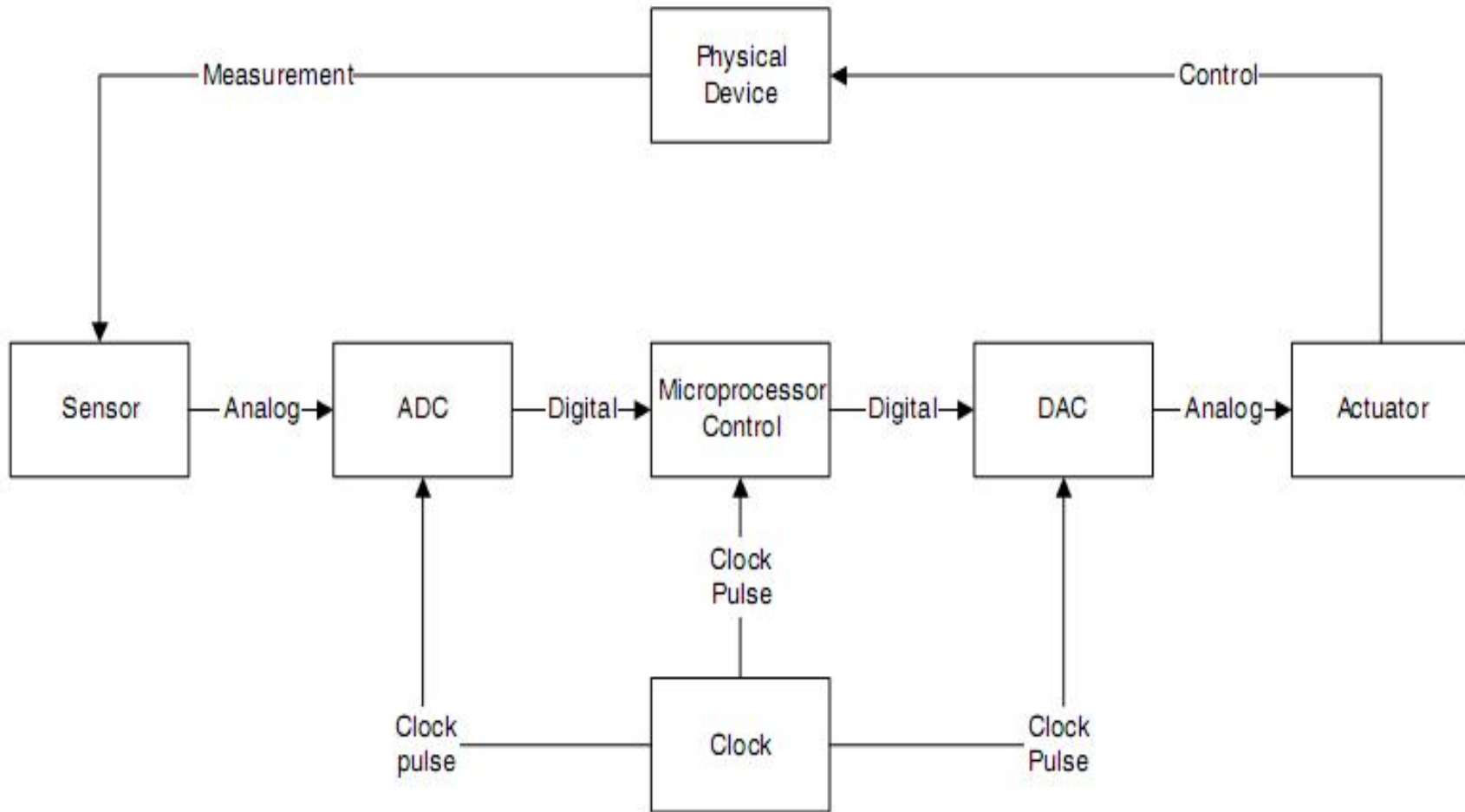


# System Interfacing, Instrumentation, and Control Systems

By:

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# Introduction



# Input Signals of a Mechatronic System

- Transducer / Sensor Input
  - Transducers , devices that convert energy from one form to another.
  - are often used synonymously with sensors.
- Sensors can be divided into 2 general classifications:
  1. Active Sensors
    - Emit a signal in order to estimate an attribute of the environment or device being measured.
  2. Passive sensors – do not

