

Overview of Automation Systems and Their Components

A Comprehensive Introduction

23MCT303 - Data Analytics in Automation System

N. KARTHI, AP/MCT

Standard sensors/
actuators

Safety
sensors/actuators

Introduction to Automation Systems

⚙️ Definition

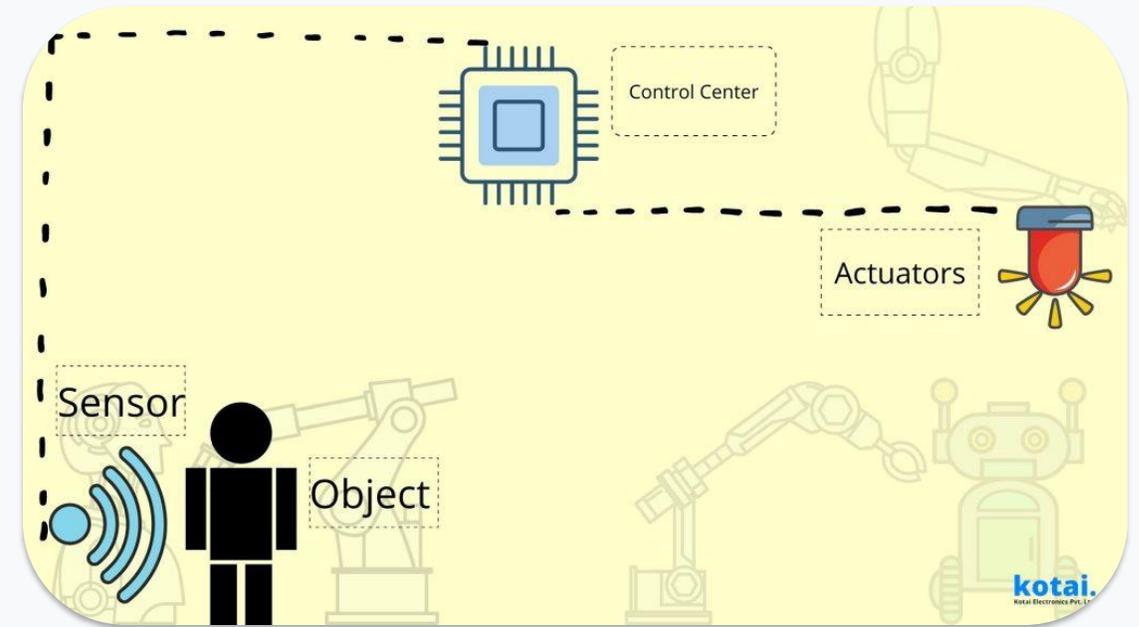
Technology performing tasks with minimal human intervention
Control of processes and operations through automatic means

💡 Purpose

Increase efficiency and productivity
Reduce human error and improve consistency
Perform tasks beyond human capabilities

📈 Benefits

Improved quality and reliability
Enhanced safety in hazardous environments
Cost reduction through optimized resource usage



