SKN3022
PROCESS INSTRUMENTATION
CHAPTER VI

CONTROLLER

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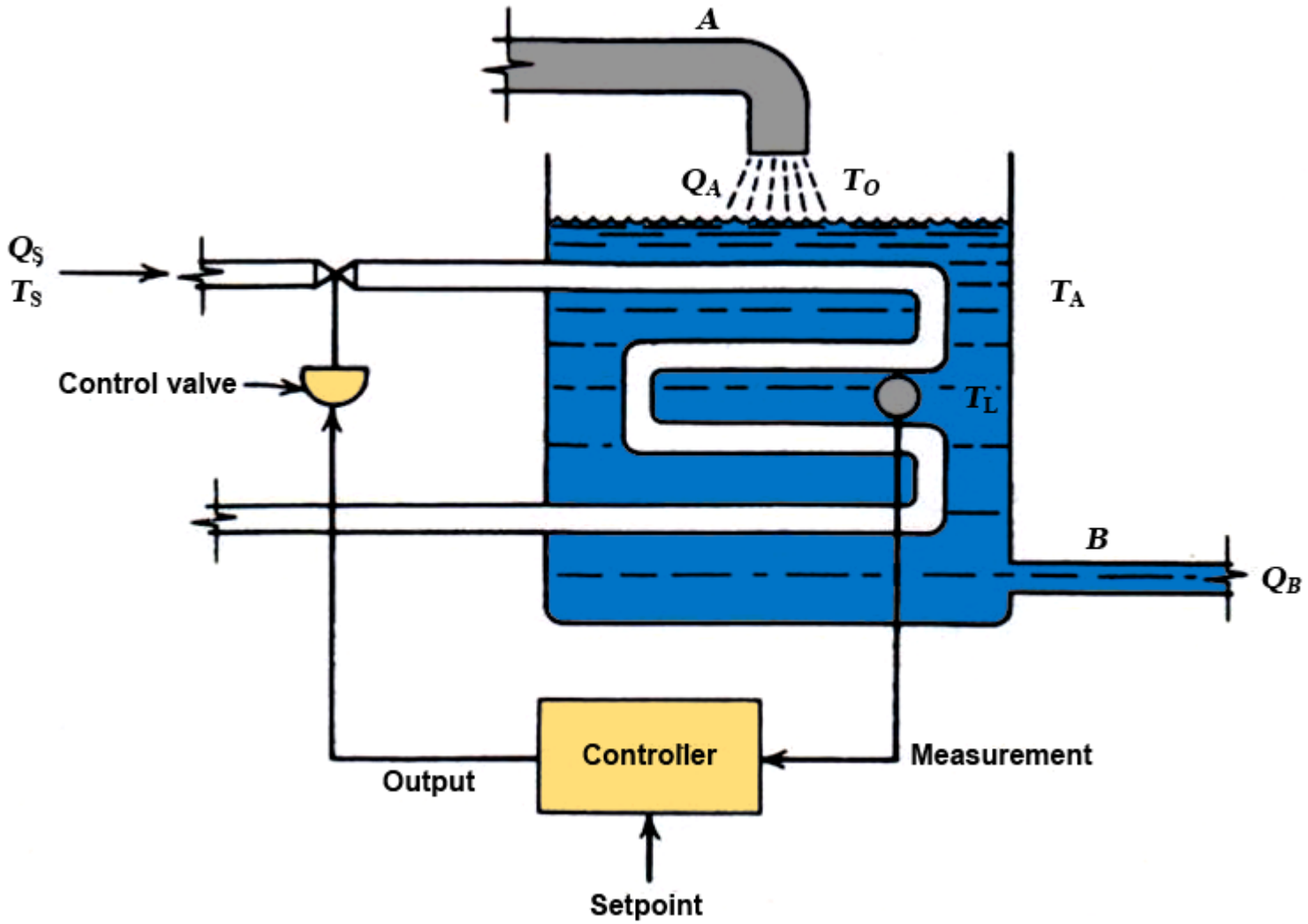
CONTROLLER

- Controller is an element which is required to emit certain control signals to a system.
- A controller is the active element in each control configuration which receives information from a measuring system and takes the necessary action by changing a value to the set point limit. And determines an appropriate output to the final control element.
- Two types: Analog Controller and Digital Controller.

