Basic Mechatronics Workshop

Module 1:Introduction to Mechatronics

Lecture-1

Introduction to Mechatronics

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Module 1:Introduction to Mechatronics

Module Objectives

Upon completion of this module, Student should be able to

1. Explain what is a mechatronic.
2. List the components of a mechatronic system
3. Give examples of real-world mechatronic systems
4. Give an overview of the topics covered in the text
5. Understand the basic features and configurations of mechatronic control systems.
6. Understand the basic Electrical, Pneumatics and Hydraulic symbols
7. Read the basic mechatronic circuits drawings.
8. Use the Control Simulation Software for mechatronics applications.

Module 1:Introduction to Mechatronics

Module Task

1. Install the ELCO Lab
2. Recognize the basic functions of ELCO Lab
3. Recognize the list of Components in the ELCO Lab.
4. Use ELCO Lab to draw simple electrical circuits.
5. Change properties of component in the ELCO Lab.
6. Run the simulation mode on the ELCO Lab.
7. Use measurements instrument to check the circuit ELCO Lab.
8. Exercises.

Lecture-1

Introduction to Mechatronics

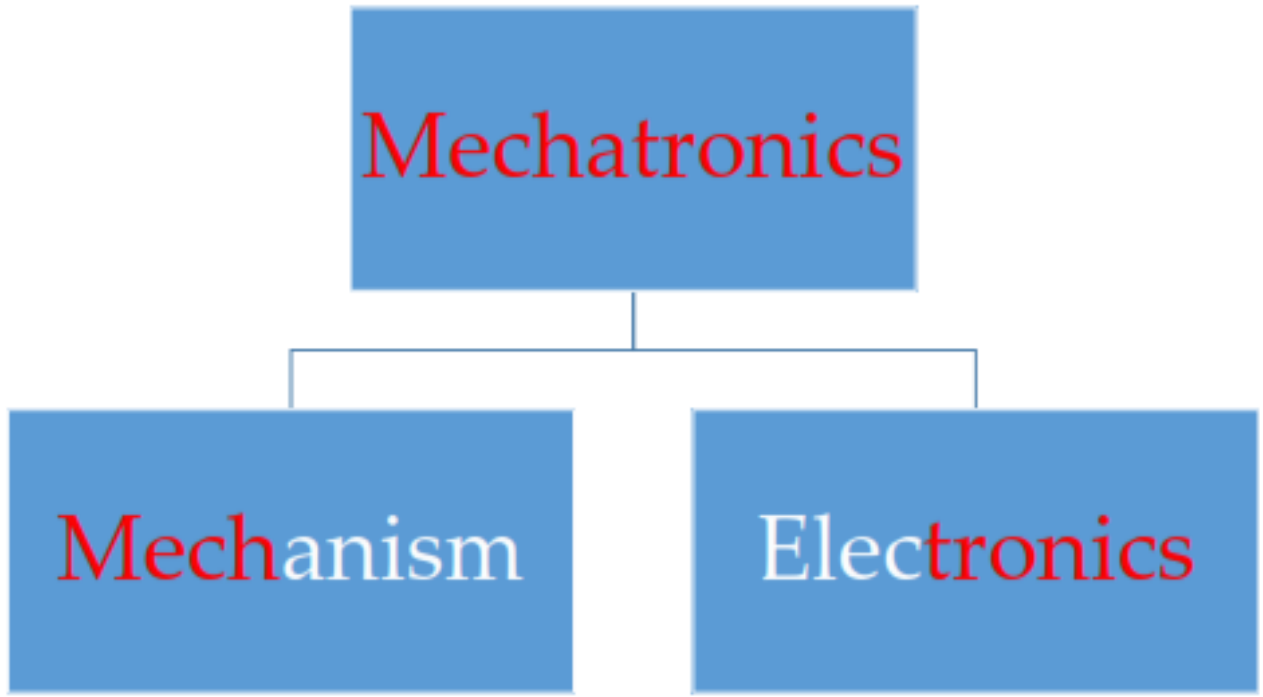
Objectives

Upon completion of this chapter, Student should be able to

1. Understand the mechatronics concepts.
2. understand the key elements of mechatronics systems.
3. Relate with everyday examples of mechatronics systems.
4. Appreciate how mechatronics integrates knowledge from different disciplines in order to realize engineering and consumer products that are useful in everyday life.
5. Define the main components of the mechatronic and control system.
6. Describe the control simulation software for mechatronics applications.

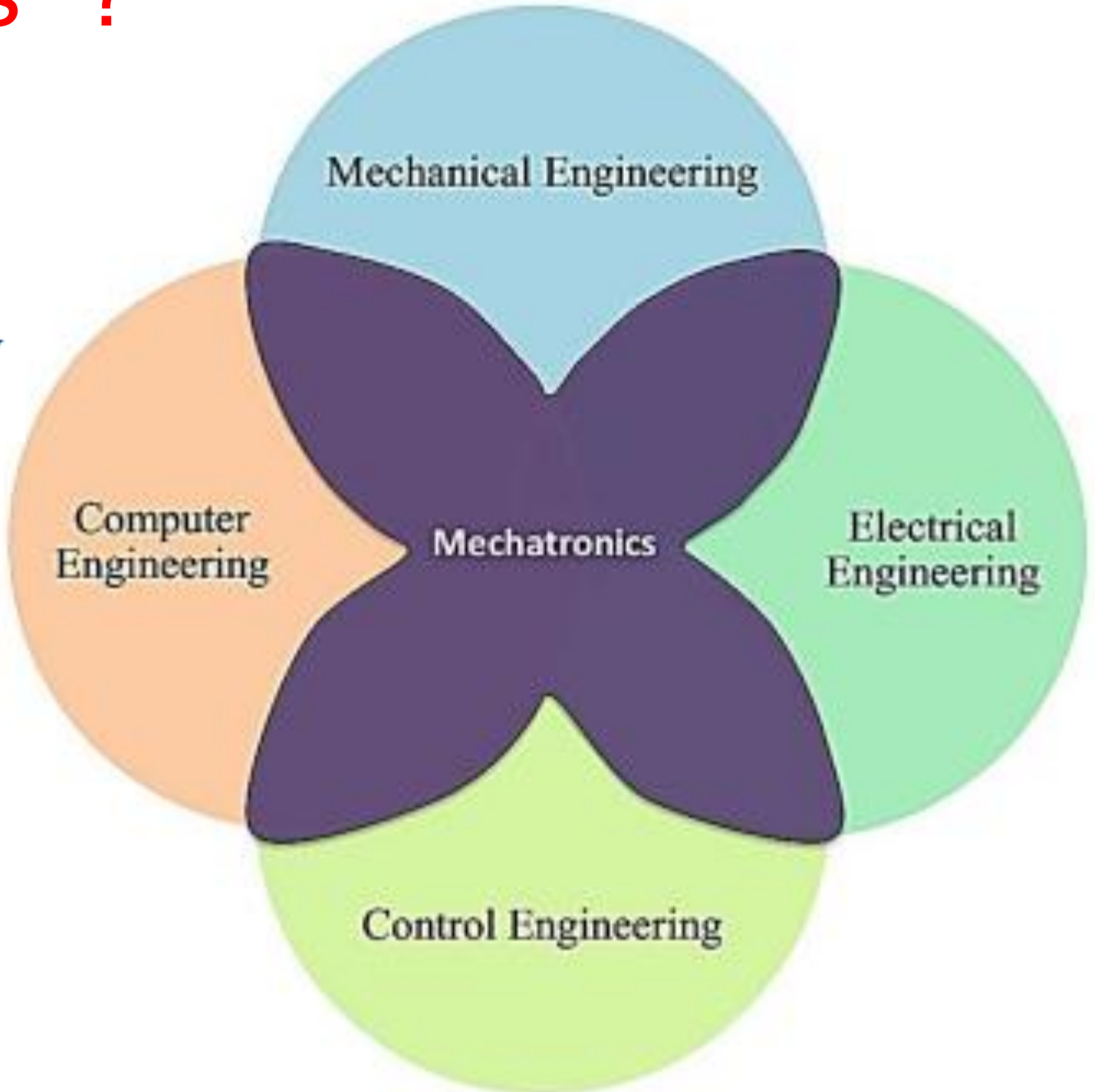
What is “Mechatronics” ?

