

Introduction to Automation

Chapter 1

1

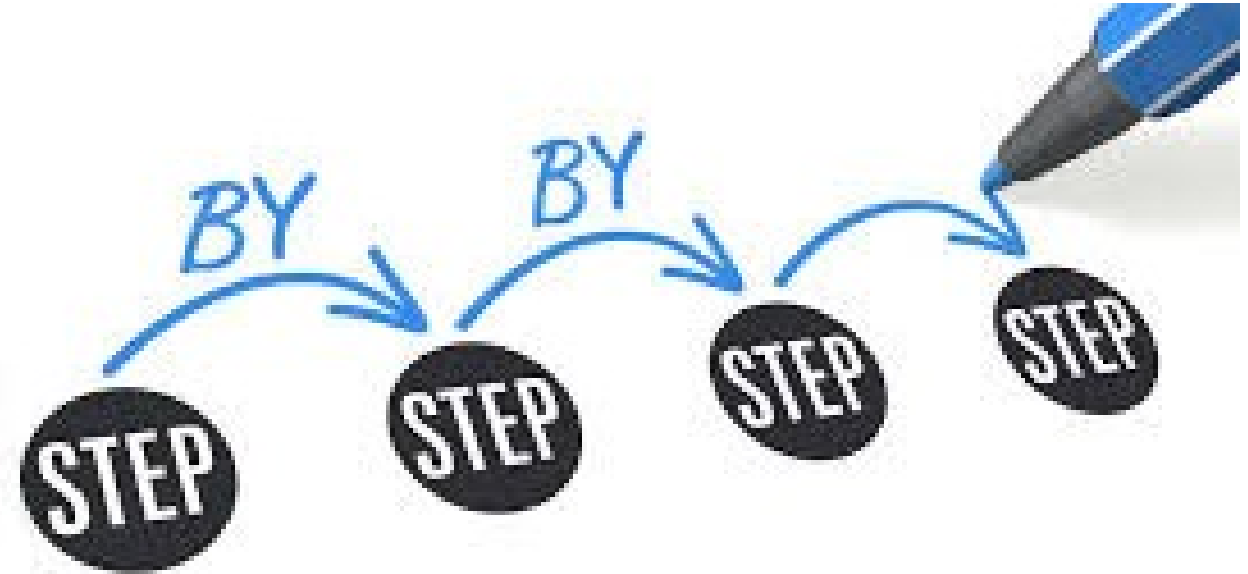
Table of Content

- Process
- Automation
- Automation System Structure
- PLC

Process

Definition of Process

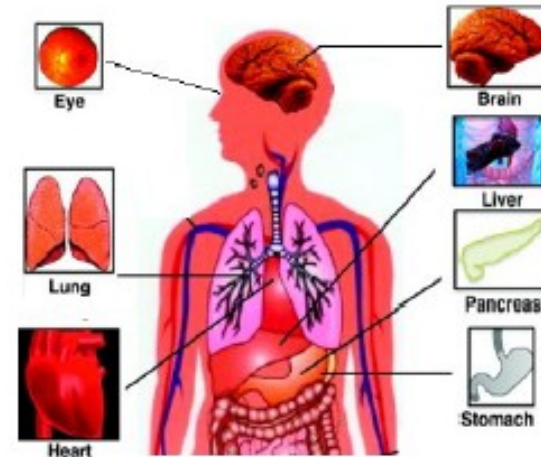
- Process : a series of actions or steps taken in order to achieve a particular end.
- Physical process as a sequence of operations or actions which, at every stage, consume one or more inputs or resources to convert them into outputs or results to reach a known goal or the desired end result in the physical world.