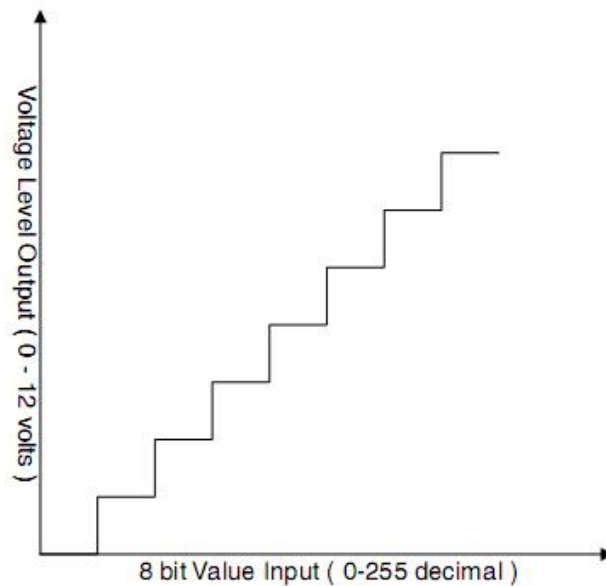
# Input Signals of a Mechatronic System

- Analog-to-Digital Converters
  - The ADC can basically be typed by two parameters:
    1. The analog input range
    2. The digital output range

Binary	Decimal	Voltage
0000 0000	0	0.0
0000 0001	1	0.00390625
1000 0000	128	6.0
1111 1111	255	11.953125

# Output Signals of a Mechatronic System

- Digital-to-Analog Converters
  - The output command from the microcontroller is a binary value in bit, byte (8 bits), or word (16 bits) form.



DAC Stepped

# Output Signals of a Mechatronic System

- Actuator Output

- 3 common actuators

1. Switches

- Relays
    - Solid-state devices (diodes, bipolar transistors, thyristors, field-effect transistors, and metal-oxide field-effect transistors)

2. Solenoids – are devices containing a movable iron core that is activated by a current flow.

3. Motors

- Direct Current (DC)
    - Alternating Current (AC)
    - Stepper motors

# Signal Conditioning

- Signal conditioning is the modification of a signal to make it more useful to a system.
  - Two important types of signal conditioning, the conversion between:
    1. Analog
    2. Digital
- Other types of signal conditioning:
  - Sampling rate
  - Filtering

# Signal Conditioning

Other types of signal conditioning:

1. Sampling rate

- The rate at which data samples are taken obviously affects the speed at which the mechatronic system can detect a change in situation. Say: 8000 samples per second (Nyquist Theorem)

2. Filtering – is the attenuation of certain frequencies from a signal.

- Types of Filters
  - Low-Pass Filter
  - High-Pass Filter
  - Band-Pass Filter
  - Band-Stop Filter

# Microprocessor Control

- Types
  1. PID Control
    - Proportional Integral Derivative
    - Control system can use P, PI, PD, or PID in creating corrective actions. The problem generally is “tuning” the system by selecting the proper values on the terms.
  2. Programmable Logic Controllers
    - PLC is a simpler, more rugged microcontroller designed for environments.
  3. Microprocessors

# Microprocessor Numerical Control

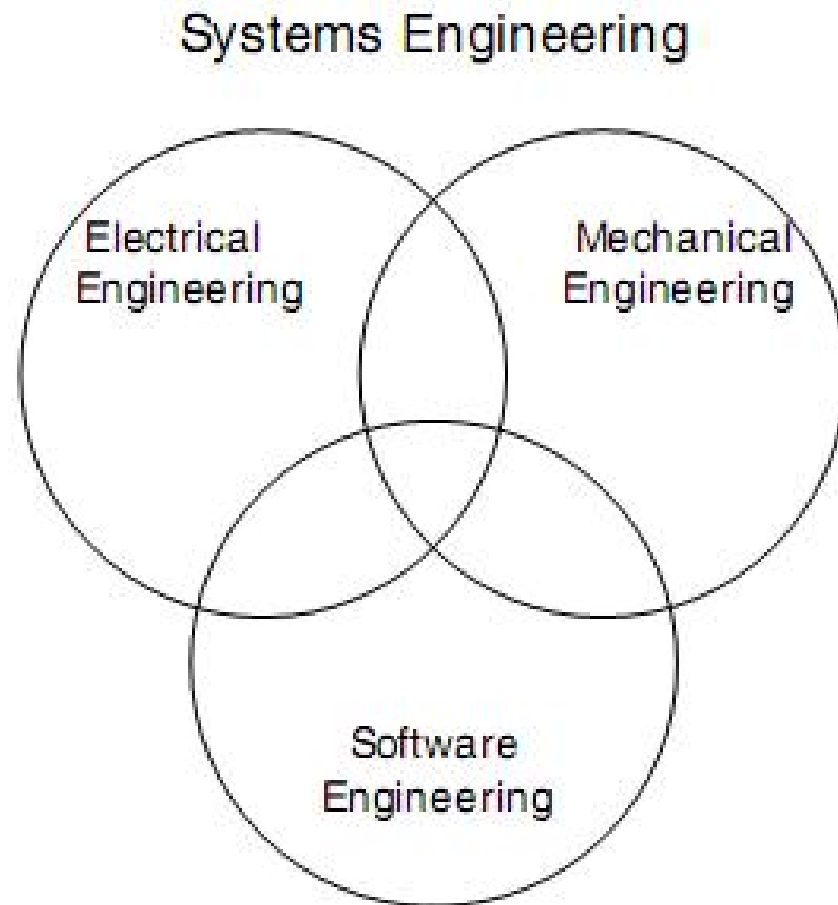
- Fixed-Point Mathematics
  - a special type of arithmetic whereby microcontrollers use integers in place of floating-point numbers to compute non-whole number values.
- Calibrations
  - The area of calibrating a system can sometimes take on an importance not foreseen when designing a mechatronic system. The use of calibrations, numerical and logical values kept in EEPROM or ROM, allow flexibility in system tuning and implementation.