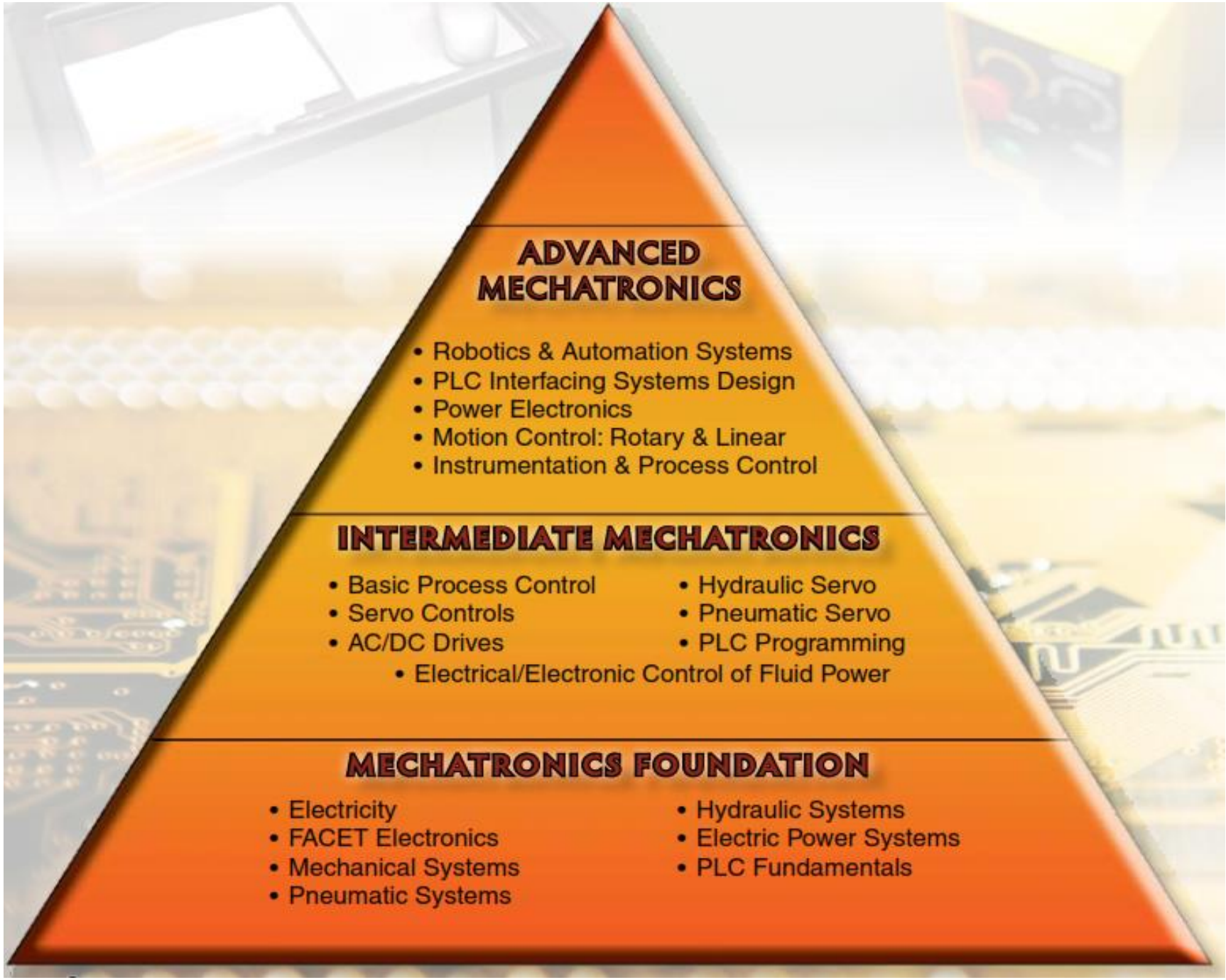
- Mechatronics is a concept of *Japanese* origin (1970’s) and can be defined as the application of electronics and computer technology to control the motions of mechanical systems.



What is “Mechatronics” ?

- It involves application of electrical, mechanical, control and computer engineering to develop products, processes and systems with greater flexibility, ease in redesign and ability of reprogramming.




ADVANCED MECHATRONICS
• Robotics & Automation Systems
• PLC Interfacing Systems Design
• Power Electronics
• Motion Control: Rotary & Linear
• Instrumentation & Process Control
INTERMEDIATE MECHATRONICS
• Basic Process Control
• Servo Controls
• AC/DC Drives
• Hydraulic Servo
• Pneumatic Servo
• PLC Programming
• Electrical/Electronic Control of Fluid Power
MECHATRONICS FOUNDATION
• Electricity
• FACET Electronics
• Mechanical Systems
• Pneumatic Systems
• Hydraulic Systems
• Electric Power Systems
• PLC Fundamentals

Introduction to Mechatronics

- Mechatronics can also be termed as replacement of mechanics with electronics or enhance mechanics with electronics.
- For example, in modern automobiles, mechanical fuel injection systems are now replaced with electronic fuel injection systems.
- This replacement made the automobiles more efficient and less pollutant.
- With the help of microelectronics and sensor technology, mechatronics systems are providing high levels of precision and reliability.

Mechatronics Systems in our daily life

Tools

Computers

Cars

Stealth Bomber

MEMS

Consumer Electronics

High Speed Trains

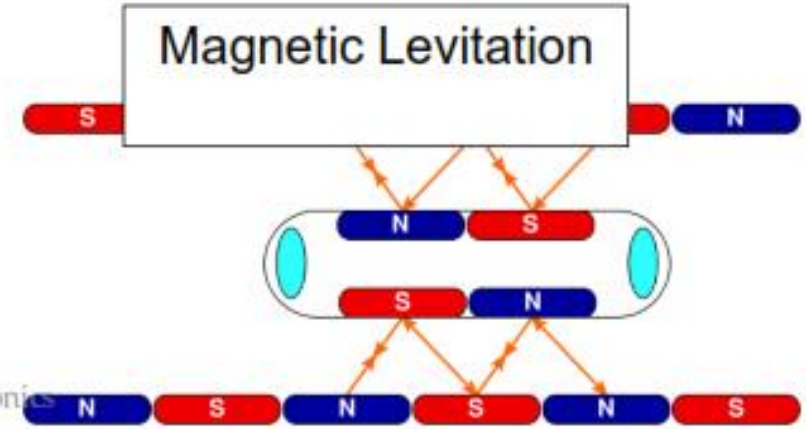
Transportation Applications

High Speed Trains

- Train Position and Velocity constantly monitored from main command center.
- Error margin in scheduling no more than 30 seconds
- Fastest trains use magnetic levitation