Types of Automation Systems



Fixed Automation

High volume • Specialized equipment • Low flexibility • Assembly lines



Programmable Automation

Batch production • Reprogrammable • Medium flexibility • CNC machines



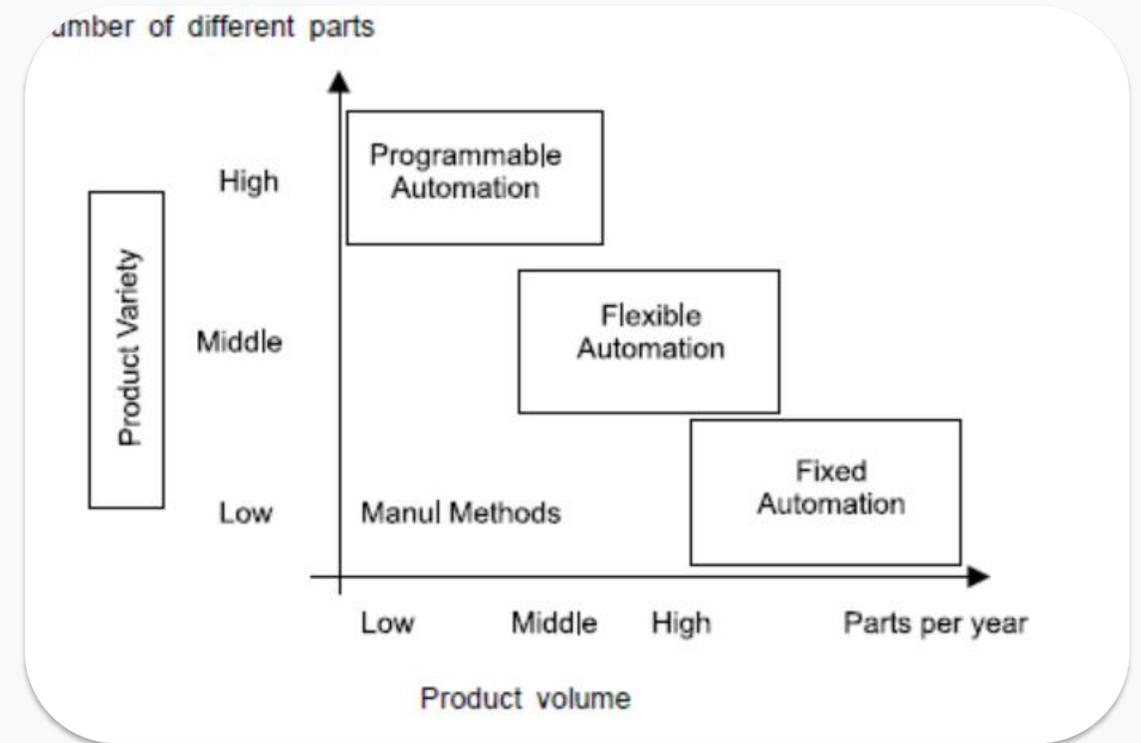
Flexible Automation

Multi-product • Rapid changeover • High flexibility • Industrial robots



Integrated Automation

Fully integrated • Computer-controlled • System-wide • Smart factories



Automation System Architecture



Enterprise Level

ERP • Business planning • Resource management



Operations Level

MES • Production monitoring • Quality control



Supervisory Level

SCADA • Process monitoring • Control operations