Physical Process

The physical processes can be broadly divided into two categories as follows:

- **Natural processes**
- **Man-made
(industrial processes)**



Industrial Process

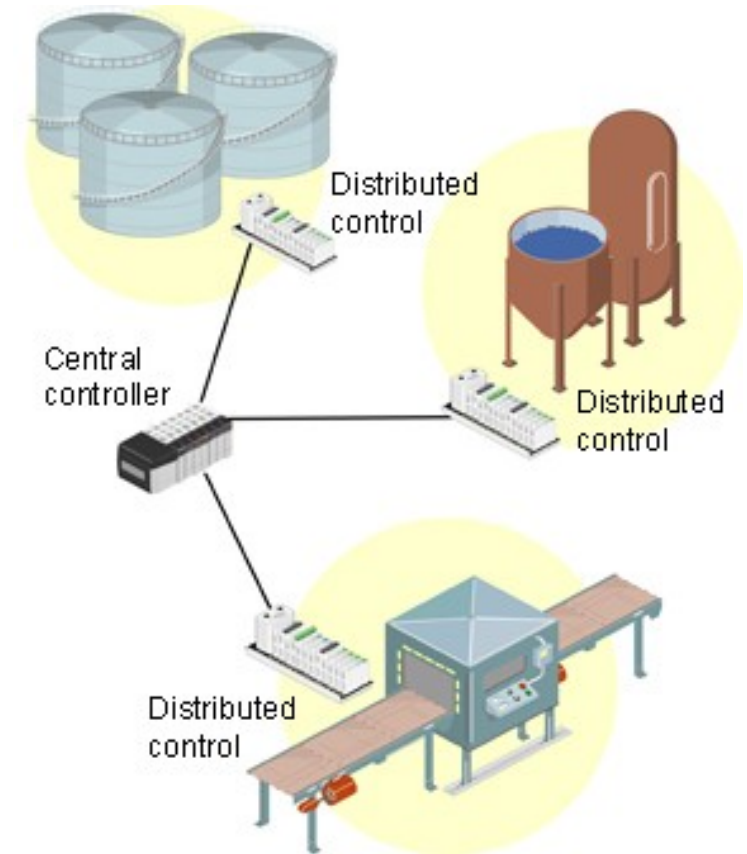
Industrial processes are broadly divided into two categories based on their nature, structure, or physical organization.

- Localized Processes

The localized process is present in a relatively small physical area with all its sub-processes or components closely interconnected.

- Distributed Processes

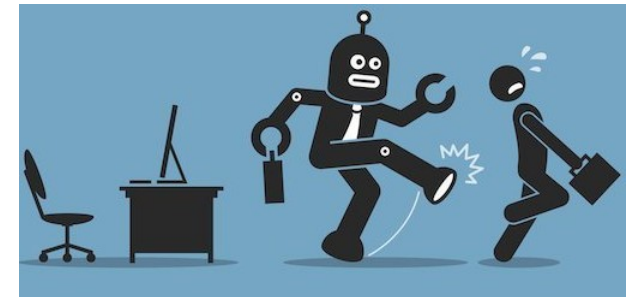
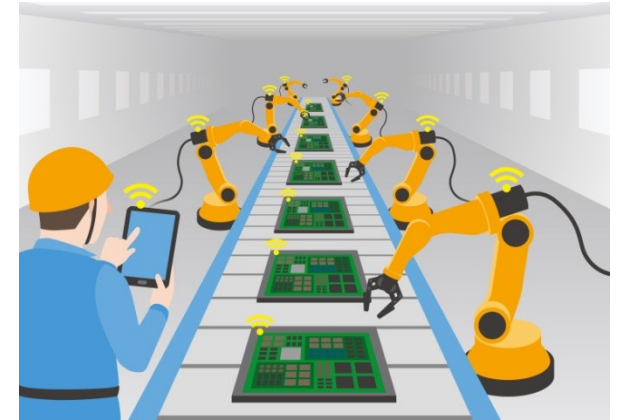
On the other hand, the distributed process is present in a relatively large physical area with its sub-processes or components loosely interconnected. Such a process is a network of many localized processes distributed over a large physical area.



