1. Introduce embedded system (complete overview) with an example either block diagram of digital camera or smart phone and characteristics of embedded system with brief on components.

2. Write short note on design matrix of embedded system.

3. Classified embedded system based on generation, and complexity and performance and write short notes on corresponding classes.

4. What is instruction pipelining? Present advantage and disadvantage of instruction pipelining.

5. Write brief notes on single purpose processor, general purpose processor and application specific processor with simple block-diagram.

6. What are the purposes of embedded system? Write brief notes on each.

7. Visit the web https://microcontrollerslab.com/embedded-systems-basics/ and write short notes on each topic presented in the web. (Copy and paste strictly deters the marks)

Note: submission after class will not be allowed.

PAGE NO. :
DATE : __/__/____

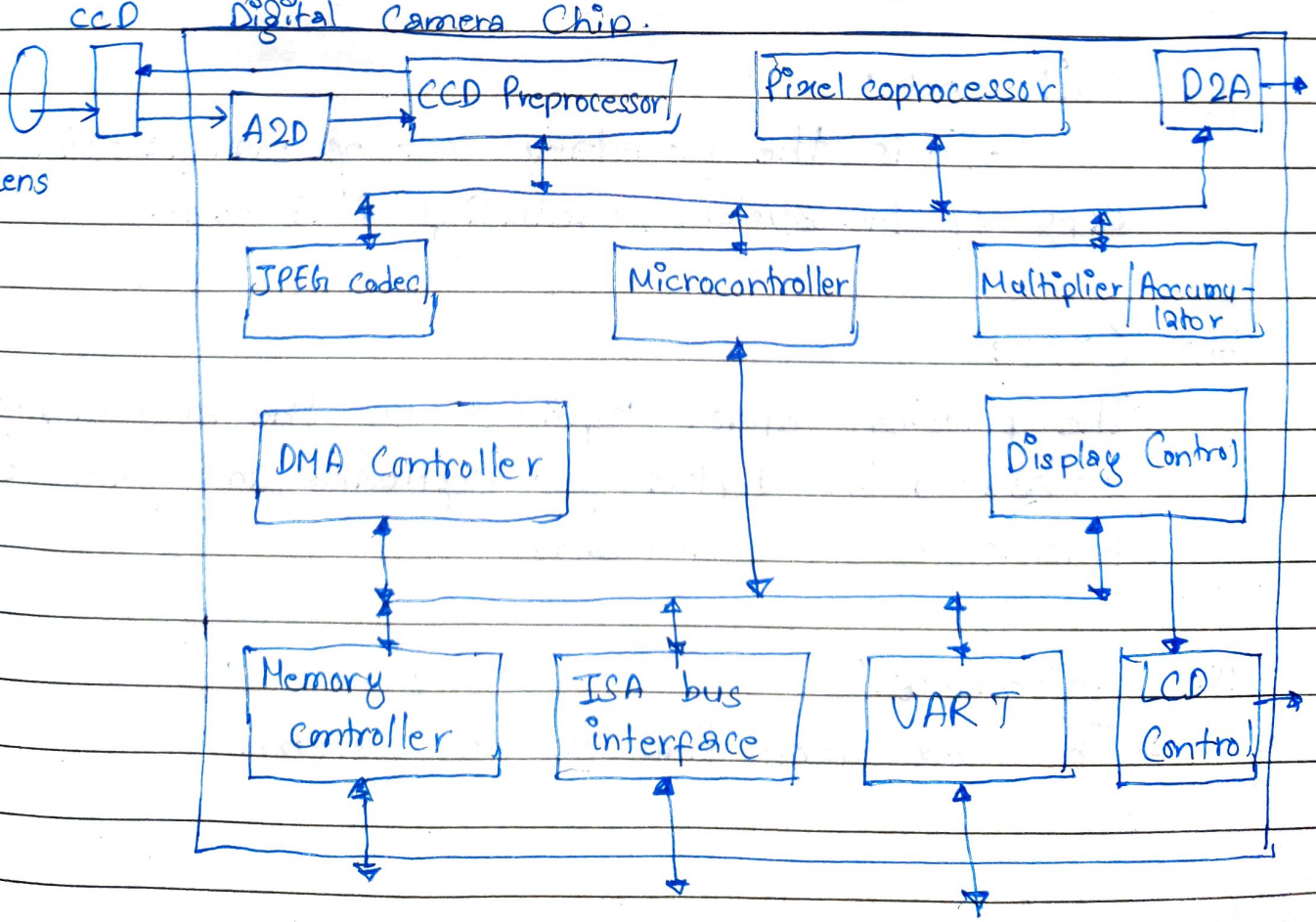
Week 1:

1. Introduce embedded system (complete overview) with an example either block diagram of digital camera or smart-phone and characteristic of embedded system with brief on components.