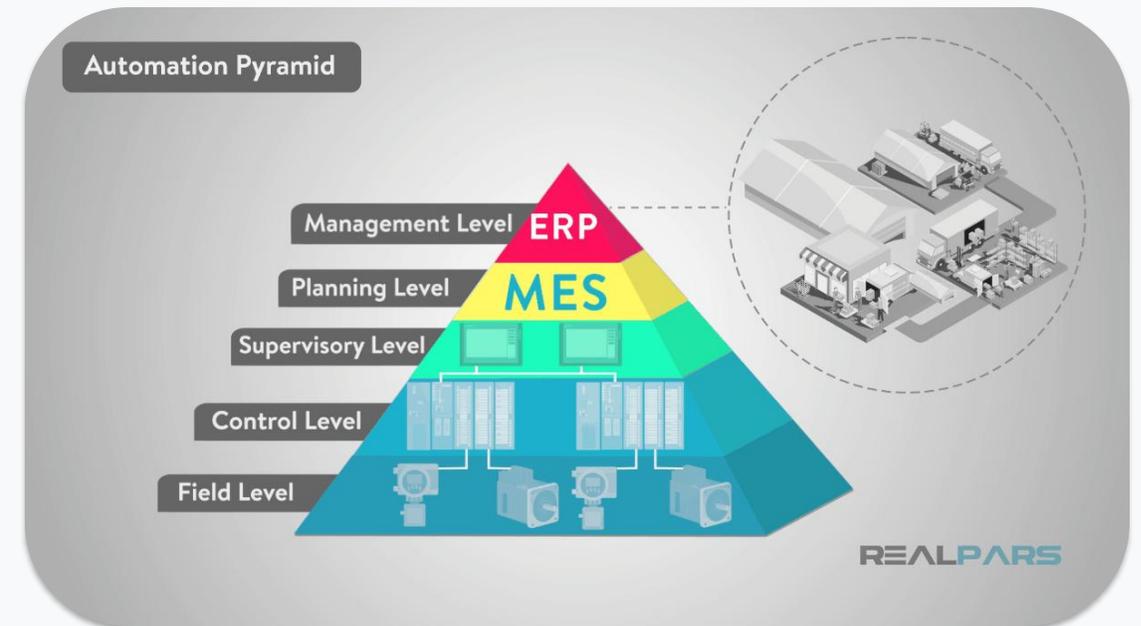
Control Level

PLC/DCS • Process control • Real-time operations



Field Level

Sensors/Actuators • Data collection • Physical control



Controllers in Automation



PLC (Programmable Logic Controllers)

Industrial control • Real-time operation • Rugged design • Ladder logic programming



DCS (Distributed Control Systems)

Process control • Multiple controllers • Redundant architecture • Complex systems



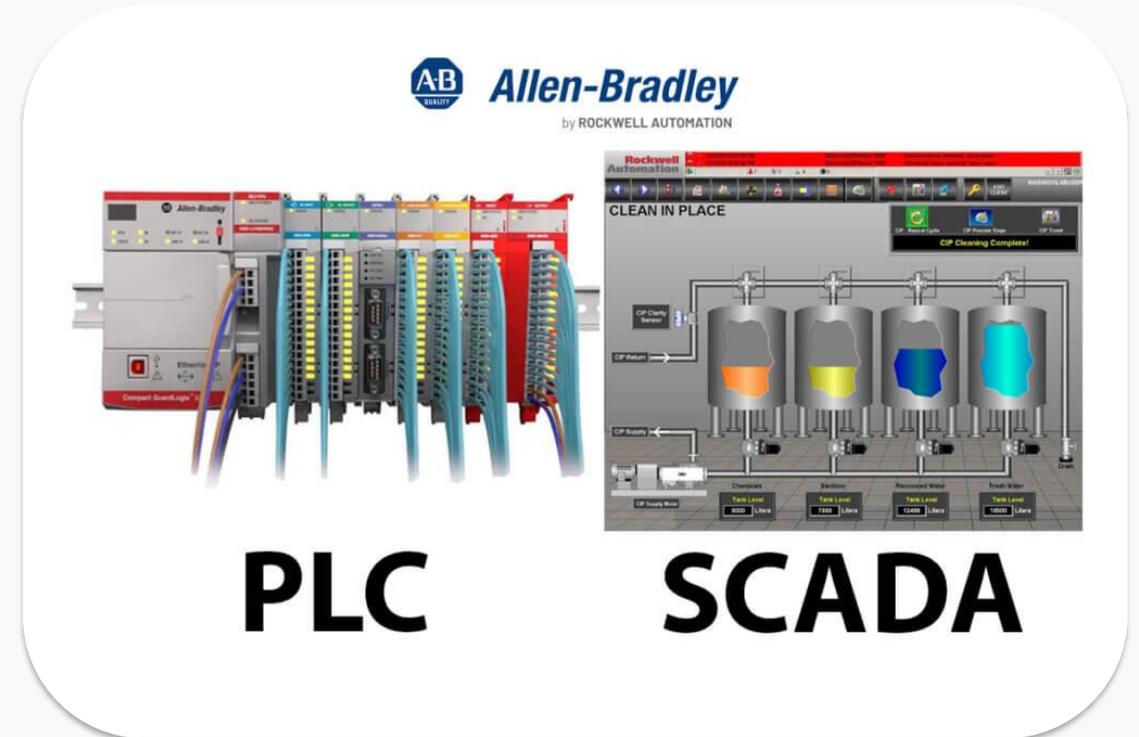
PAC (Programmable Automation Controllers)

Hybrid solution • PC-based control • Advanced features • Multiple programming languages



Key Differences

PLC: Simple control • **DCS:** Process industries • **PAC:** Advanced functionality