The Need for Control

1. Safety – an important factor for all process industries.e.g the usage of temperature limit, pressure and others should not exceed the allowed limit.
2. Production specification – all production must have a certain quality standard to ensure that the value of production quality can be fulfilled.
3. Environmental rules – all production must not in any way pollute the environment.e.g the usage of a chemical substance must not exceed the allowed concentration.
4. Operational constraint – the equipment used must have a usage limit.e.g the filling of tank without exceeding the limit.
5. Economy – the production operation must be in accordance to the market demand with ensuring minimum operation cost and maximum revenue.

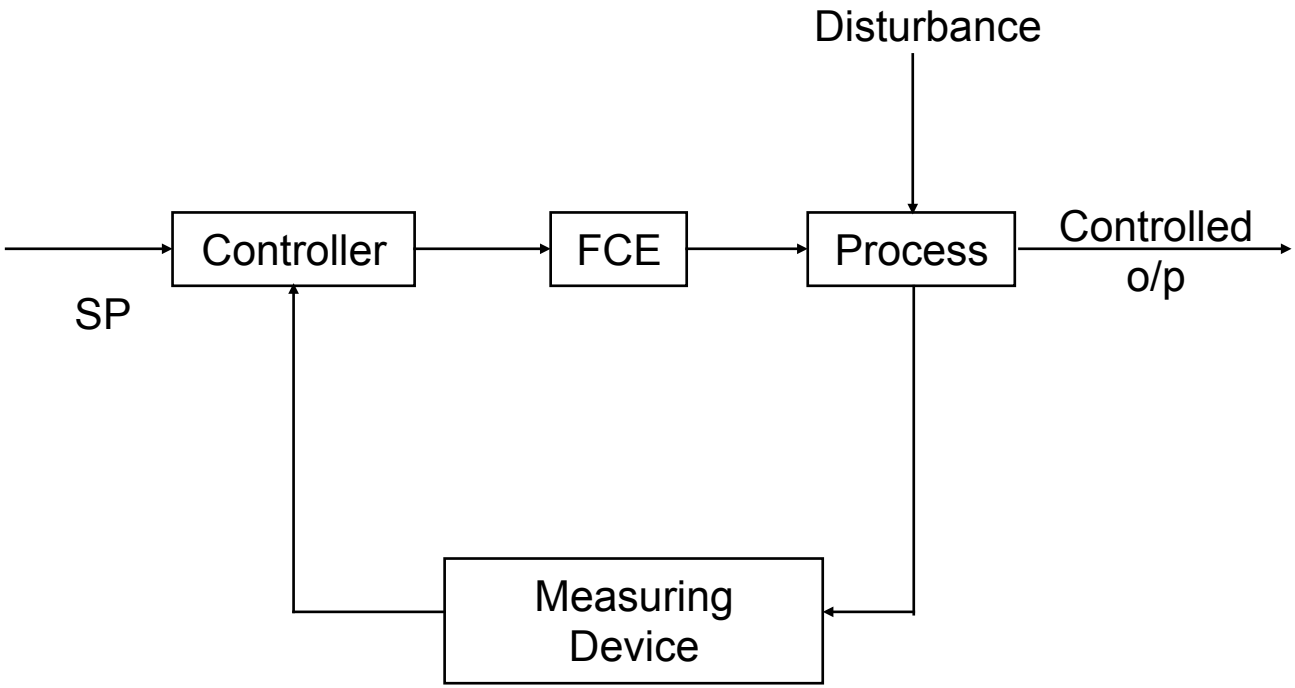


Control of temperature by process control

A. ANALOG CONTROLLER

- The controller is in analog form (pneumatic/ electronic) and all the signal transmission is in analog form.
- Carries out two basic operations:
    i. Continuous processing of analog signal from transducer.
    ii. Transmits commands in analog signals for final control elements.