Ans. Any electronic system/computing system in which hardware and software is embedded within is called embedded system. It is nearly any computing system other than a desktop computer.

Embedded systems are found in a variety of common electronic devices such as consumer electronics (cell phones, pagers, calculators), home appliances (microwave ovens, thermostats), office automation (printers, scanners), business equipment (cash register, card reader, ATM), and automobiles (fuel injection, antilock brakes).

The block diagram of a digital computer is:



Characteristics:
- Single functioned / Specific.
- Tightly constrained (Time specific)
- Reactive and Real time.

The components of embedded system are:
(i.) Hardware.
(ii.) Real-time Operating system
(iii.) Application software.

(2.) Write short notes on design matrix of embedded system.

Ans: The design metrices of an embedded system are:

(i.) NRE Cost (Non-Recurring Engineering Cost)
- It is one-time monitoring cost of designing system.

(ii.) Unit cost:
- It is the monetary cost of manufacturing each copy of the system, excluding NRE cost.

(iii.) Size:
The physical space required by the system, often measured in bytes for software, and gates or transistor for hardware.

(iv.) Performance:
- The execution time of the system.

GOOD MORNING
PAGE NO. :
DATE : __/__/____

(V.) Power :
The amount of power consumed by the system.

(VI.) Flexibility :
The ability to change the functionality of the system without incurring heavy NRE cost.

(VII.) Time-to-prototype :
The time needed to build a working version of the system.

(VIII.) Time-to-market :
The time required to develop a system to the point that it ~~release~~ can be released and sold to customers.

(IX.) Maintainability :
The ability to modify the system after its initial release.

(X.) Correctness
The accuracy of the implementation of system's functionality correctly.

(XI.) Safety :
The probability that the system will not cause harm.

3.) Classify embedded system based on generation, and complexity and performance and write short notes on corresponding classes.

Ans: Classification of embedded system based on generation:

I. First generation embedded system:
These are the early embedded system, that were built around 8-bit microprocessor and 4-bit microcontroller.
E.g: digital telephone keypad, stepper motor, etc.

II. Second generation ES:
These were built around 16-bit microprocessor and 8-bit microcontroller. It contains more complex and powerful instruction set than 1G.
E.g: Data acquisition system, SCADA system.

III. Third generation ES:
These uses powerful 32-bit microprocessor and 16-bit microcontroller for their design. Much more complex and powerful instruction set than 2G.
E.g: -Robotics media, instruction process control.

IV. Fourth generation ES:
These uses 64-bit microprocessor and 32-bit microcontroller for design. It provides very high performance to the system. These uses real time embedded OS.
E.g: Smartphone.

DATE : __/__/____

Classification of Embedded system based on complexity and performance.

I. Small scale embedded system:

These type of embedded system are built by 8-bit microprocessor and 16-bit microcontroller that may be evenly activated by a battery, simple in application, usually built around low performance and low cost may or may not contain operating system for its functioning.

II. Medium scale ES:

These are built around 16-bit microprocessor and 32-bit microcontroller. Slightly complex in both hardware and software.

III. Large scale ES:

These are built around 32-bit microprocessor and 64-bit microcontroller. Employed in the application which require high performance, involve highly complex hardware and software system.

4. What is instruction pipelining? Present advantages and disadvantages of instruction pipelining.

Ans:

Instruction pipelining is a technique used in the design of modern microprocessors, microcontrollers and CPUs to increase their instruction throughput (the numbers of instructions that can be executed in a unit of time). The processing of a CPU instruction is divided into a steps of microinstructions.

Modern day CPUs are driven by a clock. The CPU consist of internally of logic &

memory. When the clock signal arrives, the flip-flops store their new value then the logic requires a period of time to decode the flip flops new values. Then the next clock pulse arrives and the flip flops store another values, and so on. By breaking the logic into smaller ~~places~~ pieces and inserting flip-flops between pieces of logic, the time required by the logic is reduced.