JR-Maglev
Top Speed: 574 km/h (357 mph)
Country: Japan

Transrapid
Top Speed: 550 km/h (340 mph)
Country: German



Transportation Applications

Systems Uses

- Tilt and pressure sensors
- Microcontroller
- Motors
- Onboard power source

Segway

Advantages

Simple and intuitive personal transportation device

Smart Robotics Application

BigDog

System Can

- Carry 340 lb
- Run 4 mph
- Climb, run, and walk
- Move over rough terrain

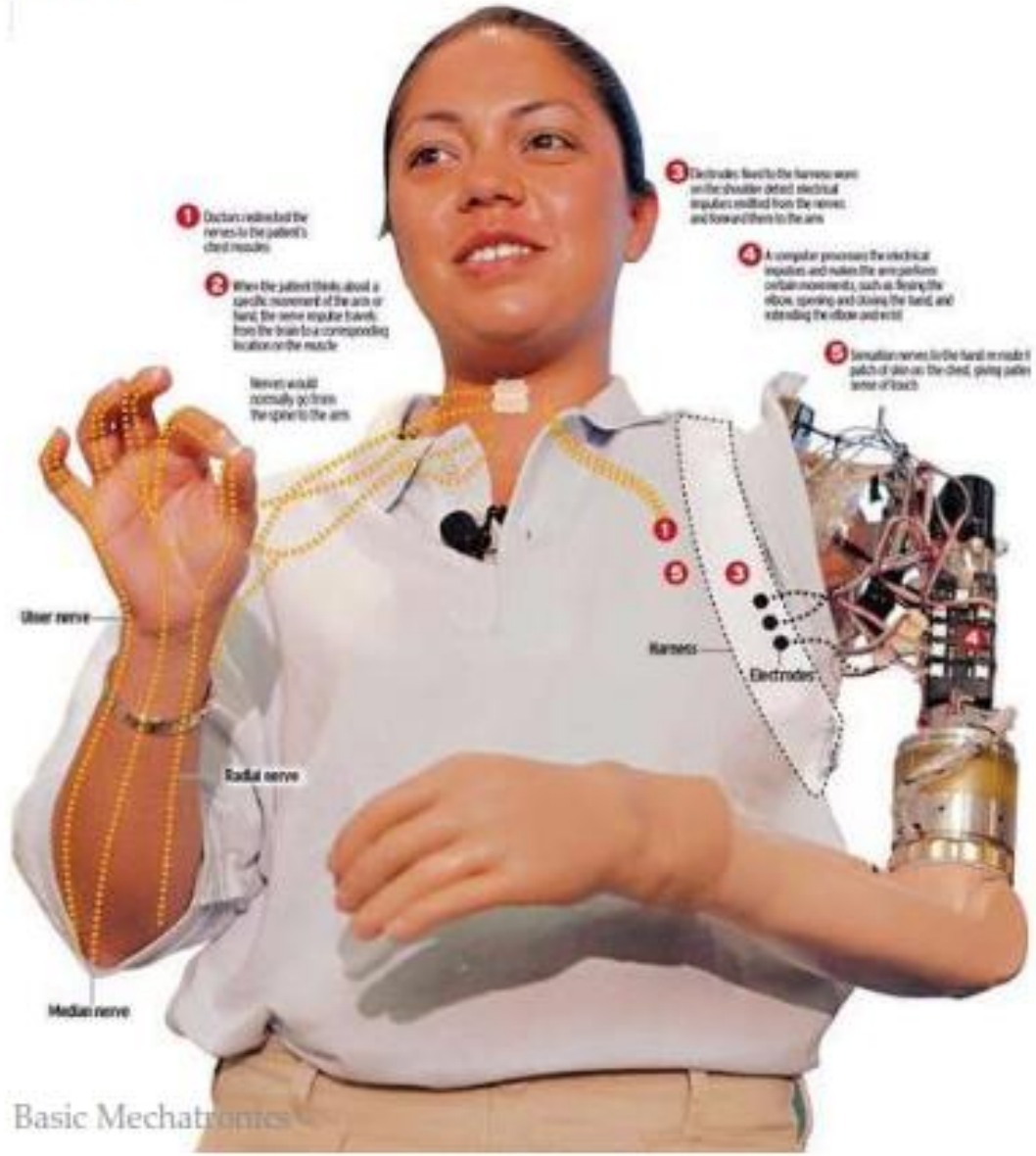
Advantages

Robot with **rough-terrain mobility** that could carry equipment to remote location.

Medical Applications

Prosthetics

Arms, Legs, and other body parts can be replaced with electromechanical ones.



Defense Applications

- Advanced technology is making our soldiers safer.
- Some planes can now be flown remotely.

