AUTOMATION

CONTENT

1. Introduction
2. Benefits of IoT
3. Application and use of IoT
4. IoT challenges
5. What needs to be done?
6. Top IoT technologies and trends
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8. Q&A

AUTOMATED MANUFACTURING SYSTEMS

Examples:

- Automated machine tools
- Transfer lines
- Automated assembly systems
- Industrial robots that perform processing or assembly operations
- Automated material handling and storage systems to integrate manufacturing operations
- Automatic inspection systems for quality control

AUTOMATED MANUFACTURING SYSTEMS

Three basic types:

1. Fixed automation
2. Programmable automation
3. Flexible automation

CHAPTER 4: INTRODUCTION TO AUTOMATION

Sections:

1. Basic Elements of an Automated System
2. Advanced Automation Functions
3. Levels of Automation

AUTOMATION DEFINED

Automation is the technology by which a process or procedure is accomplished without human assistance.

Basic elements of an automated system:

1. Power - to accomplish the process and operate the automated system
2. Program of instructions – to direct the process
3. Control system – to actuate the instructions

POWER TO ACCOMPLISH THE AUTOMATED PROCESS

Power for the process

- To drive the process itself
- To load and unload the work unit
- Transport between operations

Power for automation

- Controller unit
- Power to actuate the control signals
- Data acquisition and information processing

PROGRAM OF INSTRUCTIONS

Set of commands that specify the sequence of steps in the work cycle and the details of each step.

Example: NC part program.

During each step, there are one or more activities involving changes in one or more process parameters.

- Examples:
  - Temperature setting of a furnace
  - Axis position in a positioning system
  - Motor on or off

DECISION-MAKING IN A PROGRAMMED WORK CYCLE

Following are examples of automated work cycles in which decision making is required:

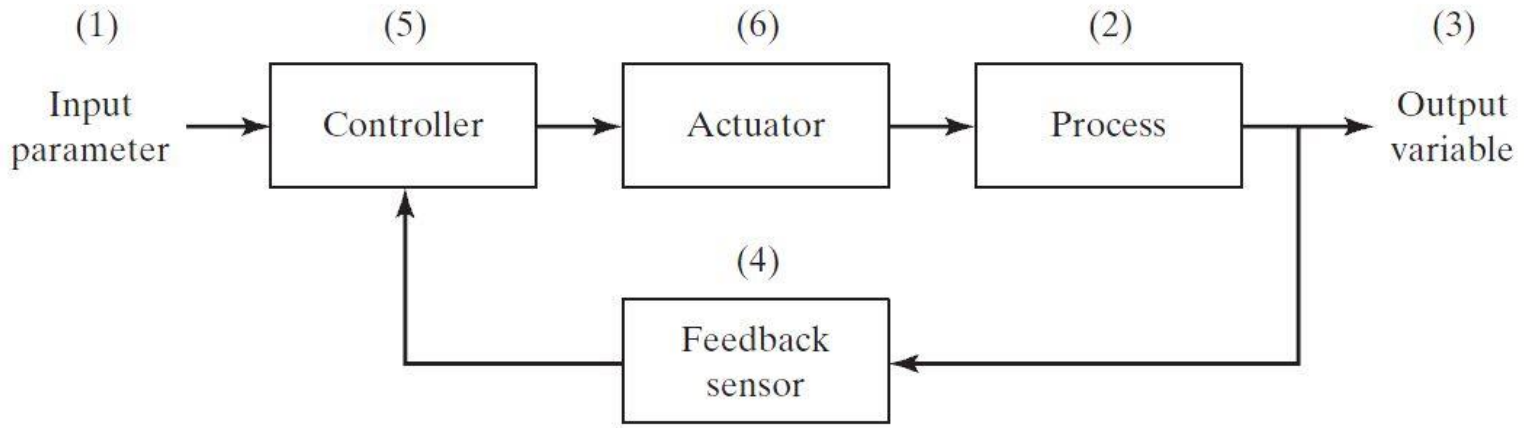
- Operator interaction:
  - Automated teller machine
- Different part or product styles processed by the system:
  - Robot welding cycle for two-door vs. four door car models
- Variations in the starting work units:
  - Additional machining pass for oversized sand casting

