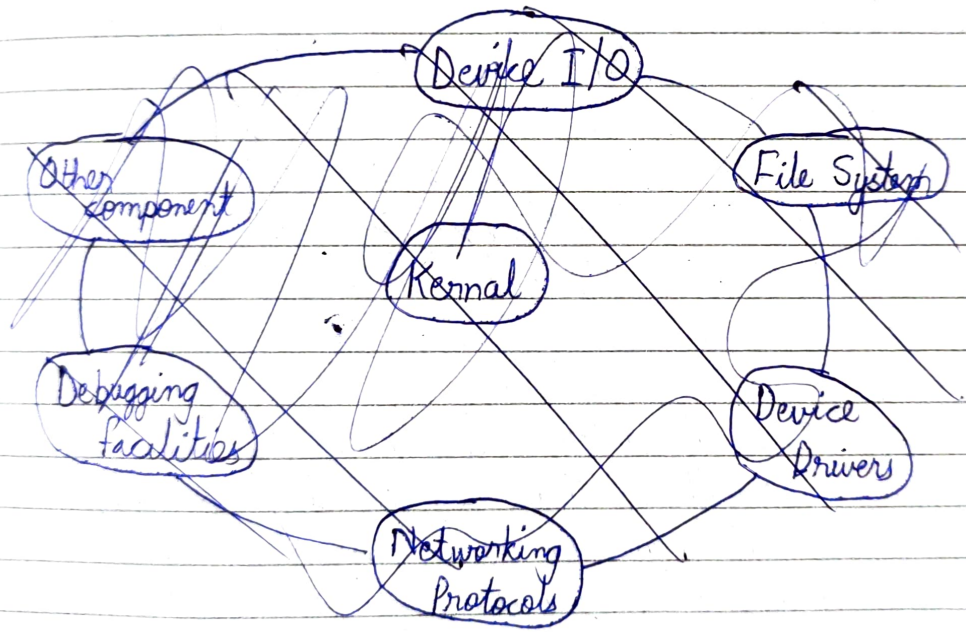
(i) Windows CE 3.0 : It is a real time OS rich in feature & is available for a variety of hardware platforms. It exhibits true real time behaviour most of the times. The system is complex & highly configurable

(ii) QNX RTOS v 6.1 : It has a client server based architecture. QNX adopts the approach of implementing an OS with 10 K bytes micro kernal surrounded by a team of processes that provide higher level OS services.

(iii) Windows NT : It is good & may be a suitable RTOS for control systems that need a good user interface & can tolerate the heavy resource requirements demanded for installation.

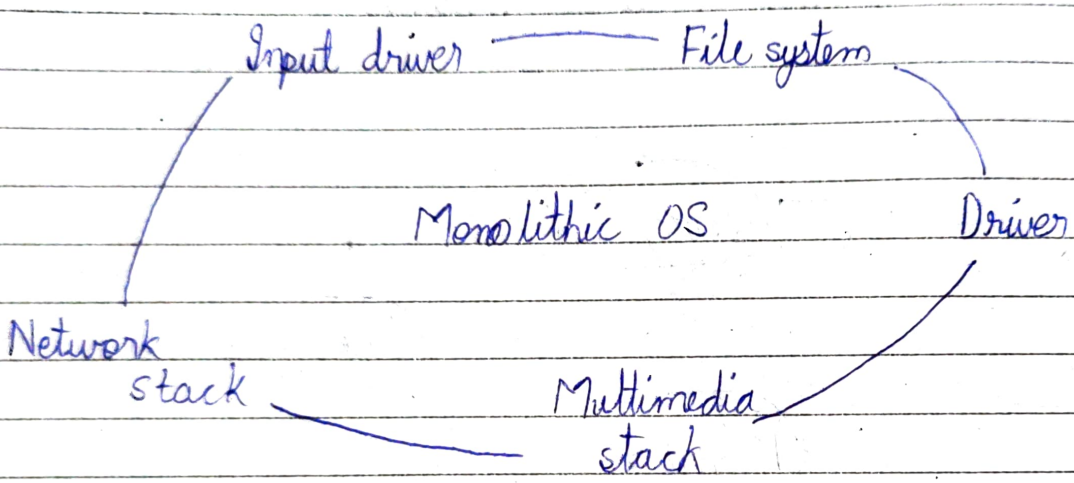
Q6. Discuss in brief the architecture of RTOS design.

