Cyber-Physical Systems and Physical Computing

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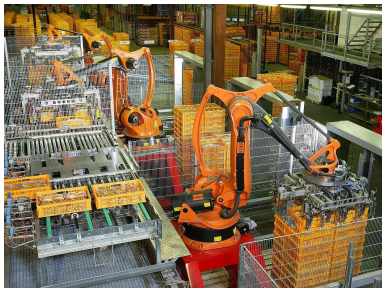
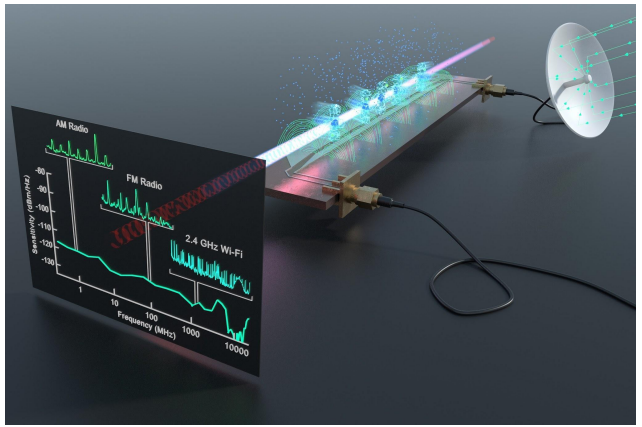
Introduction to Cyber-Physical Systems (CPS)

- Cyber-physical systems (CPS) rely on the seamless integration of computational elements with physical components for their operation and functionality
- Term coined by Helen Gill at NSF
- Such systems are becoming more widely used in our society, and their design will have long-lasting consequences



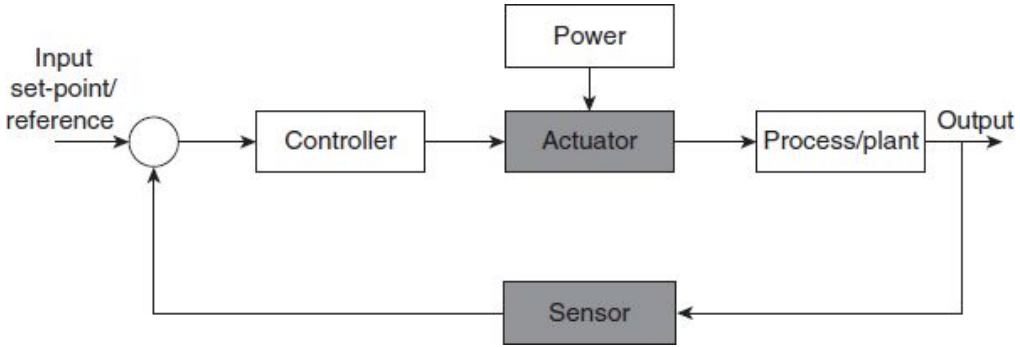
Components of Cyber-Physical Systems

- Physical Components (Sensors, actuators, controllers)
- Cyber Components (Software, algorithms, communication networks)
- Integration of physical and digital elements



Characteristics of Cyber-Physical Systems

- Real-time operation
- Interconnectedness
- Feedback loops
- Distributed control
- Adaptability



Applications of Cyber-Physical Systems

- Smart Cities (Traffic management, energy efficiency)
- Healthcare (Remote patient monitoring, medical robotics)
- Manufacturing (Industrial automation, predictive maintenance)
- Transportation (Autonomous vehicles, intelligent traffic systems)

Challenges in Cyber-Physical Systems

- Security threats (Cyberattacks, data breaches)
- Privacy concerns (Collection and use of personal data)
- Safety issues (Fault tolerance, reliability)
- Complexity (Integration of diverse technologies)
- Standardization and interoperability

Security issues in Cyber-Physical Systems

- Cyberattacks on Industrial Control Systems (ICS) - **Stuxnet 2010**
- Compromised Sensors and Actuators
- Unauthorized Access to Networked Devices
- Denial-of-Service (DoS) Attacks
- Supply Chain Vulnerabilities

Case Study: Autonomous Vehicles

- Challenges in implementing autonomous driving systems
- Safety and ethical considerations
- Crash Analysis (Koopman)
- Future outlook

Q&A And RPi Pico Example

- Obtain the data from the RPi Pico
- Analyze it
- Does everything seem ok?