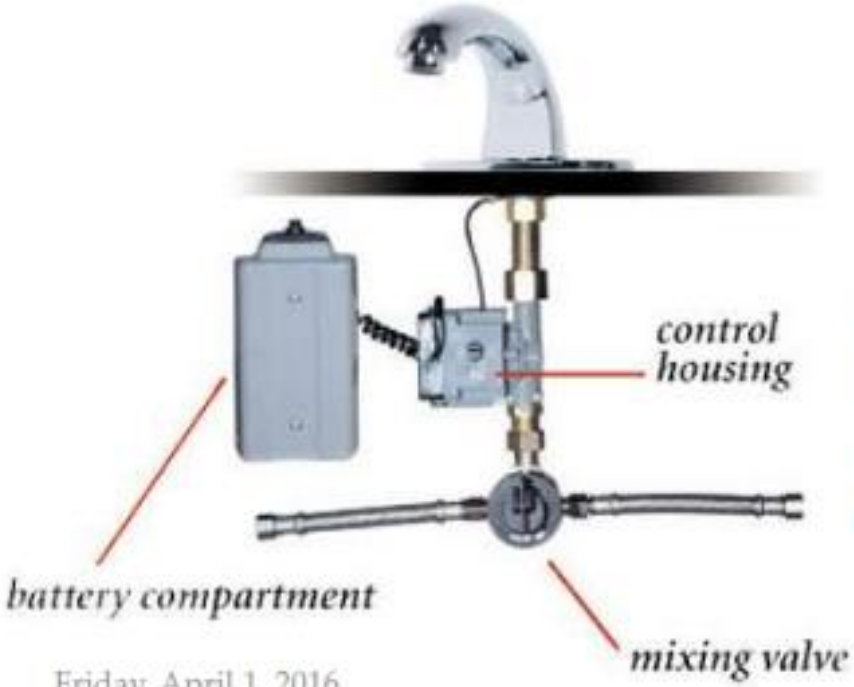
Unmanned Aerial Vehicle

Stealth Bomber

Sanitation Applications

System Uses

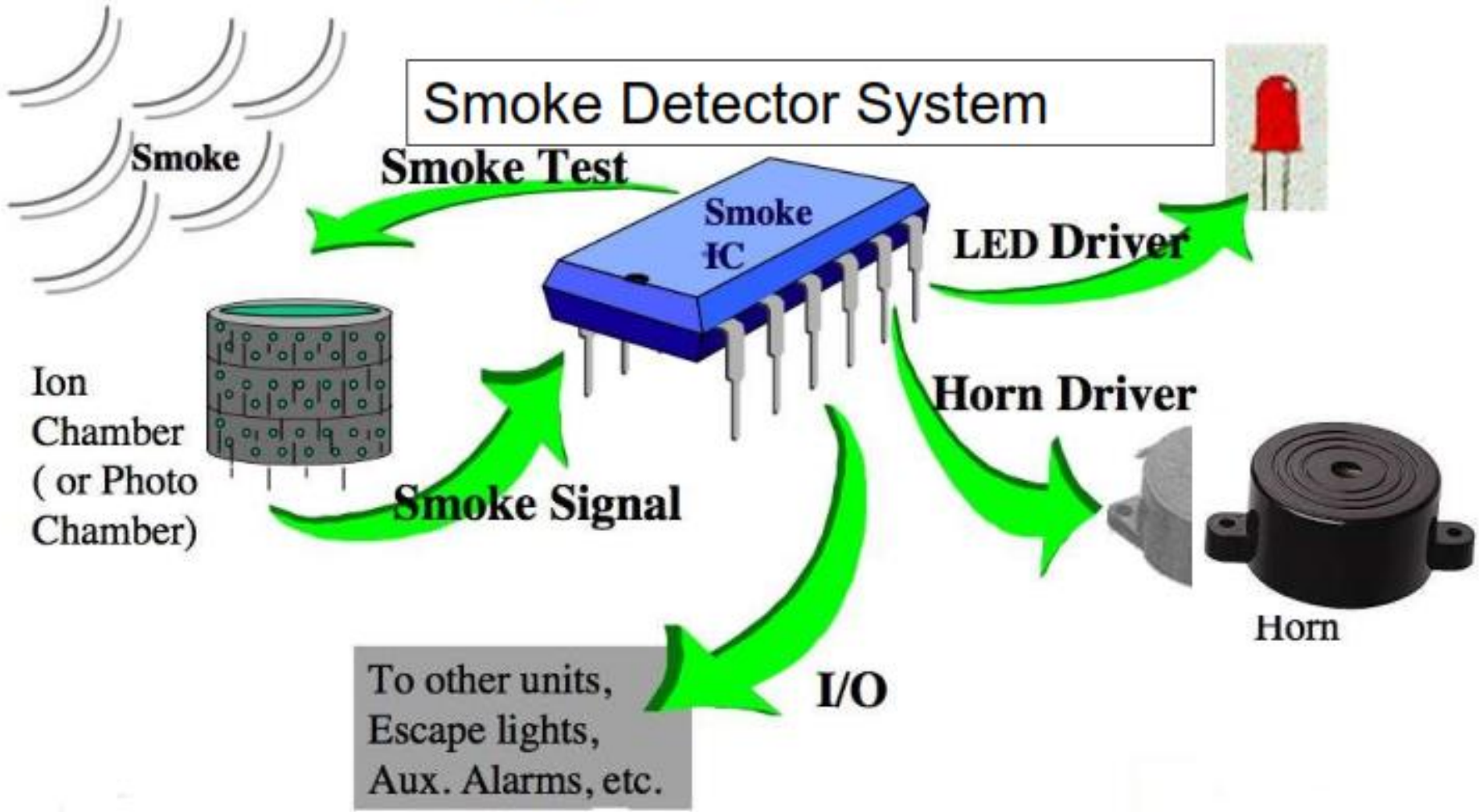
- Proximity sensors
- Control circuitry
- Electromechanical valves
- Independent power source



Advantages

- **Reduces spread of germs** by making device hands free
- **Reduces wasted water** by automatically turning off when not in use

Smart Home Applications



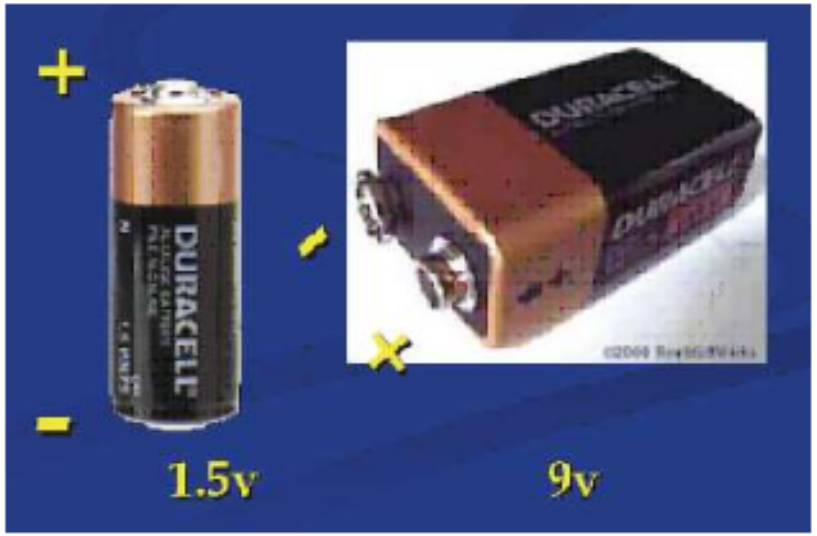
WHAT IS A CONTROL ??

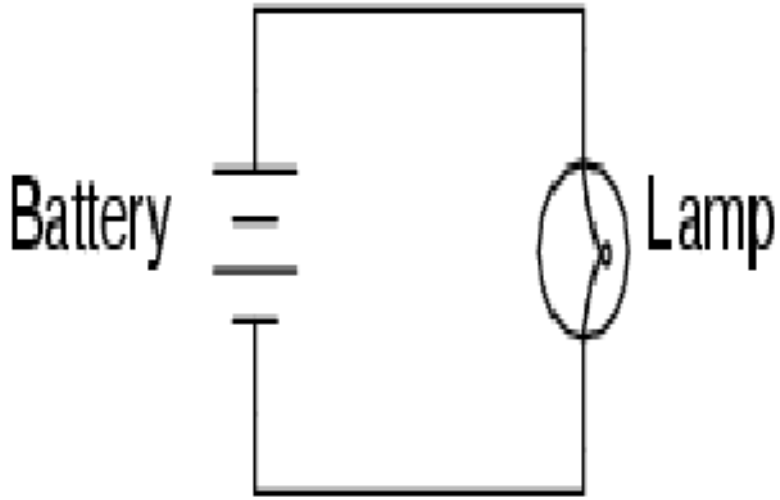
Control means to make an out put ON or OFF by help of Controlling Devices like simple toggle switch to a complex system with components such as relays, timers, and switches.

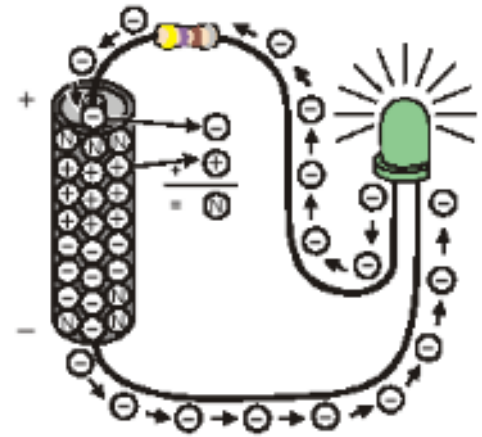
TYPES OF CONTROL

- 1) On-Off control,
- 2) Sequential control,
- 3) Feedback control, and
- 4) Motion control.