Ans- The basic architecture of a multitasking RTOS consists of (a) Program interface
(b) The Kernal
(c) Device Drivers
(d) Optical service modules



RTOS architecture affects the reliability of an embedded system & its ability to recover from faults. There are two RTOS architectures : monolithic
microkernal

(i) Monolithic : It means "one huge stone". A monolithic kernal runs all operating system components in the kernal space. For instance, a monolithic RTOS includes device drivers, file management, networking & a graphics stack as part of the kernal space.



(ii) Microkernal RTOS : A microkernal RTOS is structured with a tiny kernal that provides minimal services. The microkernal works with a team of optional co-operating processes that run outside the kernal space, which provide a higher-level OS functionality.

In a microkernal, only the core RTOS kernal is granted access to the entire system, which improves reliability & security.

Q. What do you mean by co-designing & partitioning.

Ans- Co-design : The meeting of system-level objectives by exploiting the trade offs b/w hardware & software in a system through their concurrent design.

Importance of co-design :

① Improves design quality, design cycle time, & cost, reduces integration & test time.

② Takes advantage of advances in tools & technologies
- processor cores
- High-level hardware synthesis capabilities
- ASIC development.

Partitioning : The mapping of a system level architecture into specific HW & SW application requirements is called partitioning.

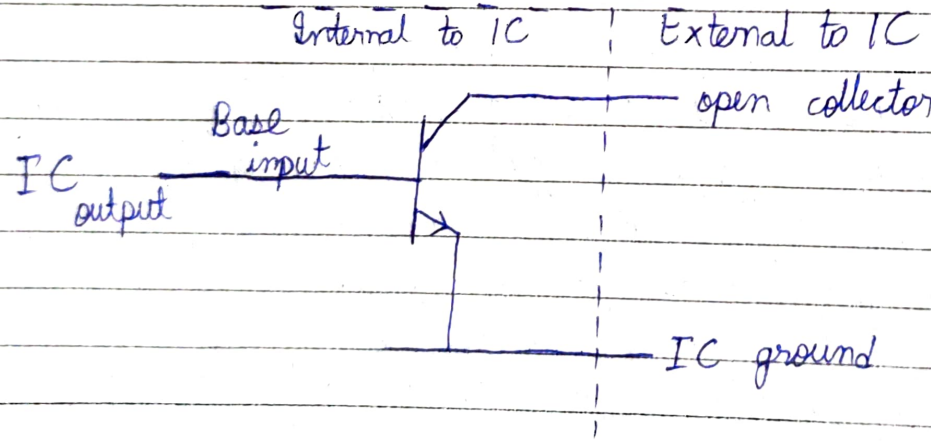
HW/SW partitioning is an important development step during HW/SW co-design to ensure application performance in embedded system. The partitioning is done in the earliest stages of the design, at the stage where there is the greatest possibility for changes.

Benefits

(i) Faster integration – reduced design time & cost.
(ii) Better integration – better performance
(iii) lesser errors & re-spin.

Q. Discuss about open collector output & tri-state buffer in detail.

Open collector output : It is a common type of output found on many integrated circuit (IC). Instead of outputing a signal of a specific voltage or current, the output signal is applied to the base of an internal NPN transistor whose collector is open on a pin of the IC.

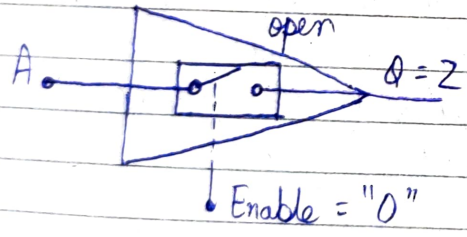


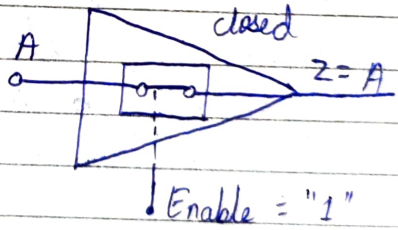
It is normally used in logic circuits & can be viewed as a common emitter configuration for a BJT transistor & normally of type NPN.

Tri-state buffer : It can be thought of as an input controlled switch with an output that can be electronically turned "ON" or "OFF" by means of an external "Control" or "Enable" (EN) signal input.

This control signal can be either a logic "0" or "1" type signal resulting in the Tri-state buffer being in one state following its output to operate normally producing the required output or in another state were its output is blocked.