Advantages:

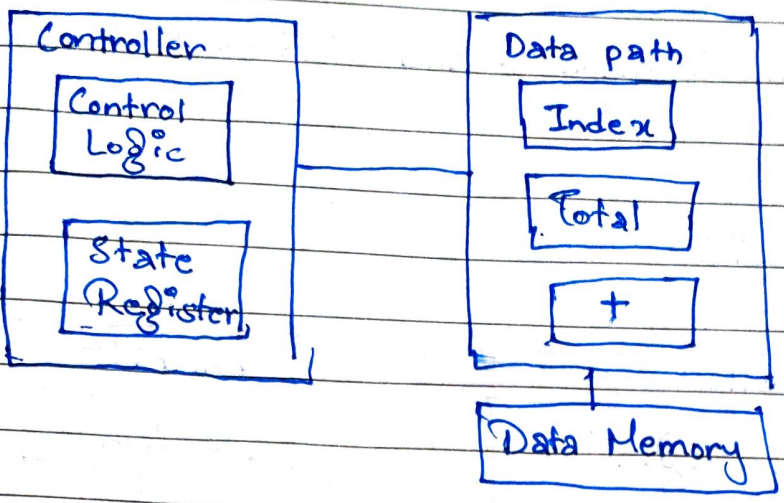
1. The cycle time of the processor is reduced.
2. If pipelining is used, the CPU Arithmetic logic unit can be designed faster.
3. Pipelining in theory increases performance over an un-pipelined core by a factor of the no. of stages.
4. Pipelined CPUs generally work at a higher clock frequency than RAM clock frequencies, increasing computer's overall performance.

Disadvantages:

1. It involves adding hardware to the chip.
2. Instruction latency increases in pipelined processor.
3. The throughput of a pipelined processor is difficult to predict.
4. The longer the pipeline, worse the problem of hazard for branch instruction.

5. Write brief notes on single purpose processor, general purpose processor and application specific processor with simple block diagram:

Ans: Single purpose processor:



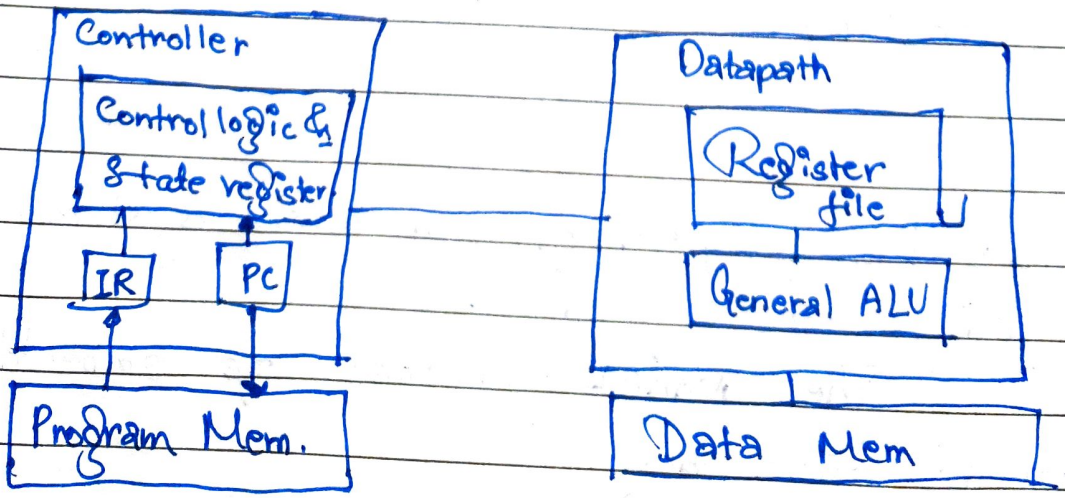
It is a digital circuit designed to execute exactly one program.

E.g: Accelerator or peripherals

Features: - Contains only the components needed to execute a single program
- No program memory.