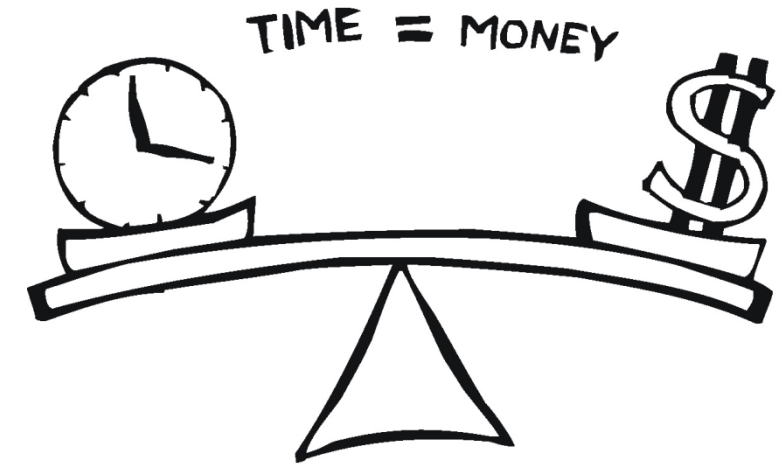
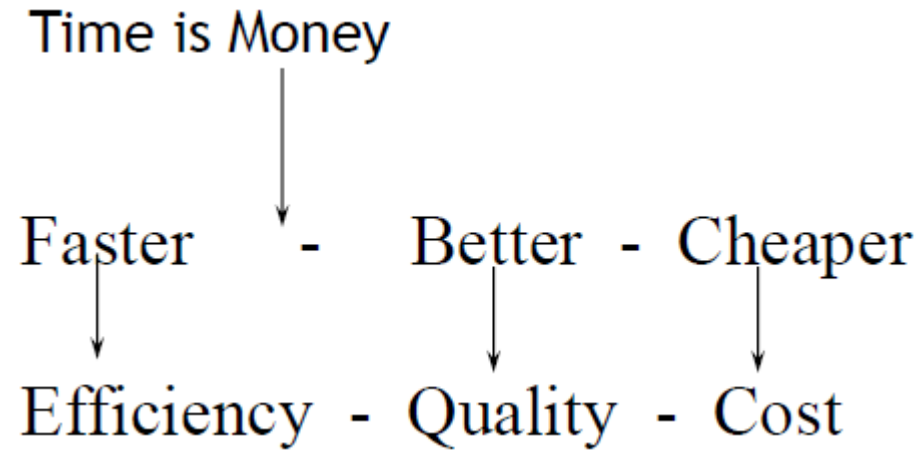
Automation

Definition of Automation

- A process automation system is an arrangement for automatic monitoring and control of the industrial process to get the desired results with minimum manual interventions.
- The term automation, inspired by the earlier word automatic (coming from automaton), was not widely used before 1947, when General Motors established the automation department.
- Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques.



Competition Rule



The biggest benefit of automation is that it saves labour, however, it is also used to save energy and materials and to improve quality, accuracy and precision.

Automation Steps

- Step 1: Information Acquisition

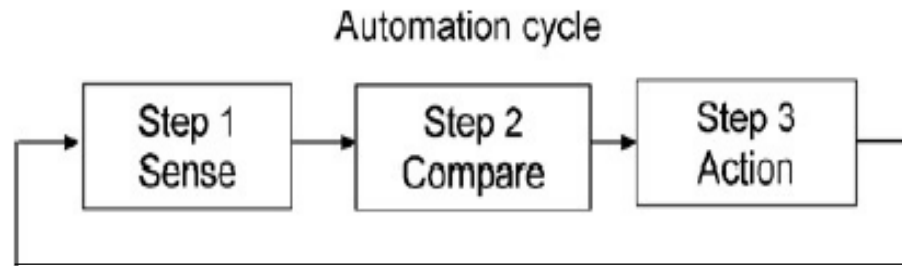
Information acquisition step observes the behaviour of the process by sensing or measuring process parameters of interest. These parameters are called process inputs.

- Step 2: Information Analysis and Decision Making

The information analysis and decision making step analyse the behaviour of the process by comparing the acquired information with the desired result. Then a decision is made about the new directives or commands that would be required to effect any corrections.