Then a tri-state buffer requires two input. One being the data input & other being the enable or control





Q. What do you mean by watch dog timer.

A watchdog timer is an electronic or software timer that is used to detect & recover from computer malfunctions. They are widely used in computers to facilitate automatic correction of temporary hardware faults, & to prevent errant or malevolent software from disrupting system operation.

The computer regularly restarts the watchdog timer to prevent it from elapsing, or "timer out". If, due to hardware fault or program error, the computer fails to restart the watchdog, the timer will elapse & generate a timeout signal. The timeout signal is used to initiate corrective actions. The correction action is basically to placing computer & hardware in a safe state & invoking a computer reboot.

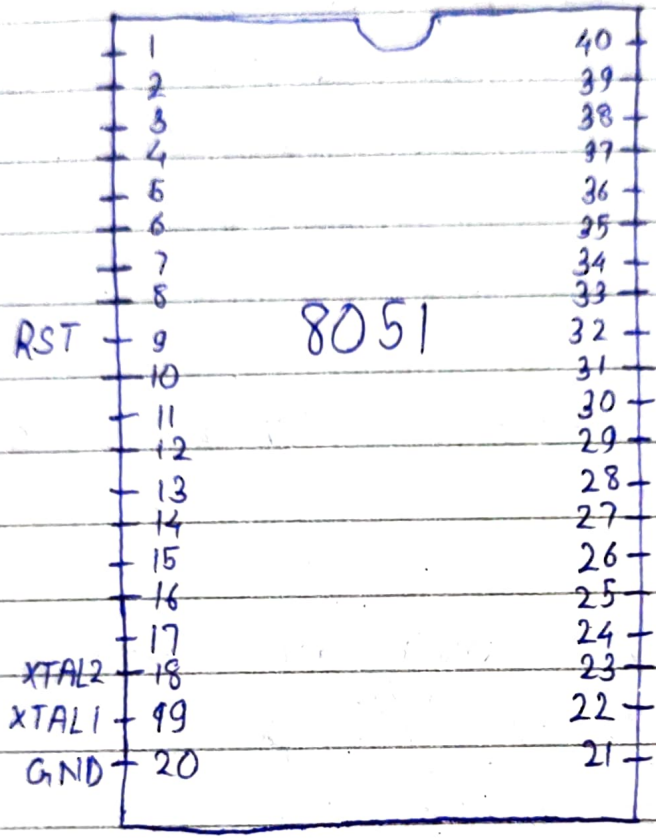
Watchdog timers are commonly used in embedded systems & other computer controlled equipment where humans can't easily access the equipment or would be unable to react to faults in a timely manner.

Operations :-

(i) Restarting or Kicking
(ii) Enabling
(iii) Single - stage watchdog
(iv) Multi stage "
(v) Time intervals

Q. Design & explain pin diagram of 8051 microcontroller?

Ans- 8051 microcontroller is a 40 pin dual line package (DIP). These 40 pins serve different functions like read, write, I/O operations, interrupts, etc.



Pin 1 to 8 : These pins are known as Port 1. They are bi-directional I/O port.

Pin 9 – It is a reset pin, which is used to reset the microcontroller to its initial values.

Pin 10-17 → These pins are known as Port 3. These ports serves some function like interrupts, time input, control signal, serial communication signals RxD & TxD, etc.

Pins 18-19 : These pins are used for interfacing an external crystal to get the system clock.

Pin 20 - It provides power supply to the circuit

Pin 21 to 28 - These pins are known as Port 2. It serves as I/O port.

Pin 29 - This is PSEN pin (Program Store Enable).

Pin 30 - This is EA pin which stands for External Access input.

Pin 31 - This is ALE pin (Adress Latch Enable). It is used to

Pin 32 to 39 - These pins are known as Port 0. It serves as I/O port.

Pin 40 - It provide power supply.

Q. What is the difference b/w microprocessor & microcontroller.

Ans-

Microprocessor	Microcontroller
① It is the heart of computer system.	① It is the heart of an embedded system.
⑪ It is only a processor, so memory & I/O components need to be connected externally.	⑪ It has a processor along with internal memory & I/O components.

(iii) Cost of the entire system is high	(iii) Cost of the entire system is low.
(iv) Due to external components, total power consumption is high.	(iv) Here, total power consumption is less.
(v) It is mainly used in PCs.	(v) It is used in washing machine, MP3 players & embedded systems.
(vi) They are based on Von Neumann model	(vi) They are based on Harvard architecture