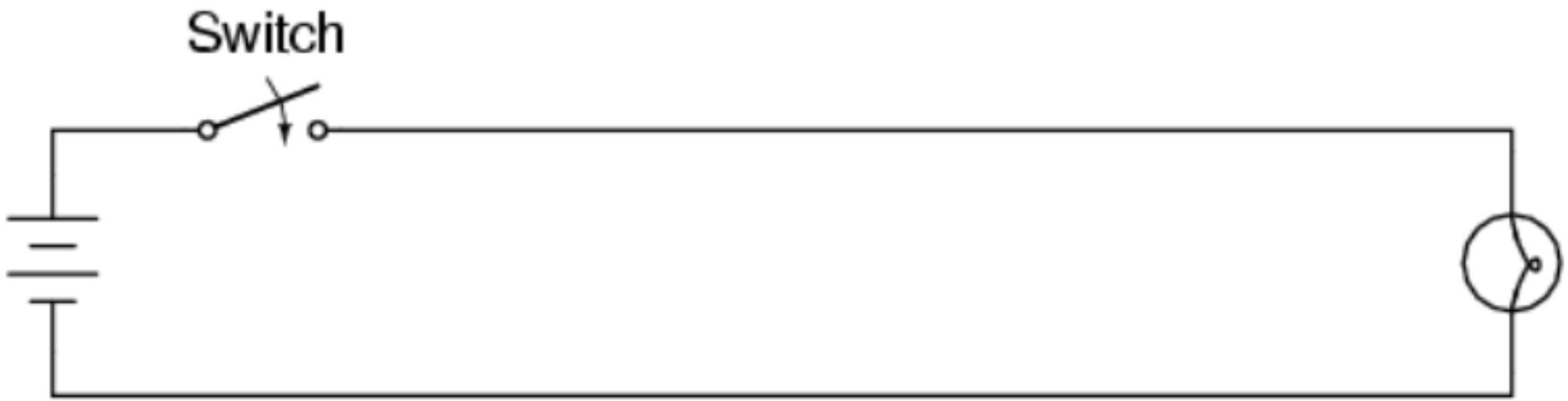
EXAMPLE OF
AN UNCONTROLLED CIRCUIT.







A CONTROLLED CIRCUIT

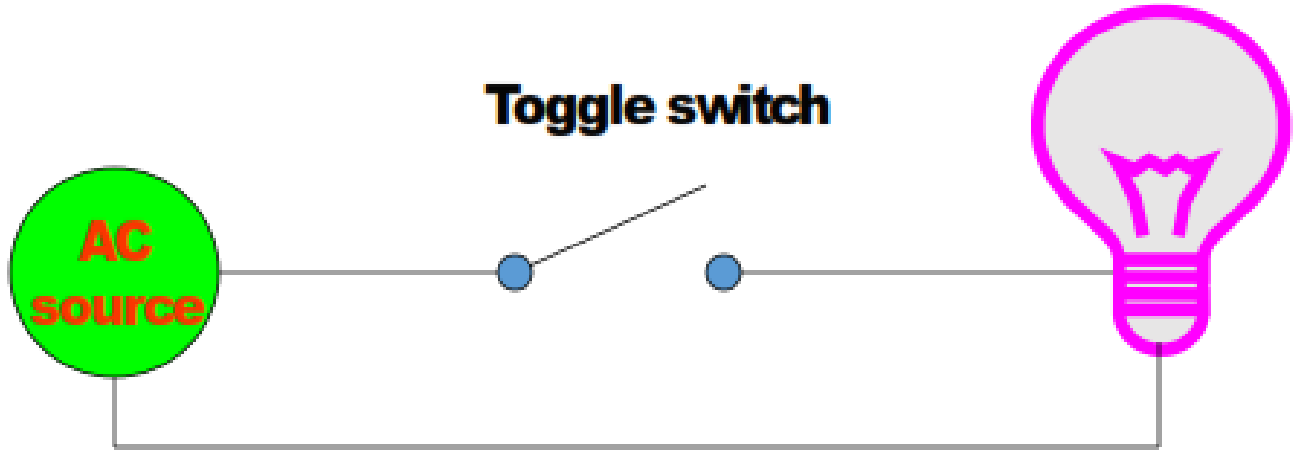


MANUAL CONTROL AND AUTOMATIC CONTROL

- Control circuits may require
- Manual control
- Automatic control
- or
- Combination of both.

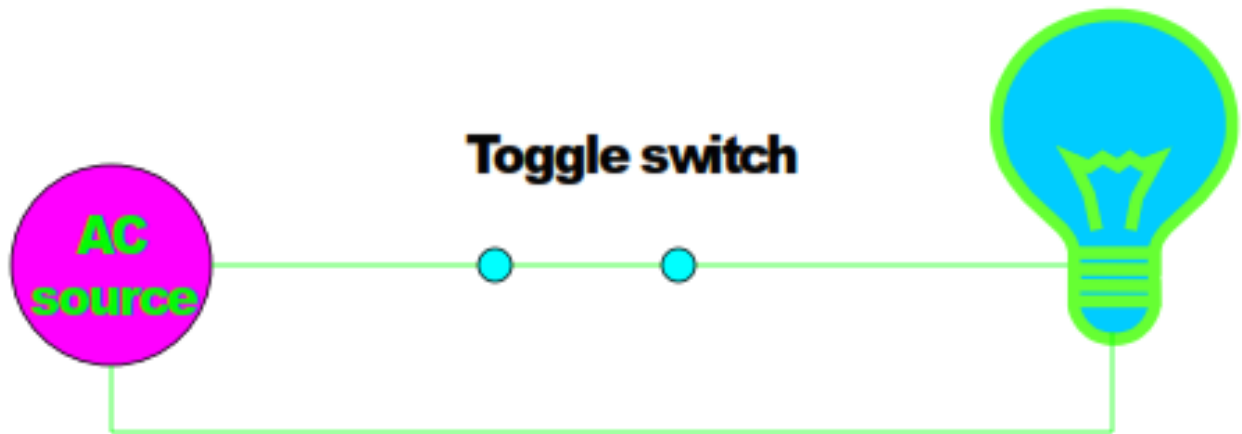
EXAMPLE OF MANUAL CONTROL

Manual Control circuits use components that require human interaction in order to operate.



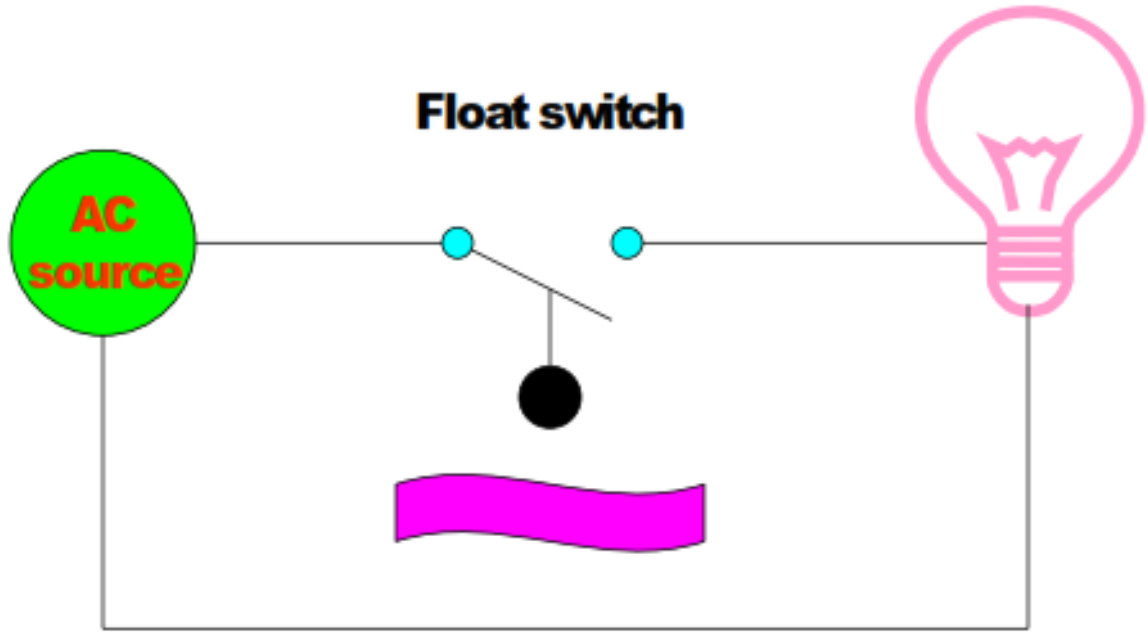
EXAMPLE OF MANUAL CONTROL

After the toggle switch is made on manually the bulb gets ON.