Sensors in Automation Systems



Temperature Sensors

Thermocouples • RTDs • Thermistors • Infrared sensors



Pressure Sensors

Strain gauge • Piezoelectric • Capacitive • Optical



Position & Motion Sensors

Encoders • Proximity sensors • Accelerometers • LVDTs



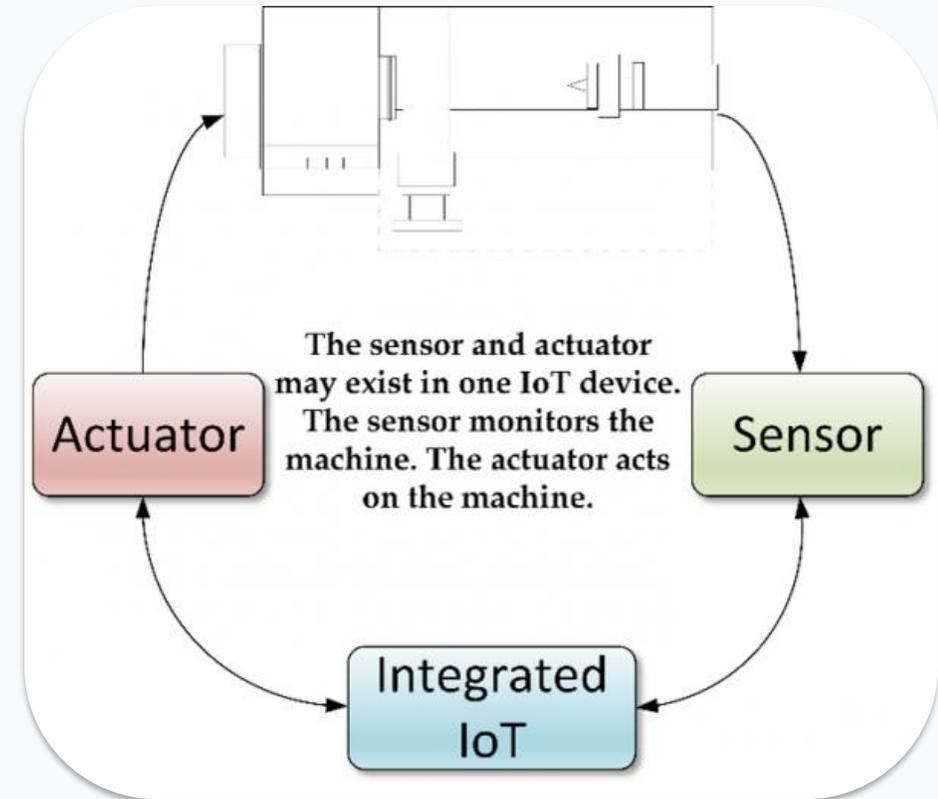
Chemical & Gas Sensors

pH sensors • Gas detectors • Spectroscopy • Biosensors



Optical Sensors

Photoelectric • Vision systems • Laser • Fiber optic



Actuators in Automation Systems



Electrical Actuators

Servo motors • Stepper motors • Solenoids • Linear actuators



Pneumatic Actuators

Cylinders • Air motors • Valves • Grippers



Hydraulic Actuators

Hydraulic cylinders • Motors • Pumps • Valves



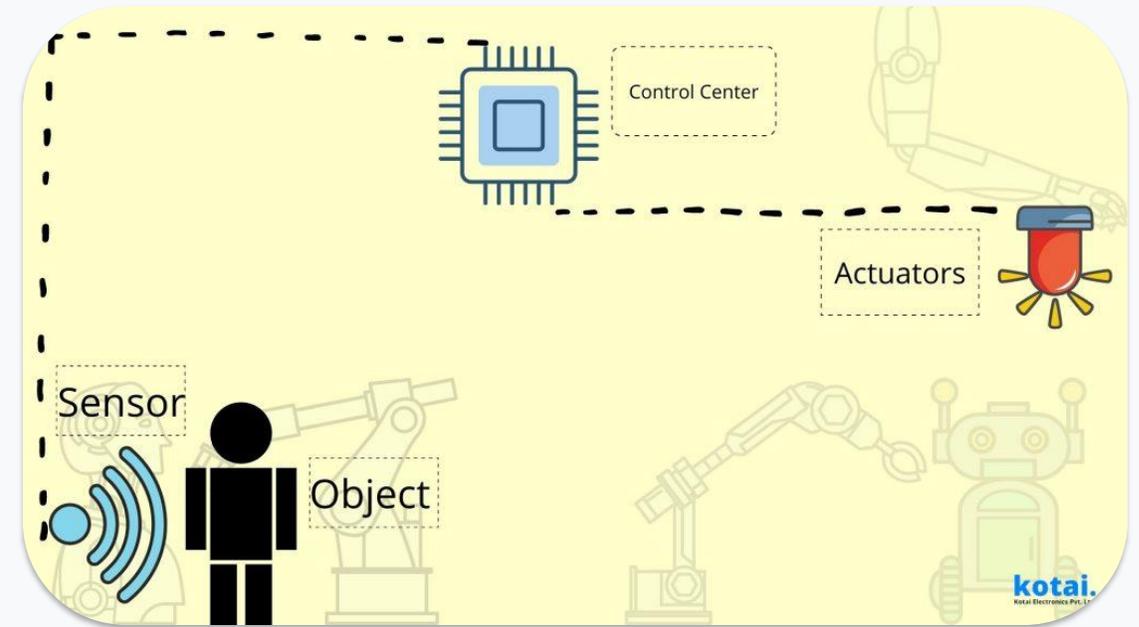
Mechanical Actuators