CONTROL SYSTEM – TWO TYPES

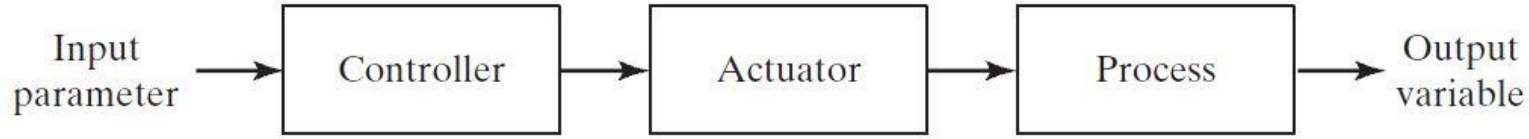
1. Closed-loop (feedback) control system – a system in which the output variable is compared with an input parameter, and any difference between the two is used to drive the output into agreement with the input
2. Open-loop control system – operates without the feedback loop
   - Simpler and less expensive
   - Risk that the actuator will not have the intended effect

(A) FEEDBACK CONTROL SYSTEM AND (B) OPEN-LOOP CONTROL SYSTEM

(a)

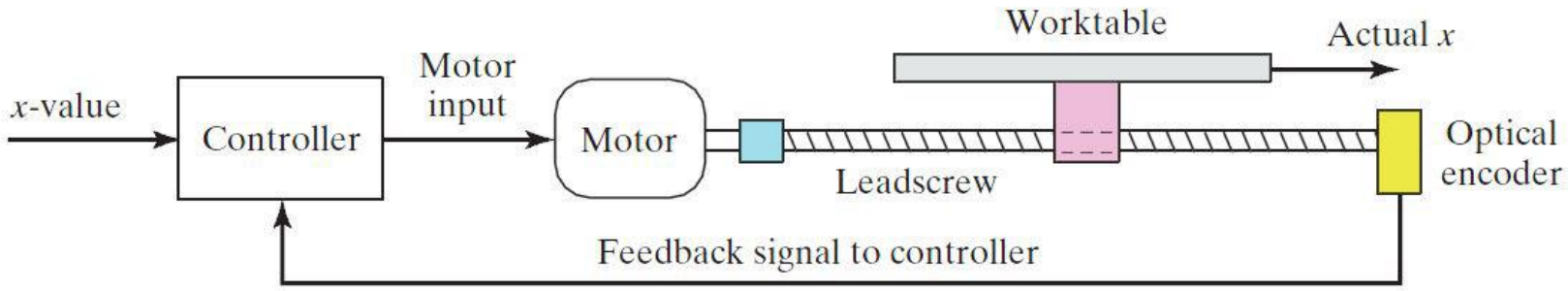


(b)



POSITIONING SYSTEM USING FEEDBACK CONTROL

A one-axis position control system consisting of a leadscrew driven by a dc servomotor and using an optical encoder as the feedback sensor



WHEN TO USE AN OPEN-LOOP CONTROL SYSTEM

Actions performed by the control system are simple.

Actuating function is very reliable.

Any reaction forces opposing the actuation are small enough as to have no effect on the actuation.

If these conditions do not apply, then a closed-loop control system should be used.

ADVANCED AUTOMATION FUNCTIONS

1. Safety monitoring
2. Maintenance and repair diagnostics
3. Error detection and recovery

SAFETY MONITORING

Use of sensors to track the system's operation and identify conditions that are unsafe or potentially unsafe

Reasons for safety monitoring

- To protect workers and equipment

Possible responses to hazards:

- Complete stoppage of the system
- Sound an alarm
- Reduce operating speed of process
- Take corrective action to recover from the safety violation

MAINTENANCE AND REPAIR DIAGNOSTICS

Status monitoring:

- Monitors and records status of key sensors and parameters during system operation

Failure diagnostics:

- Invoked when a malfunction occurs
- Purpose: analyze recorded values so the cause of the malfunction can be identified

Recommendation of repair procedure:

- Provides recommended procedure for the repair crew to effect repairs

ERROR DETECTION AND RECOVERY

1. Error detection – functions:
   - Use the system's available sensors to determine when a deviation or malfunction has occurred
   - Correctly interpret the sensor signal
   - Classify the error
2. Error recovery – possible strategies:
   - Make adjustments at end of work cycle
   - Make adjustments during current work cycle
   - Stop the process to invoke corrective action
   - Stop the process and call for help

LEVELS OF AUTOMATION

1. Device level – actuators, sensors, and other hardware components to form individual control loops for the next level.
2. Machine level – CNC machine tools and similar production equipment, industrial robots, material handling equipment.
3. Cell or system level – manufacturing cell or system.
4. Plant level – factory or production systems level.
5. Enterprise level – corporate information system.

LEVELS OF AUTOMATION