Analog Controller



SP : set point

FCE : final control element

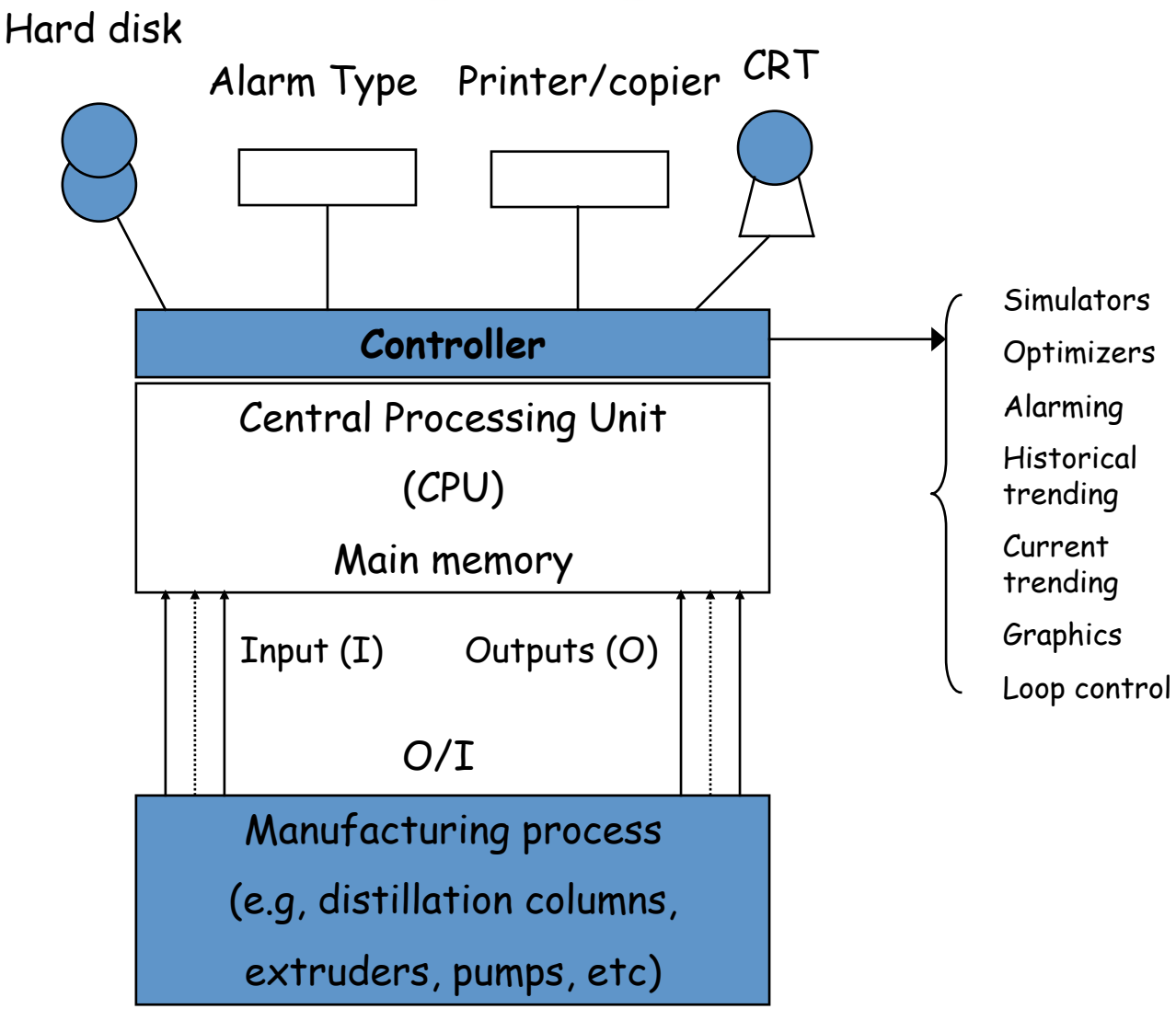
B. DIGITAL CONTROLLER

- Computer based controller.
- The function of this controller is stored in the computer memory.
- Consists of 4 types:

1. Direct Digital Controller (DDC)
2. Supervisory Digital Controller (SDC)
3. Distributed Digital Controller (DiDC)
4. Programmable Logic Controller (PLC)

