Programmable Logic Controllers

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TOPICS

INTRODUCTION

- ## Adoptability of industrial processes
- ## Relay panels are hard wired
  - ### Hard to change, bulky, and expensive

Relay panels may look like this

Source:
http://www.prasiddham.in/F23943/control_and_relay_panel_with_substation_automation_system.html

INTRODUCTION

- Processor embedded in PLC (counters, registers…)
  - Load software, smaller, and cheaper
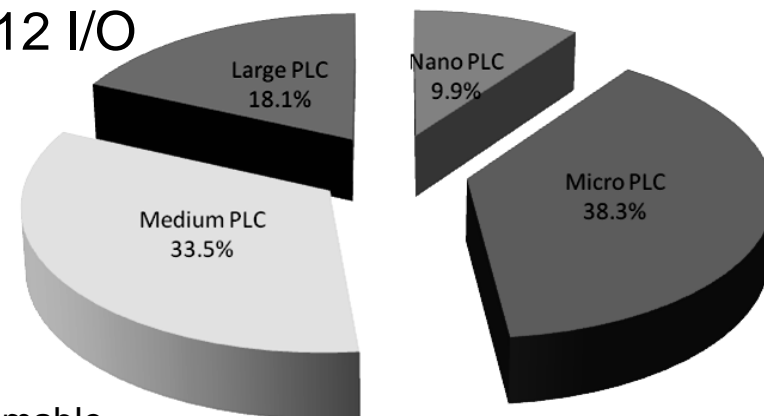- Machines that use PLCs are easier to build

PLCs may look like this

Source:
http://www.kollewin.com/blog/allen-bradley-price/
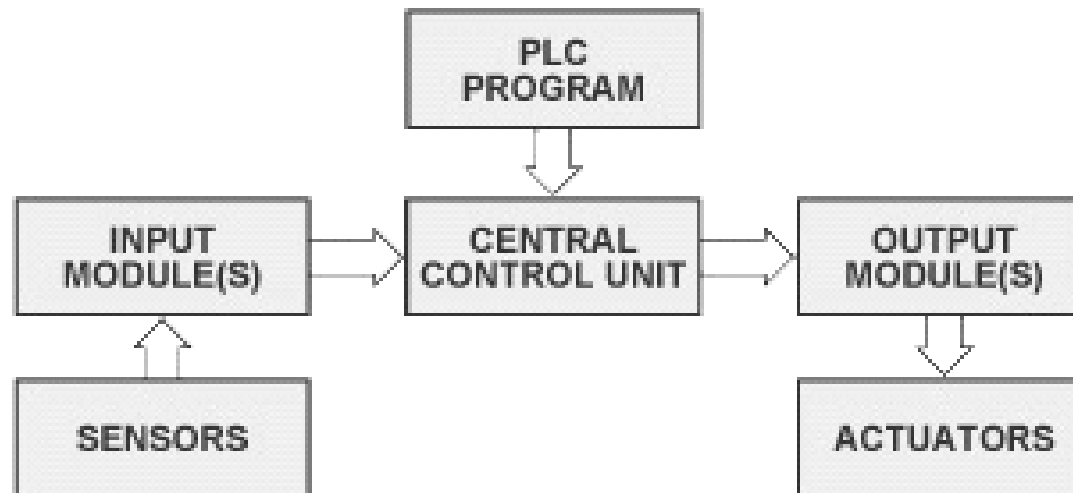
PLCs and DESIRED FUNCTIONALITIES

- Number of I/O points
- Communication by serial, Ethernet, or wireless
  - Nano PLC: less than 15 I/O
  - Micro PLC: 15-128 I/O
  - Medium PLC: 129-512 I/O
  - Large PLC: greater than 512 I/O

Market share of PLCs

Source of data:
Johnson; Control Engineering; "Programmable
Logic Controllers"

PLC ARCHITECTURE

- Similar to PC

Simplified PLC architecture

Source of data:
http://www.pldesignline.com/219500322%3Bjsessionid=5TXIUQ335QO
HHQE1GHRSKH4ATMY32JVN?printableArticle=true

PLC ARCHITECTURE

- Processor:

    Registers, counters, control unit, arithmetic unit…

- Power supply:

    AC/DC conversion

- I/O modules:

    ADC and DAC

PLC ARCHITECTURE

- Communication with other PLCs and PCs:

    Ethernet, wireless…

- Software:

    Ladder Logic

    Higher level languages like C, Pascal, Fortran…

LADDER LOGIC

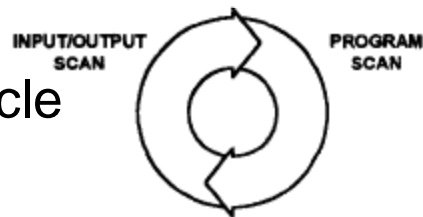- Electric ladder diagram
- "Joe the Electrician" does not like C++
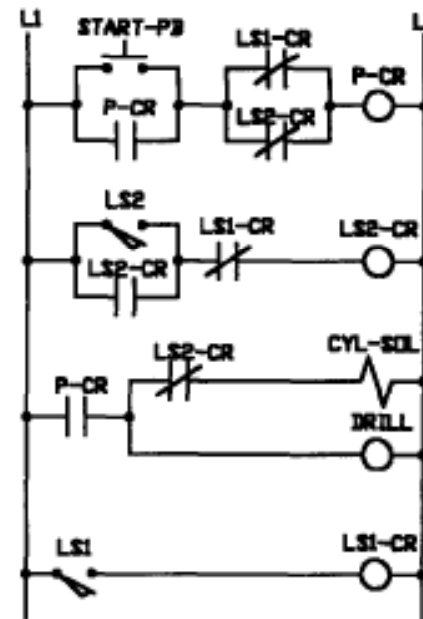
Electric ladder diagram