Gears • Cams • Springs • Linkages



Selection Criteria

Force • Speed • Precision • Environment • Cost



Human-Machine Interfaces (HMIs)



Definition & Purpose

User interface • Control systems • Data visualization • Operator interaction



Touchscreen HMIs

Interactive displays • Graphical interface • Intuitive operation • Mobile compatibility



Web-based HMIs

Remote access • Browser interface • Cloud integration • Multi-device support



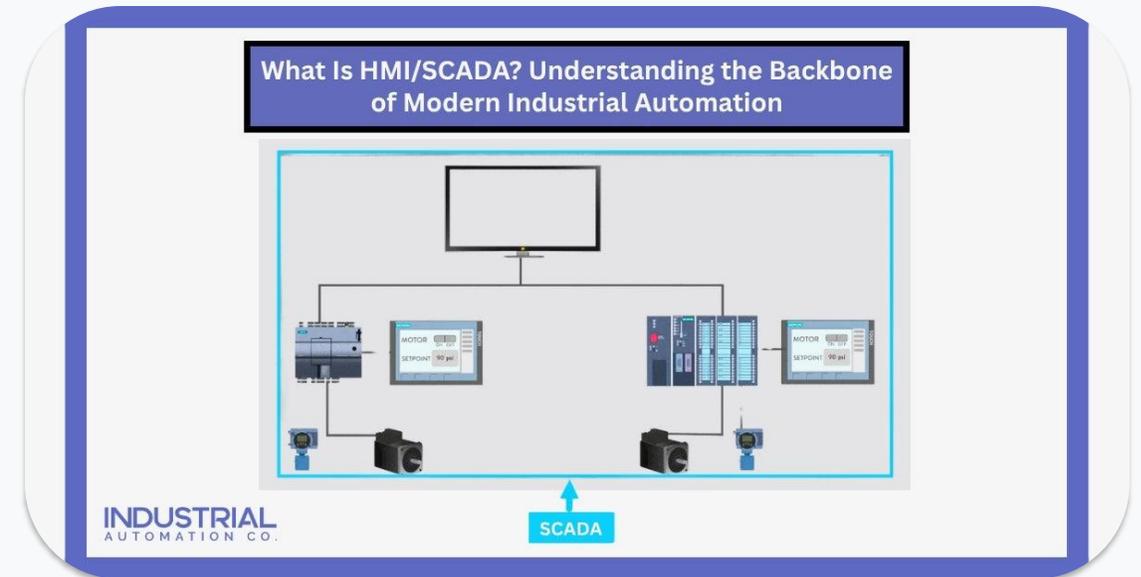
Traditional HMIs

Physical controls • Push buttons • Indicator lights • Panel displays



Key Features

Real-time monitoring • Alarms & alerts • Historical data • System diagnostics



SCADA Systems



Definition

Supervisory Control and Data Acquisition • Industrial control system • Remote monitoring