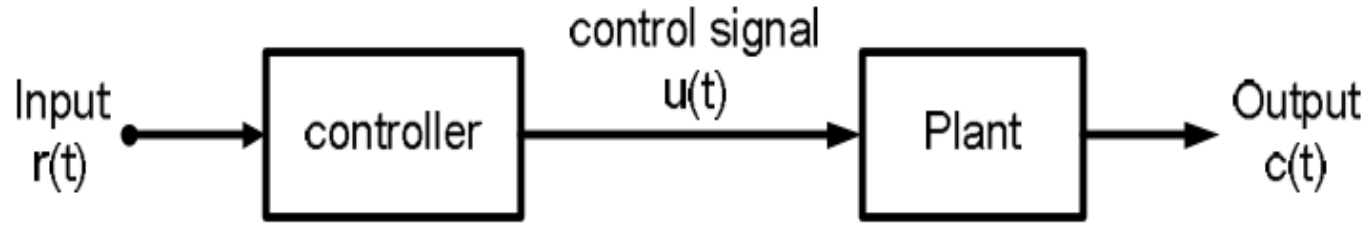
EXAMPLE OF AUTOMATIC CONTROL

Automatic control circuits can operate themselves without the need for human interaction.

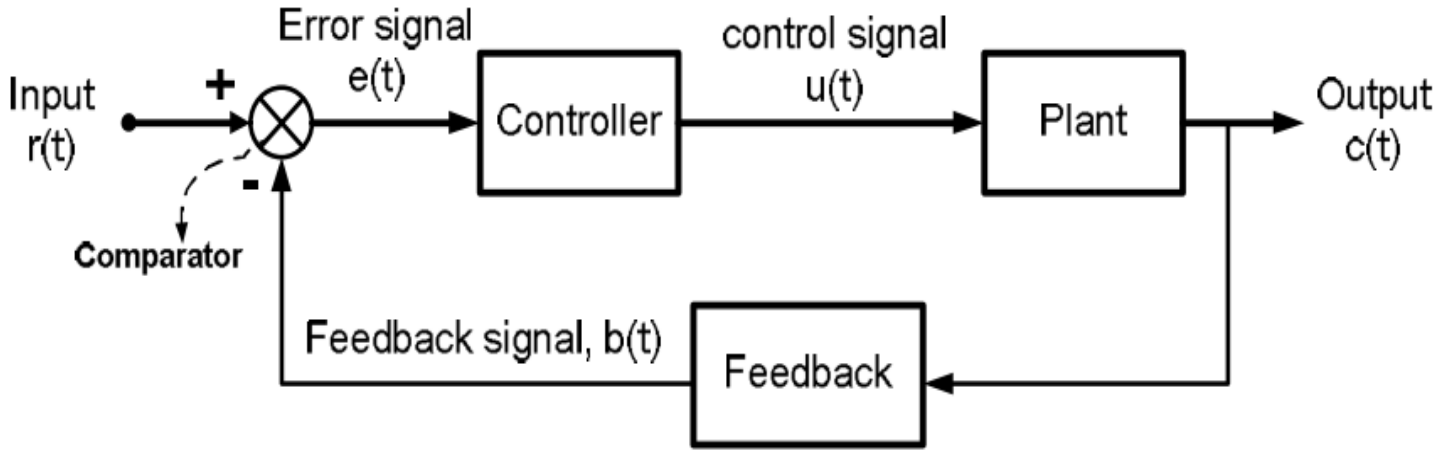


control loop systems

Open-loop control system

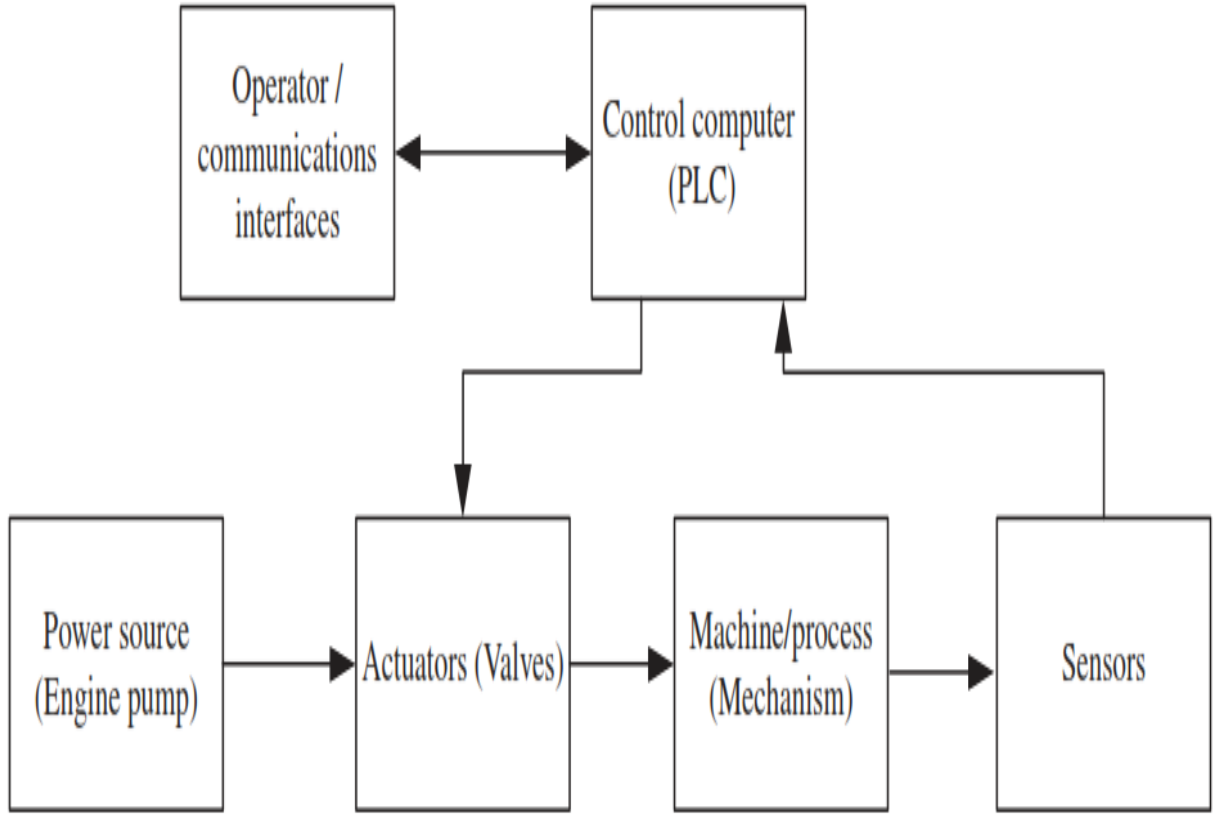


Closed-loop control system



Mechatronics system

- A Mechatronics system integrates various technologies involving
- Sensors & Measurement systems,
- Drives & Actuation systems *(Mechanical /Pneumatics /Hydraulics),*
- Controlling system *(microprocessor / microcontroller /PLC)* and software engineering.