- Step 3: Control Execution

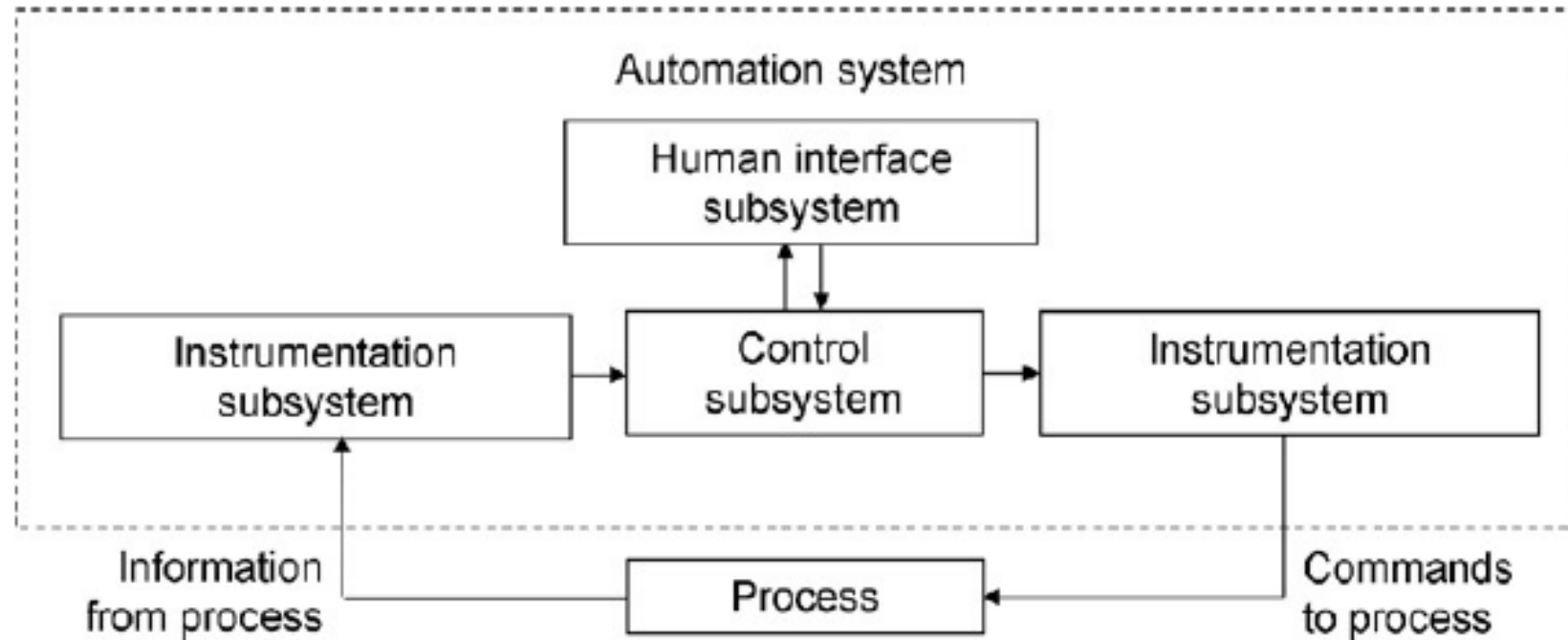
Control execution step actually controls the behaviour of the process by sending any new directives or commands into the process to effect the corrections. These directives are called command outputs.