Source:
Rullán; Programmable Logic Controllers versus
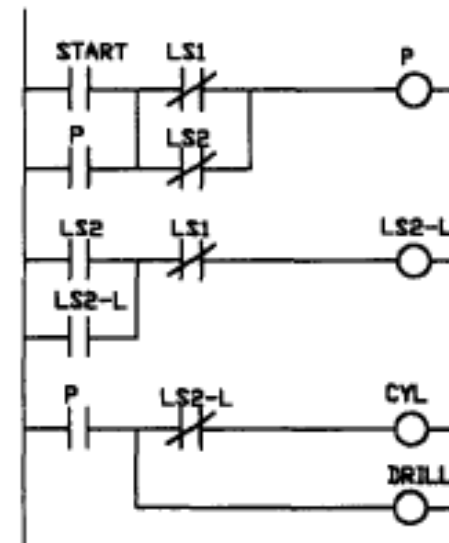Personal Computers for Process Control

LADDER LOGIC

- Elements of ladder logic
  - Input relay from sensors or other output relays
  - Output relay to actuators

PLC scanning cycle
aka "while loop"

Source:
Rullán; Programmable Logic Controllers versus
Personal Computers for Process Control
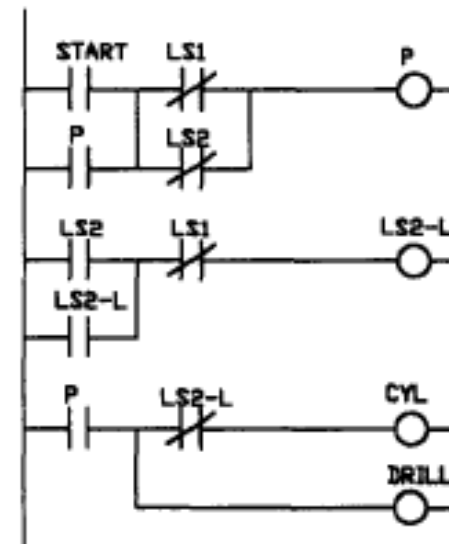
Ladder logic

Source:
Rullán; Programmable Logic Controllers versus
Personal Computers for Process Control
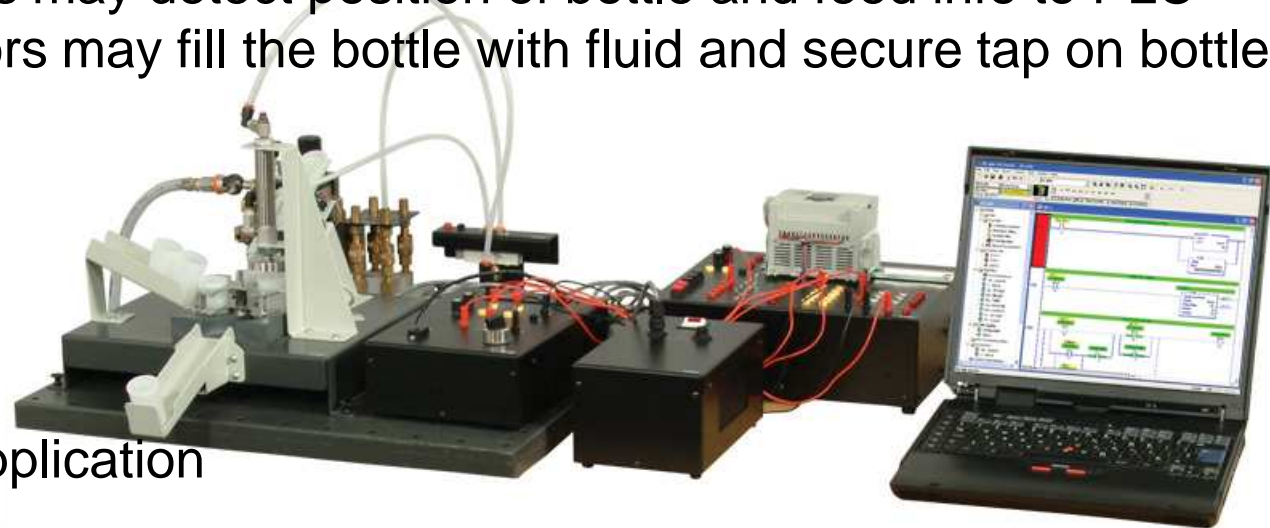
LADDER LOGIC

- Sequential
- Logical AND or OR
  - ANDed: series
  - ORed: parallel
- Logical INV
  - NO: normally open relay
    Positive logic
  - NC: normally closed relay
    Inverted logic

Ladder logic

Source:
Rullán; Programmable Logic Controllers versus
Personal Computers for Process Control

APPLICATION EXAMPLE

- Bottling
  o PLC instructed using ladder logic
  o Sensors may detect position of bottle and feed info to PLC
  o Actuators may fill the bottle with fluid and secure tap on bottle

Bottling application

Source:
http://www.labvolt.com/products/electric-powercontrols/programmable-logic-controllers/plc-application-bottling-process-system-8075-70#

PLC OUTPERFORMS PC

- PC has limited capacity of I/O to interface with industrial machinery
- PC cannot sustain in the harsh industrial environment of heat, moisture, vibration…

The WILLIAM STATES LEE COLLEGE *of* ENGINEERING
UNC CHARLOTTE

CONCLUSION

- PLCs arose from the demands of industry
- Ladder language is preferred
- Regular PCs are less desirable in industrial setting