1. Direct Digital Controller

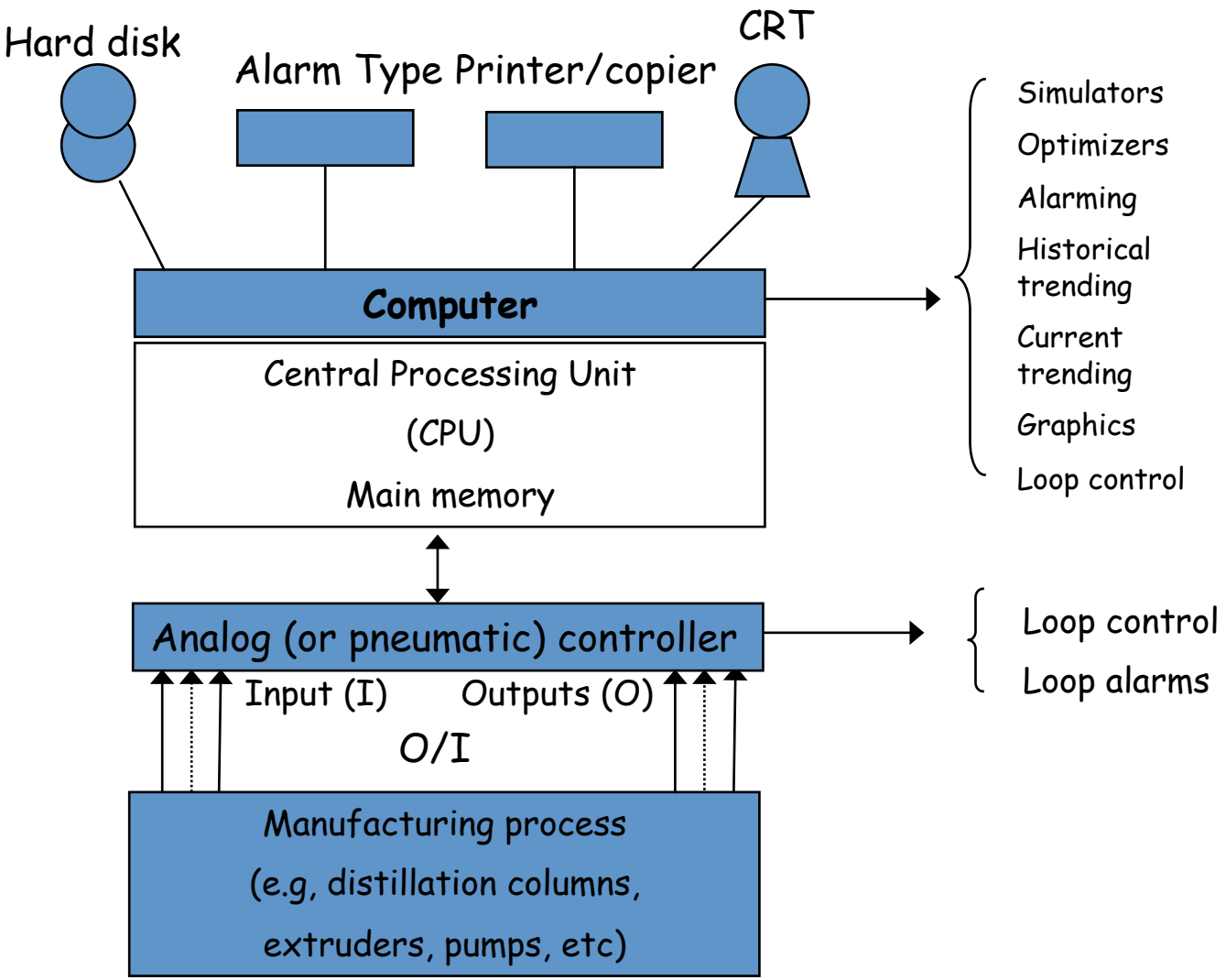
- In a DDC system, the computer system interacts directly with the production equipments.
- All the input process variables and output control signals communicate directly with the CPU which effects the speed accuracy, cost and the memory size of the operation by overloading the system.
- If the computer system is halted, all the control loops will also stop.
- Basically, DDC is similar to an analog controller with exceptions on its abilities to evaluate the process and its simulation abilities.