Automation System

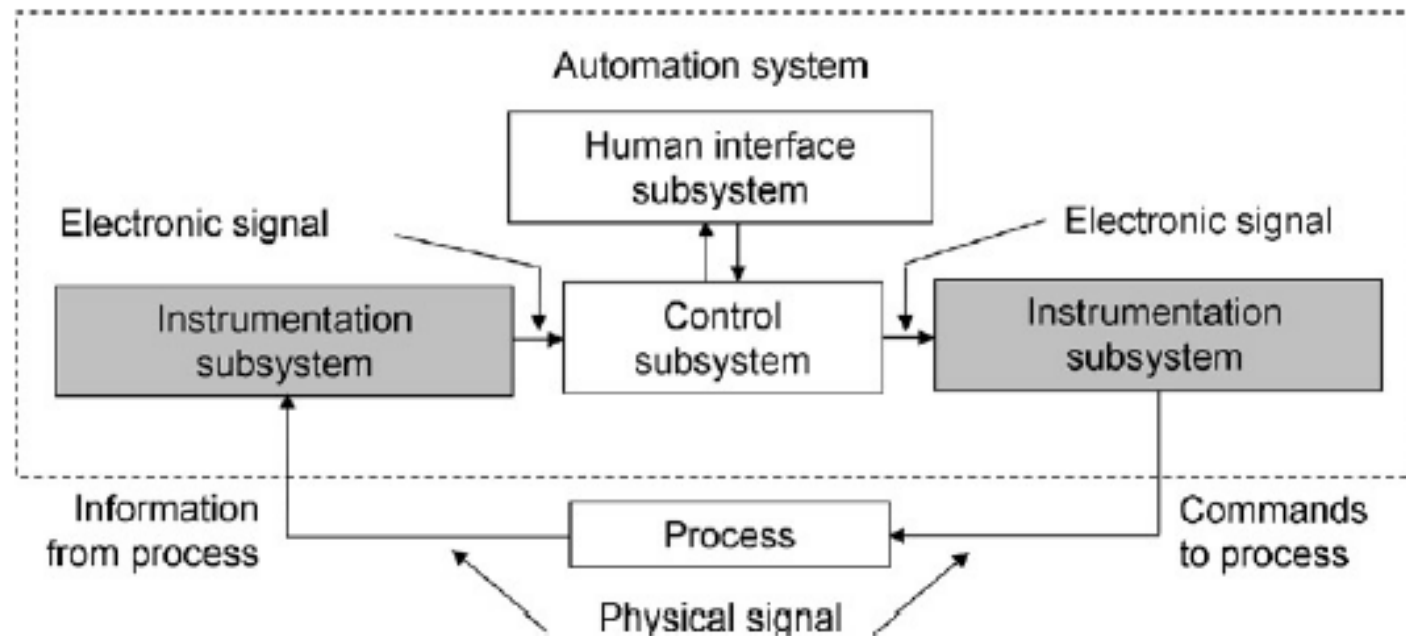
The automation system is divided into three subsystems as follows:

- Instrumentation subsystem
- Human interface subsystem
- Control subsystem



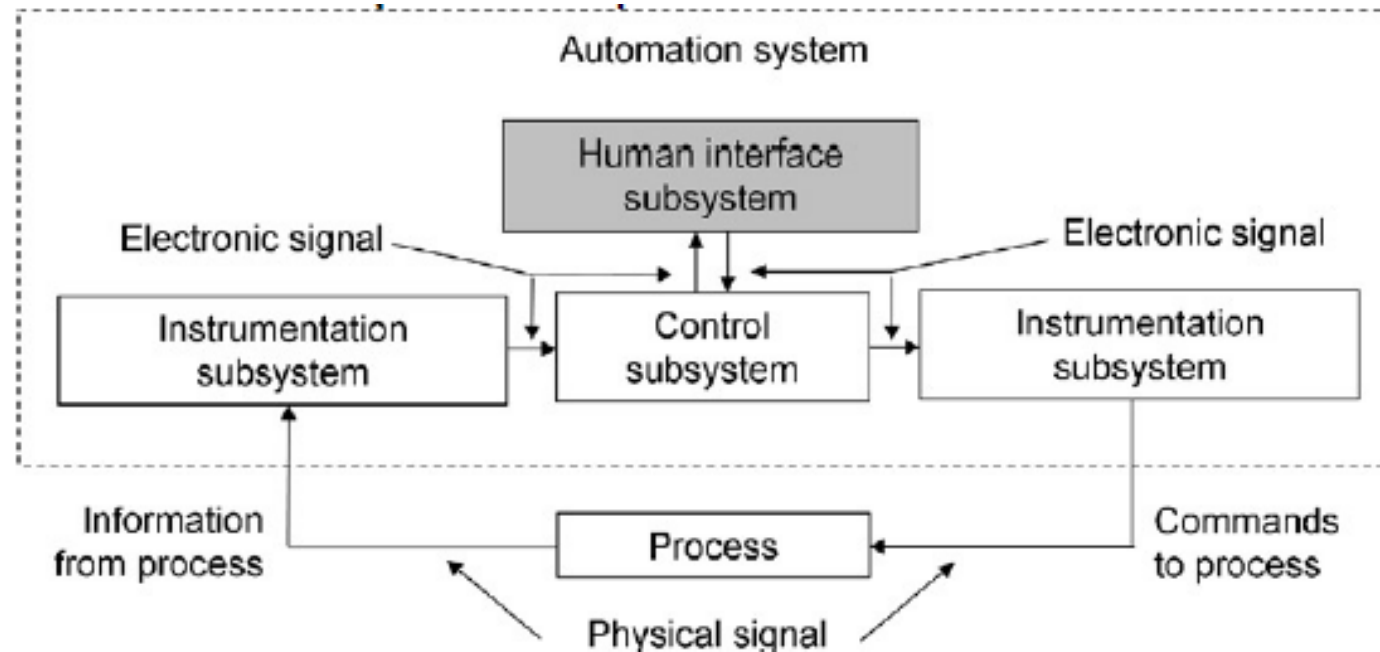
Instrumentation Subsystem

- An instrumentation subsystem acquires information on the behaviour of the process (through measurement of the process parameters) and sends this to the control subsystem in an acceptable form.
- In the other direction, the instrumentation subsystem sends the information to the process in an acceptable form to change the behaviour of the process (control of process parameters).



Human Interface Subsystem

- The human interface subsystem, also called human-machine interface (HMI) or man-machine interface (MMI) or human-system interface (HSI), is the means by which the users or operators manually interact with the process.
- The human interface subsystem allows the operator to manually interact with the process. The operator may observe and monitor what is happening inside the processor issue manual commands, if required, to force a change in the process behaviour.