Components

HMI • RTUs/PLCs • Communication infrastructure • Central server



Functions

Data collection • Process monitoring • Control operations • Alarm management



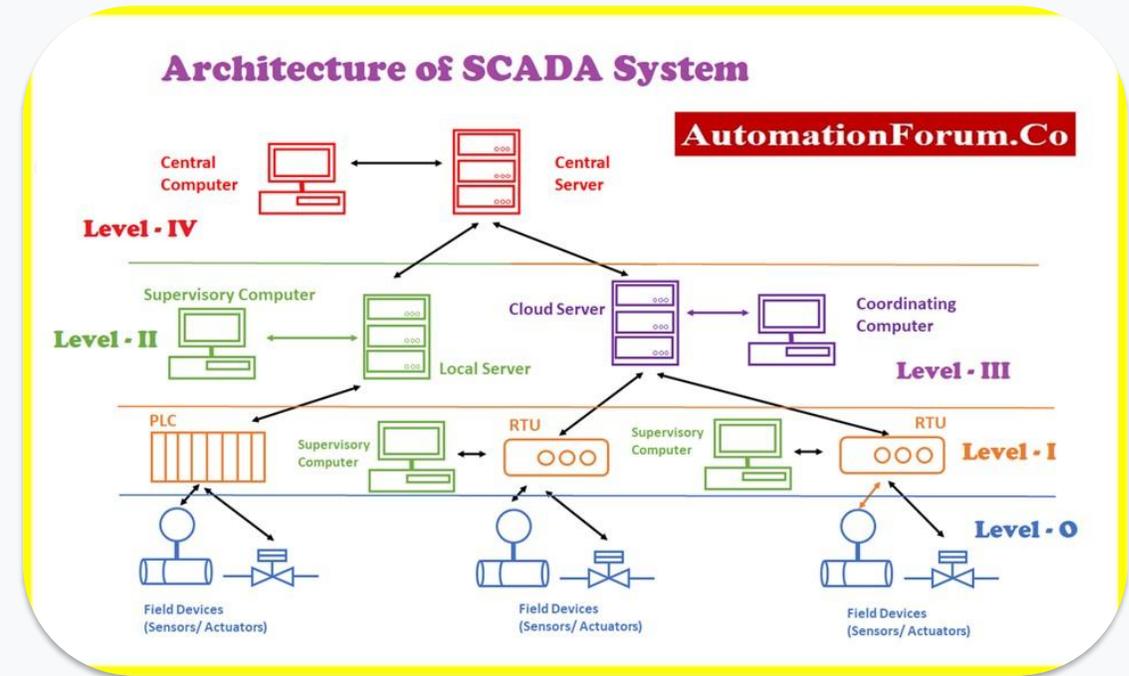
Applications

Power generation • Water treatment • Manufacturing • Transportation

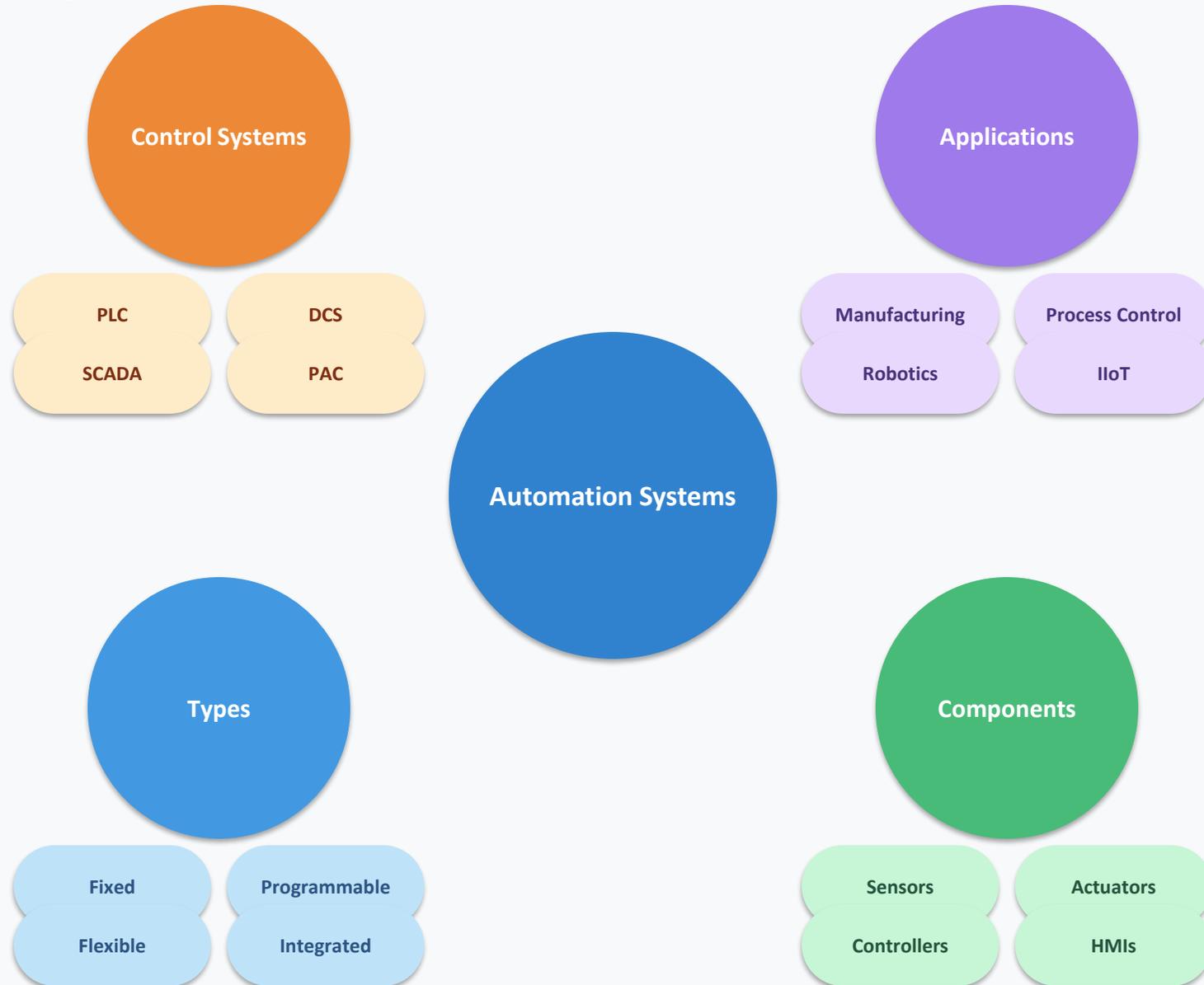


Modern Trends

Cloud integration • IIoT connectivity • Advanced analytics • Cybersecurity



Mind Map of Automation Systems



Summary and Recap



Key Points

- **Four types** of automation: Fixed, Programmable, Flexible, Integrated
- **Hierarchical architecture** from enterprise to field level
- **Core components**: Controllers, Sensors, Actuators, HMIs, SCADA
- **Control systems** range from PLCs to complex SCADA networks



Future Trends

- **IIoT integration** connecting devices across networks
- **AI and machine learning** for predictive maintenance
- **Edge computing** for real-time processing
- **Digital twins** for system simulation and optimization



Questions & Discussion

- ? How will automation transform your industry?
- ? What are the challenges in implementing automation?
- ? How can data analytics enhance automation systems?
- ? What skills are needed for automation professionals?