# Microprocessor Input-Output Control

- Polling and Interrupts
  - These are the two basic methods for the microprocessor to control input and output.
- Input and Output Transmission
  - A third way of differentiating data transmission is by direction.
    1. Simplex
    2. Half-duplex
    3. Full-duplex

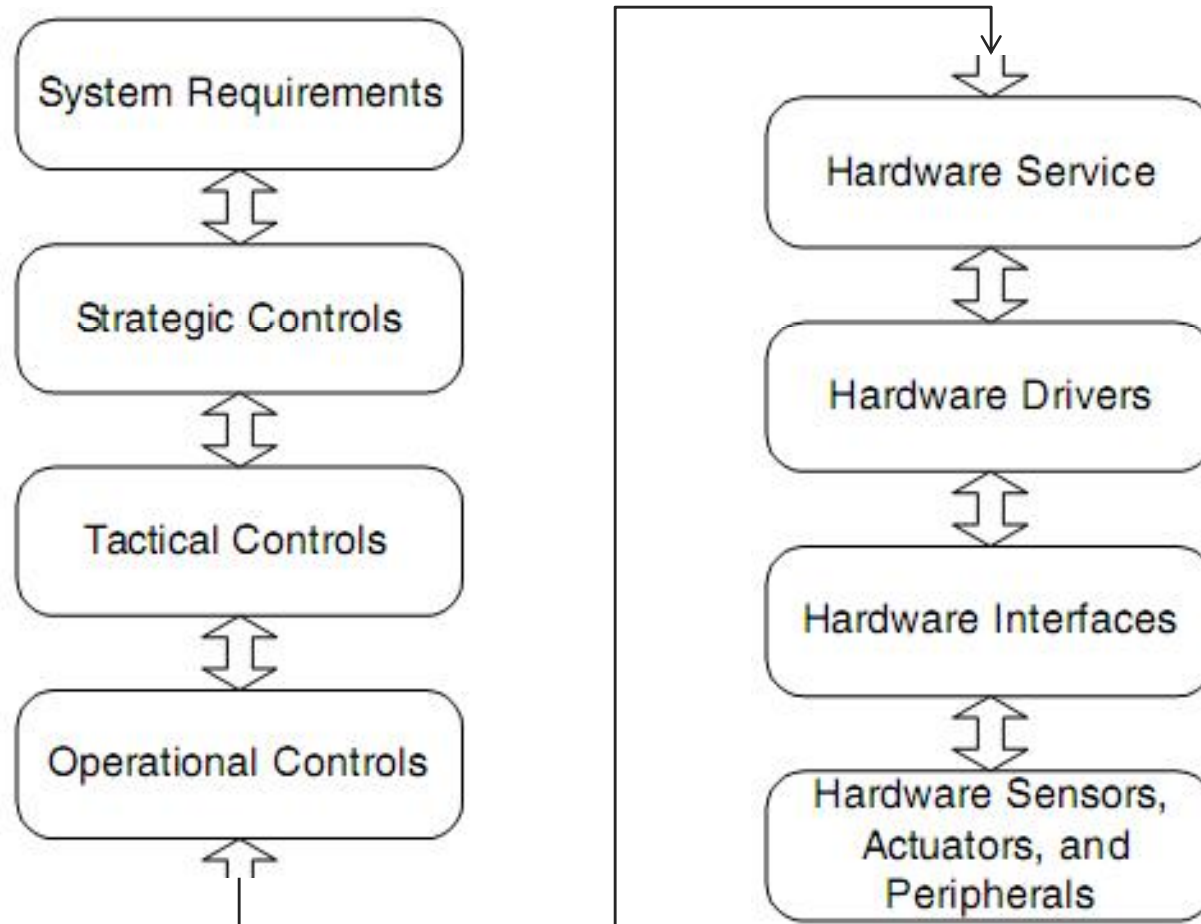
# Software Control

- **Systems Engineering**
  - is the systems approach to the design and development of products and systems.



# Software Control

- Software Design



# Testing and Instrumentation

- Verification and Validation
  - Verification as “building the product right”
  - Validation as “building the right product”
- Debuggers
  - is a software program that allows a view of what is happening with the program code and data while the program is executing.
- Logic Analyzer
  - is a device for nonintrusive monitoring and testing of the microcontroller. It is usually connected to both the microcontroller and a simulator.