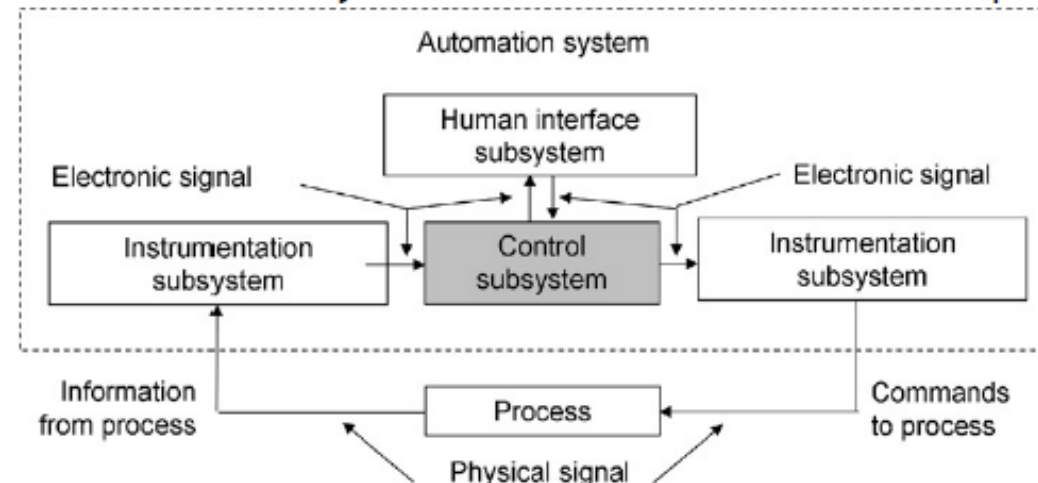


Control Subsystem

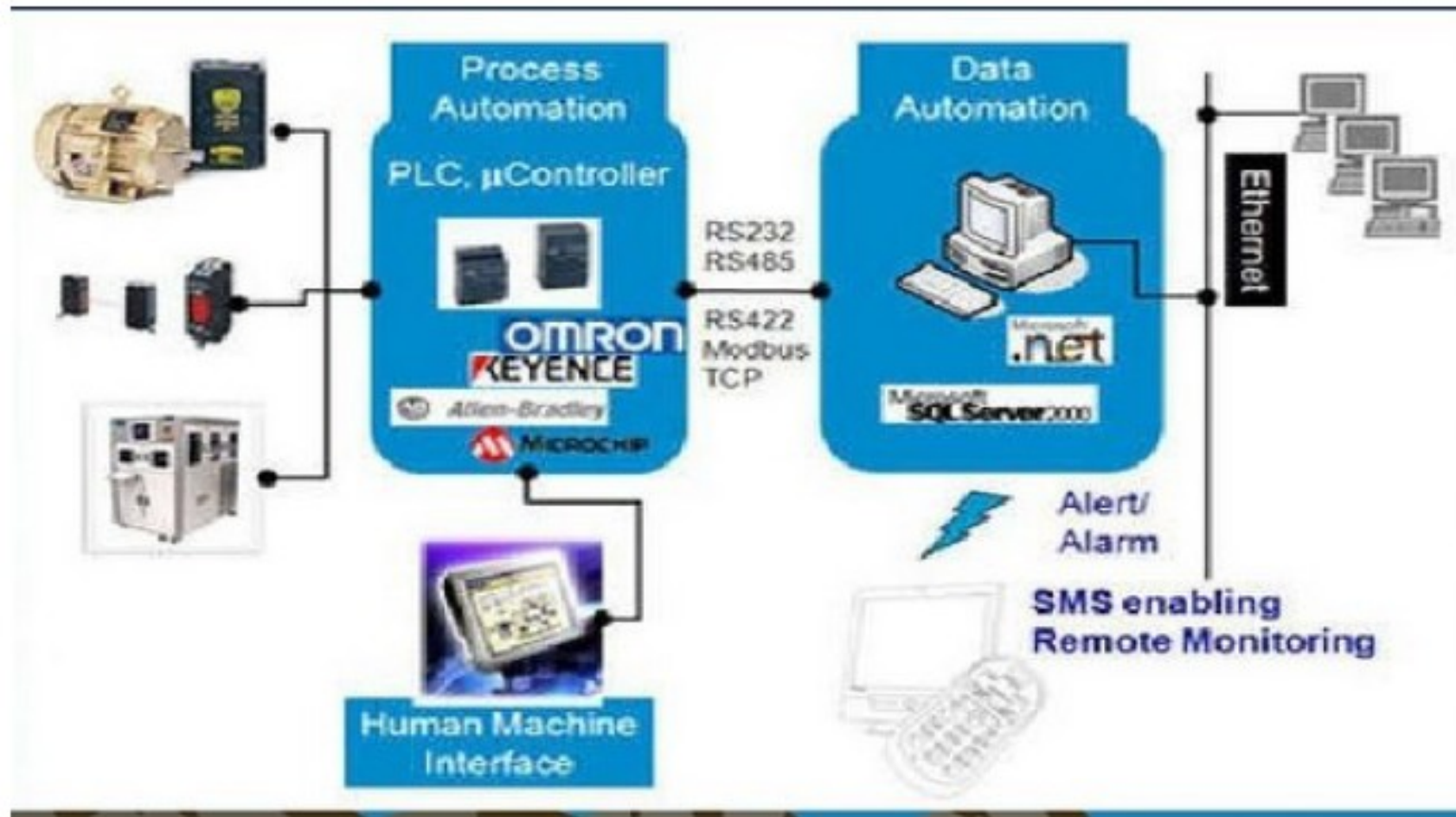
Control subsystem is the heart of automation system and performs the following functions:

- With instrumentation subsystem:
 - Acquires information continuously via instrumentation on the behaviour of the process.
 - Compares the received information with the desired behaviour of the process.
 - Decides on actions on whether or not to issue commands for correcting the behaviour of the process.
- With the human interface subsystem:
 - Acquires the information continuously from the human interface subsystem.
 - Routes the received information to the process for control via instrumentation.
 - Collects the information from the process and routes it to the human interface subsystem for display.

To sum up, the control subsystem manages the information flow to and from the instrumentation subsystem for process monitoring and control, and to and from the human interface subsystem for manual interaction with the process.



The Concept of Automation



Programmable Logic Controller

✍ *Programmable Logic Controller (PLC)* is an industrial computer that *monitors inputs, makes decisions* based on its program and *controls outputs* to automate a process or machine.



✍ The automation of many different processes, such as controlling machines or factory assembly lines, is done through the use of small computers called a **programmable logic controllers (PLCs)**.