Generalized diagram of DDC

2. Supervisory Digital Controller

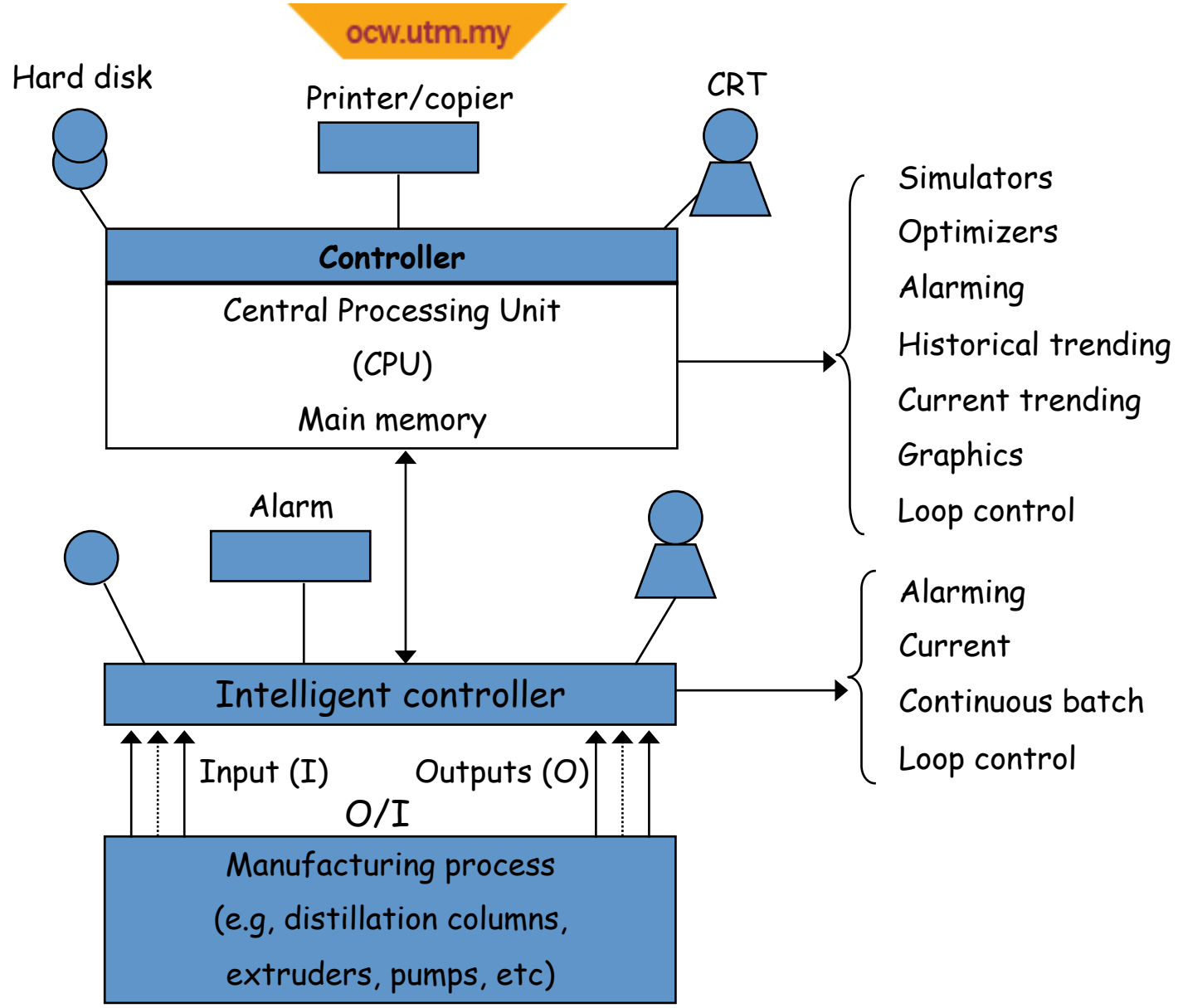
- In SDC system, the computer system interacts directly with a few control loops (normally analog controllers) where these control loop will communicate with the actual process.
- The advantage of SDC over DDC is that the ability of SDC to keep control of its control loops if the computer stops operating.