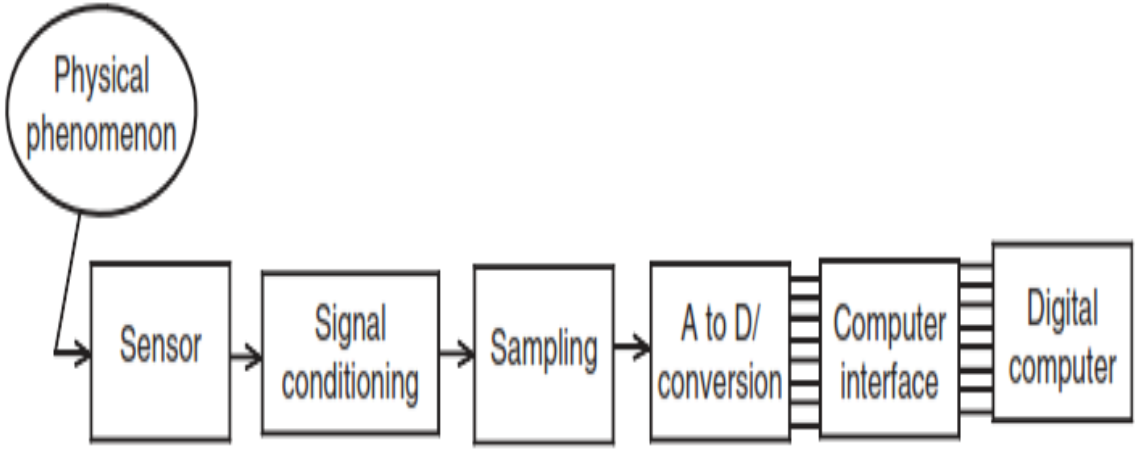
Sensors and Actuators

- **Sensor**

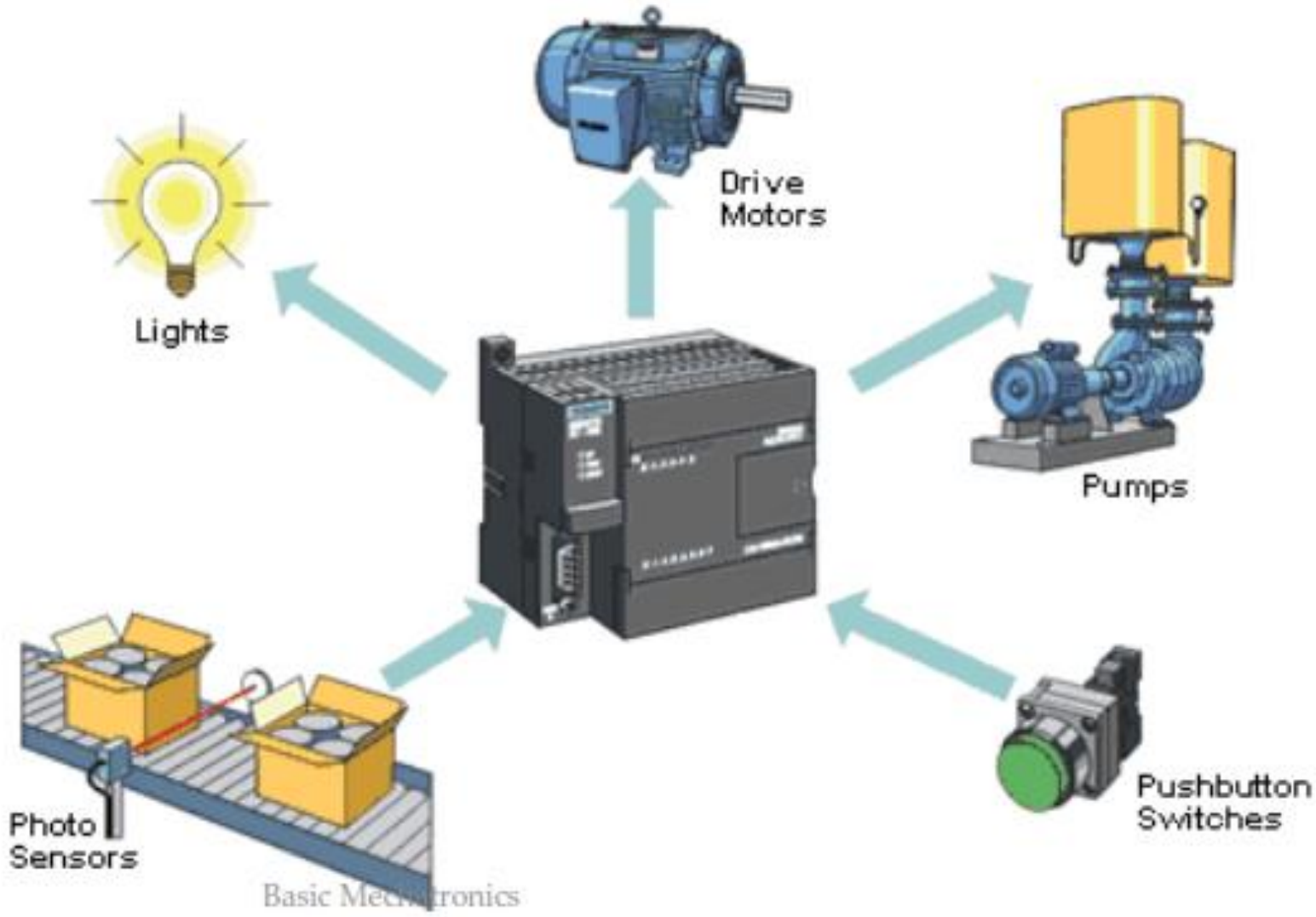
  A device that converts an environmental condition into an electrical signal.
- **Actuator**

  A device that converts a control signal (usually electrical) into mechanical action (motion).