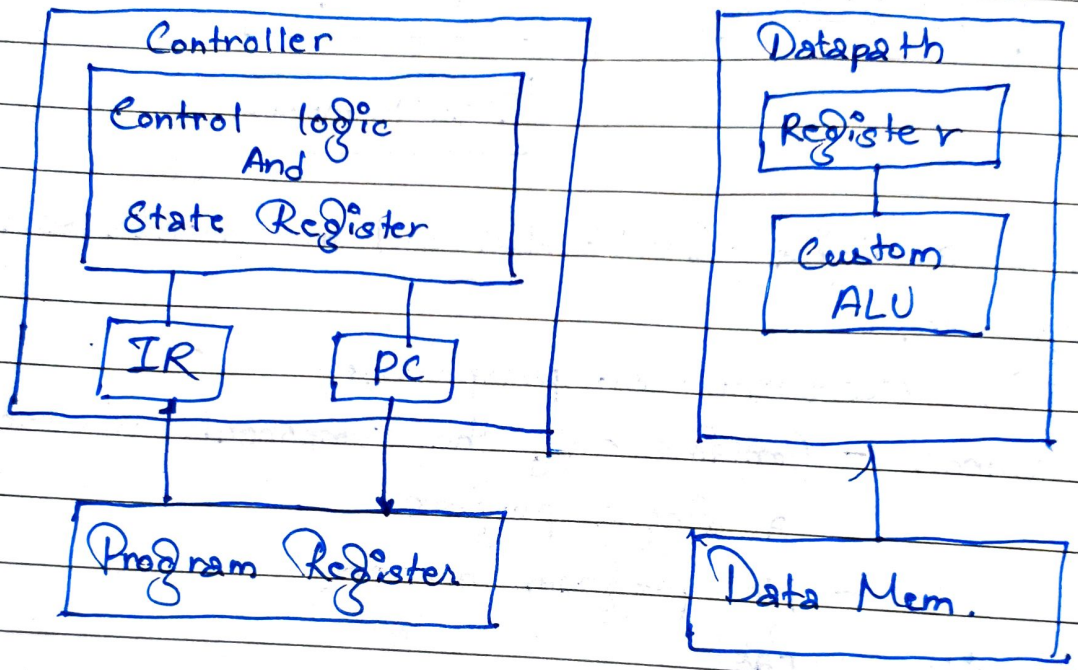
Benefits: - Fast
- Low Power
- Small Size.

General Purpose Processor.



- Programmable device used in variety of application.
- Features:
  - Consists of program memory, general data path with large register files and general ALU.
- User benefits:
  - Low time to market and NRE cost, high flexibility.

Application Specific



- Programmable processor optimized for a particular class of applications having common characteristic.
- Compromised between single purpose and general purpose register.

) What are the purpose of embedded system? Write brief notes on each.

The various purpose of embedded system are given as:

a.) Data collection, storage & representation:

In a data acquisition system, the processed input data could be collected as output, and stored and represented by using embedded system.

b.) Data communication:

Embedded system is implemented to transmit data from one place-to-another. Ex. Telephone, cellphones, modems, etc. are some of the examples.

c.) Data / signal processing:

Different data processing activities such as analog-to-digital conversion, multiplexing, modulation can be carried out with the help of embedded system.

d.) Monitoring

Embedded systems are used to monitor the process activities in factories, power plants, etc.

e.) Control:

Embedded system are used to control different sensors and actuators to change the response of the system as required

f.) Application-specific user interface:

User interface for a certain hardware can be implemented using embedded system. //

(7) Short notes:
microcontrollerslab.com/embedded-system-basics/

Ans: I. Embedded Systems Basics.

Embedded system is the process of running tasks within a set of rules. Some of the examples are an eye, washing machine, etc. The device with software program embedded to perform such tasks is known as embedded device. The components of embedded system are:

- Embedded gadget hardware
- Embedded gadget software
- Operating gadget.

II. Embedded Systems Hardware:

It is the component of the embedded system in which the operation is carried out. It is made up of microprocessor or microcontroller. It consists of:

- Power supply
- Processor
- Timers
- Serial exchange ports
- Input/Output circuits
- System service specific circuits.

III. Embeded System Software.

It is a special program written for the embedded system to perform some specific task. It is designed to keep in view of the 3 limits:

- Availability of machine memory
- Availability of processor's speed
- Whether the system requires interrupt.

GOOD MORNING
PAGE NO. :
DATE : __/__/____

IV. Real-time operating system.

Real time operating system acts as an interface between the applications and hardware. It increases the reliability of the system. It manages the overall timing activity of the system.

V. Memory:

Memory is used to store the programs, data, temporary data, etc. Different types of memory can be used in the system on the basis of size, access method, physical characteristics, etc.

VI. Processors:

Processors used in embedded system are multiprocessor, RISC processor, ASIP processor, ASSP processor, arm processor, microcontroller and virtual digital processor

VII. Characteristics of Embedded System.

- They are designed to carry out some specific task.
- Firmware is the software program for the embedded system which is stored in chip
  - It executes a particular operation.
  - It should consume less power.
  - It should react to the changes in the system.

VIII. Applications.

- Transportation mediums
- Telecommunication
- Computer networking.