Generalized diagram of SDC

3. Distributed Digital Controller

- In a DiDC system, the computer system interacts directly with a few digital control loops where these loops will communicate with the real process. At the same time, more functions can be carried out efficiently.
- The control loops in DiDC are capable of carrying out sequential operations and increasing the overall system performance.
- DiDC decreases the danger of damaging the entire system by protecting the system because operations has been distributed among the smaller systems. If there is a damage on one system, the other systems would not be affected.
- Requires a back up computer.

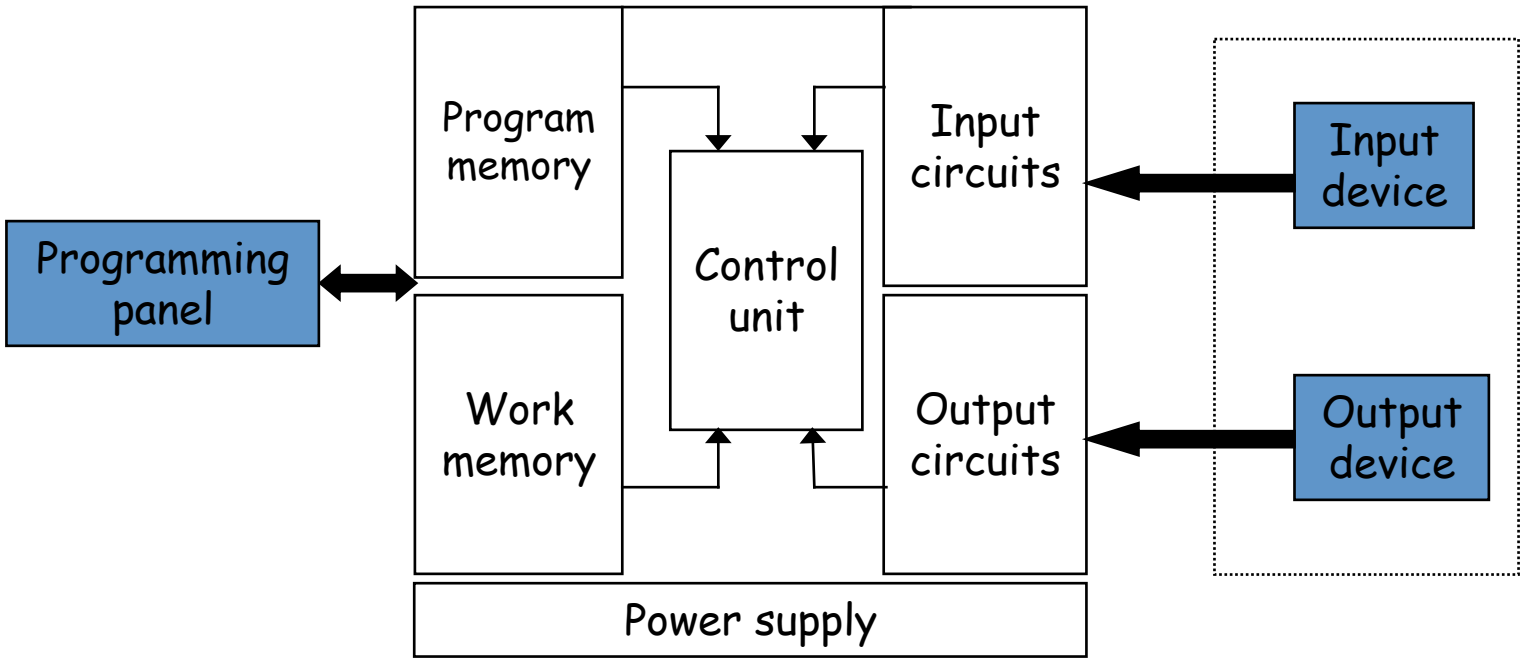


Generalized diagram of DiDC

4. Programmable Logic Controller

- Used for automatic control systems.
- Flexible and easy control system based on simple programs where the logic used is in the form of “ladder diagram”.
- An interface has been readily available in a PLC so it can be directly connected to actuators or final control elements without additional circuits.
- Control system can be changed without getting rid of the connection but by only changing the program.
- Shorter assembly time.
- PLC is not a flexible instrument because its sequential operations are in a large, uninterruptible cycle.

Programmable Logic Controller



Programmable Logic Controller Structure