Sensors

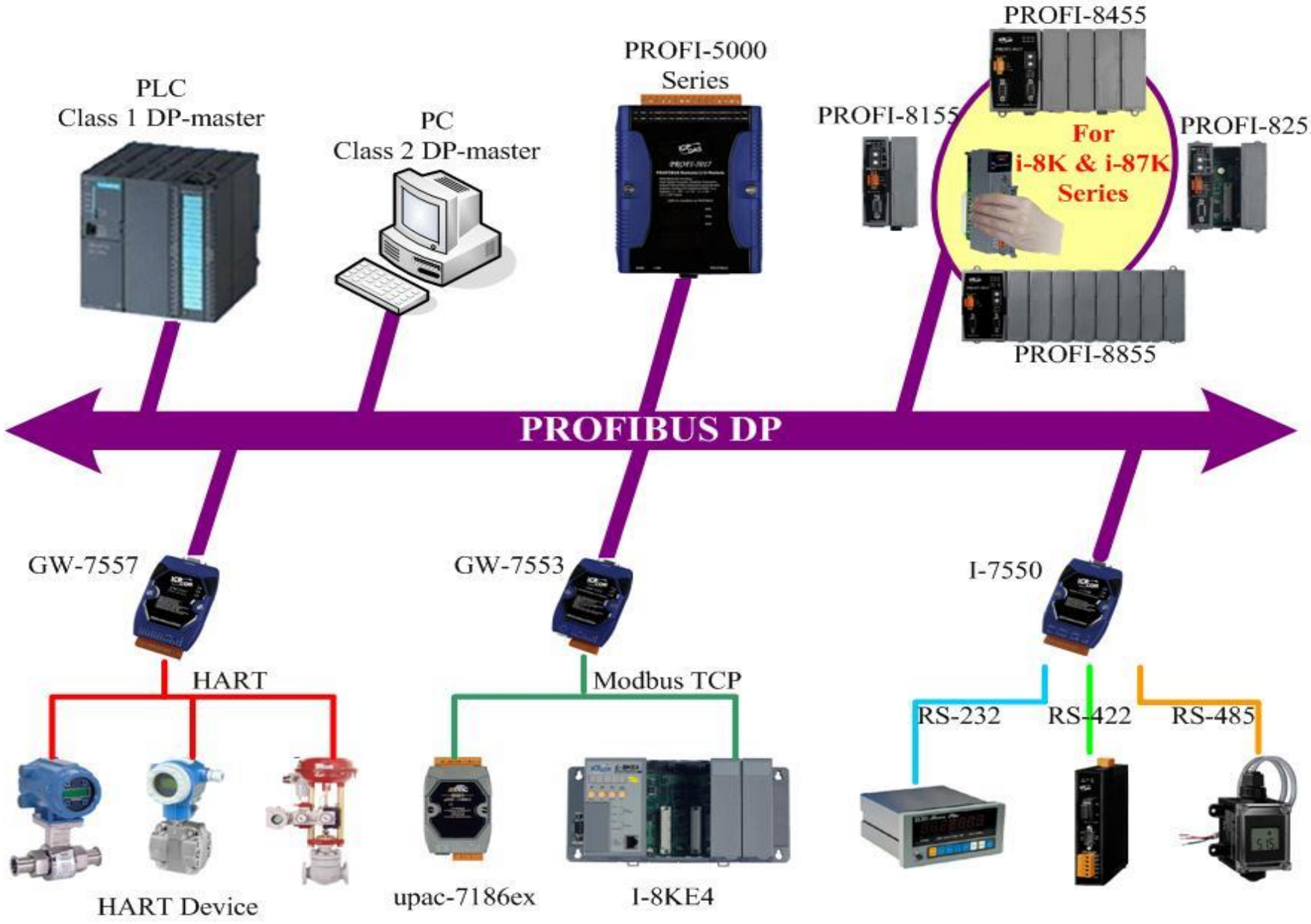

Physical phenomenon
Sensor
Signal conditioning
Sampling
A to D/ conversion
Computer interface
Digital computer

PLCs (Programmable Logic Controllers)

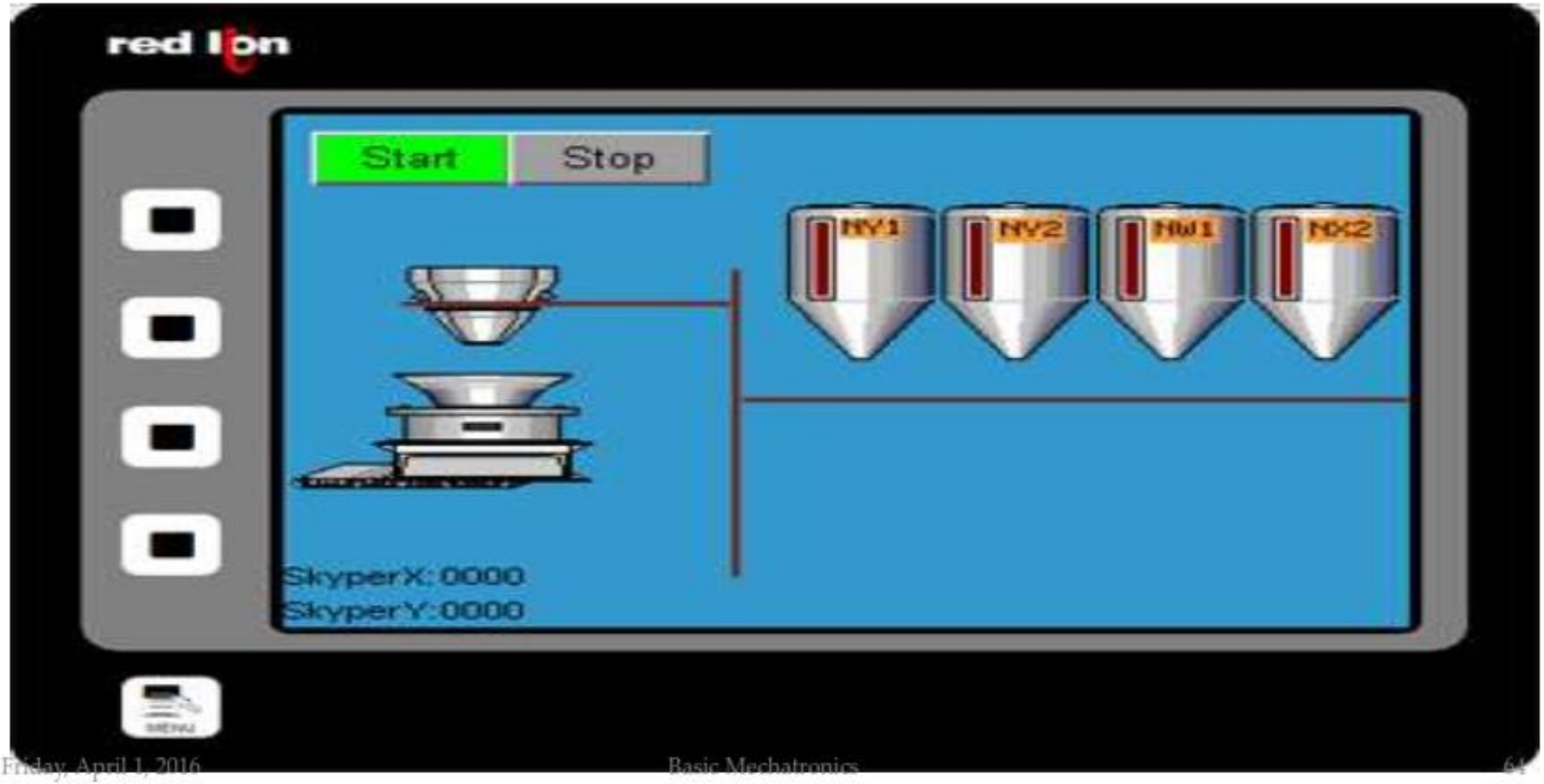


Communication (Fieldbus)

PROFIBUS (PROCESS FIELD BUS) which is anchored in the international standards IEC 61158 and IEC 61784 is an open, digital communication system with a wide range of applications, particularly in the fields of factory and process automation. It is suitable for both fast, time-critical applications and complex communication tasks.



EXAMPLES OF AUTOMATED PLANTS



Control Simulation Software ELCO Lab