Chapter 1:
Things and Connections

IoT Fundamentals

Connecting Things 2.01

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Chapter 1 - Sections & Objectives

- 1.1 What are Things?
  - Analyze the things that make up the IoT.
- 1.2 What are Connections?
  - Explain how things connect to other things and to the IoT.
- 1.3 Chapter Summary

1.1 What are Things?

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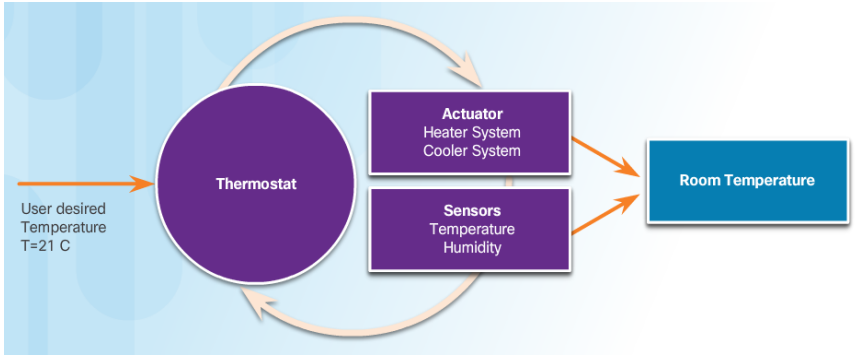
1.1.1 The Internet of Things

- The Presence of IoT in Today's World
  - The IoT is all around us.
  - The IoT helps individuals to improve quality of life.
  - The IoT also helps industries to become more efficient.
- Cisco IoT Solutions
  - The rapid IoT growth has introduced new challenges.
  - Cisco IoT System reduces the complexities of digitization.
  - Six Pillars of the Cisco IoT System are:
    - Network Connectivity
    - Fog Computing
    - Cybersecurity and Physical Security
    - Data Analytics
    - Management and Automation
    - Application Enablement Platform

1.1.2 Building Blocks of an IoT System

- Overview of a Controlled System
  - Feedback loops are used to provide real-time information to its controller based on current behavior.
  - In a closed loop, feedback is continuously being received by the controller from its sensors.
  - The controller continuously analyzes and processes information, and use actuators to modify conditions.
- Sensors
  - A sensor is a device that can be used to measure a physical property by detecting some type of information from the physical world.
  - A sensor may be connected to a controller either directly or remotely.

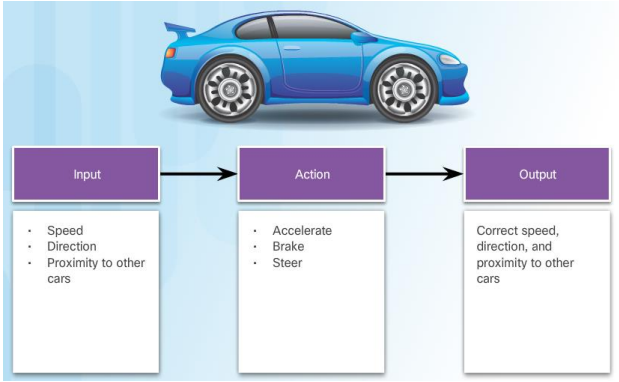


Building Blocks of an IoT System (Cont.)

- Actuators
  - An actuator is a basic motor that can be used to control a system.
  - Can be hydraulic, electric or pneumatic.
  - can be responsible for transforming an electrical signal into physical output.
- Controllers
  - Responsible for collecting data from sensors and providing network connectivity.
  - Controllers may have the ability to make immediate decisions.
  - May also send data to remote and more powerful computer for analysis.

- IoT Process Flow
  - A simple IoT system include sensors connecting, through a wireless or wired connection, to actuators or controllers.
  - Some devices can have more than one function.

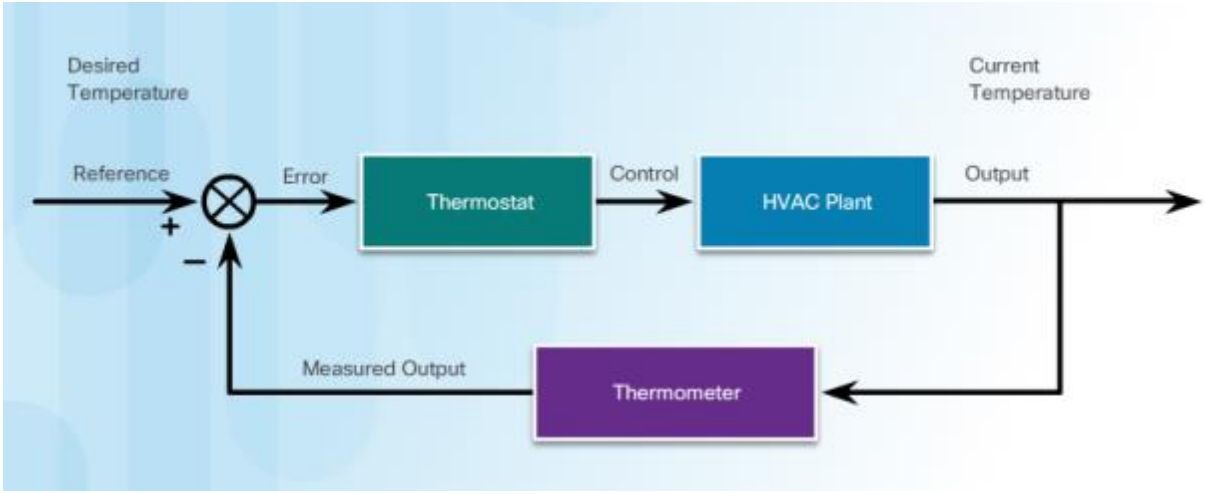
1.1.3 Processes in Controlled Systems



- Processes
  - A process is a series of steps or actions taken to achieve a desired result by the consumer of the process.
- Feedback
  - Feedback is when the output of a process affects the input.
  - Feedback is often referred to as a feedback loop.
  - Feedback loops can be positive or negative.
- Control Systems
  - Includes a controller that uses inputs and outputs to manage and regulate the behavior of the system in an attempt to achieve a desired state.
  - The controlled portion of the system is often called the plant.
  - Choosing the adjustments to apply to a plant to achieve a desired output is called control theory.
  - Control theory is applied to many systems, including driving a car.

Processes in Controlled Systems (Cont.)

- Open-Loop Control Systems
  - Open-loop control systems do not use feedback.
  - The plant performs a predetermined action without any verification of the desired results.
  - Open-loop control systems are often used for simple processes.
- Closed-Loop Control Systems
  - A closed-loop control system uses feedback to determine whether the collected output is the desired output.
  - The result is then fed back into a controller to adjust the plant for the next iteration of output, and the process repeats.



Processes in Controlled Systems (Cont.)

- Closed-Loop Controllers
  - There are many types of closed-loop controllers:
    - Proportional controllers (P): based on the difference between the measured output and the desired output.
    - Integral controllers (PI): use historical data to measure how long the system has deviated from the desired output.
    - Proportional, Integral and Derivative controllers (PID): include data about how quickly the system is approaching the desired output.
    - PID controller is an efficient way to implement feedback control.
    - The Arduino and Raspberry Pi devices can be used to implement PID controllers.
- Interdependent Systems
  - Most systems have many interdependent pieces contributing to and affecting the output.