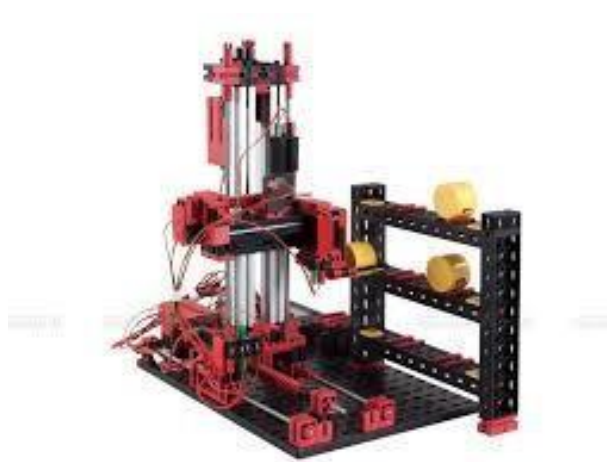


7

AUTOMATION AND SIMULATION OF HYDRAULICS AND PNEUMATICS



Course Contents

- 7.1 Introduction
- 7.2 Types of automation in the industry
- 7.3 Advantages and disadvantages of automation control in industry

7.1 INTRODUCTION

- In today's fast-moving, highly competitive industrial world, a company must be flexible, cost-effective and efficient if it wishes to survive. In the process and manufacturing industries, this has resulted in a great demand for industrial control systems/ automation in order to streamline operations in terms of speed, reliability and product output. Automation plays an increasingly important role in the world economy and in daily experience.

- **Automation** is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well.

7.1.1 What is automation control system?

- Automation Control System - system that is able to control a process with minimal human assistance or without manual and have the ability to initiate, adjust, action show or measures the variables in the process and stop the process in order to obtain the desired output.

- The main objective of Automation Control System used in the industry are:

1. To increase productivity
2. To improve quality of the product
3. Control production cost

7.2 TYPES OF AUTOMATION IN THE INDUSTRY

Classification of automation

a) Permanent/Fixed Automation

- This control system is designed to perform a specific task
- Functions of control circuit is fixed and permanent.
- It will be complicated if we want to do other task apart from the existing task

b) Programmable /Flexible Automation

- Programmable automation or flexible automation is a complex control system that can perform several tasks
- Functions of control circuit programmed by the user and can be modified.
- When the task to be performed by machines changed, changes only need to be done by making modifications to the machine control program.

7.2.1 Comparison between fixed and flexible automation system

	FIXED AUTOMATION	FLEXIBLE AUTOMATION
Purpose	Specific	Variety
Ease of making changes / upgrade	Difficult	Easy
Maintenance	Hard	Easy
Capability	Depends on manufacturing and design	Very high
Speed	Slow	Fast
Economy efficiency	Suitable for small system	Suitable for all types of systems

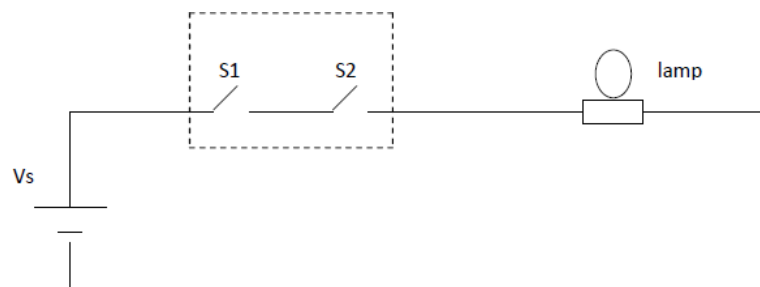
Example:**Fixed automation**

Figure 7.1 – Fixed automation

Programmed automation

- There are three types of the control system based on supply
 - a) Pneumatic control systems
 - b) Hydraulic control system
 - c) Electrical control system

a) Pneumatic control system

- Pneumatic control system is a system that uses compressed air to produce power / energy to perform any task
- Pneumatic systems found in many industrial systems such as food industry, petrochemical and industrial involves robotics.

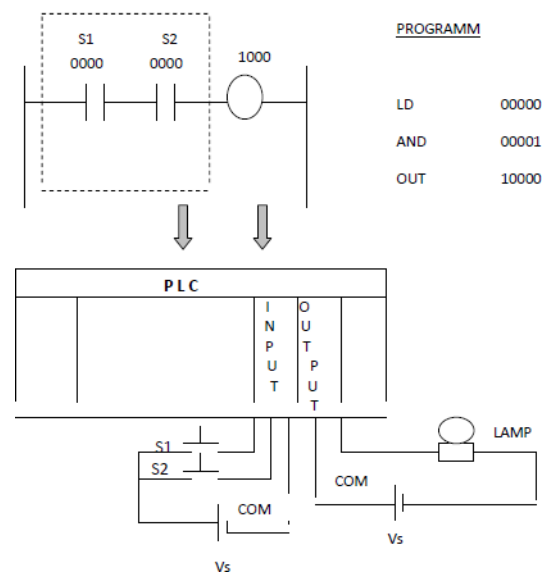


Figure 7.2 – Programmed automation

- Pneumatic systems requires:

- i. Compressed air supply
- ii. Control valve
- iii. Connecting tube
- iv. Transducer

- Pneumatic control system can be controlled manually and automatically.

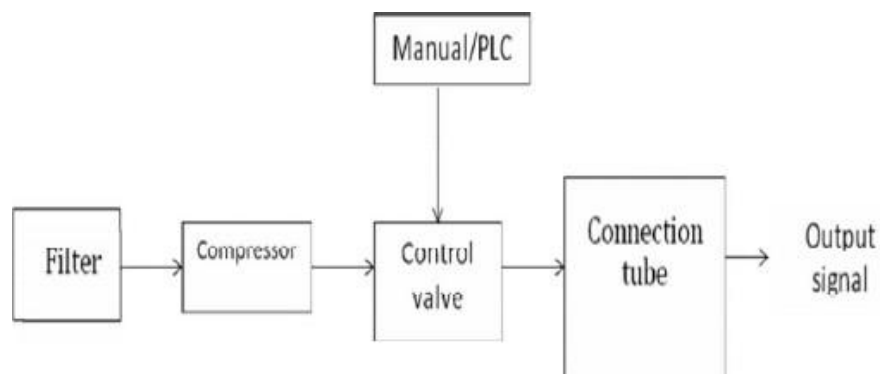


Figure 7.3 - Basic Block Diagram of Pneumatic Control System using manual/PLC

b) Hydraulic control system

- Hydraulic control system is a system that uses fluid to generate power/energy.
- The hydraulic system used in the automobile industry such as power systems, braking systems, cranes, car jack, satellite and others.
- The fluid used is oil.
- The hydraulic system requires:

- a) Hydraulic fluid supply
- b) Control Valve
- c) Cylinder

- Hydraulic control system can be controlled manually and automatically

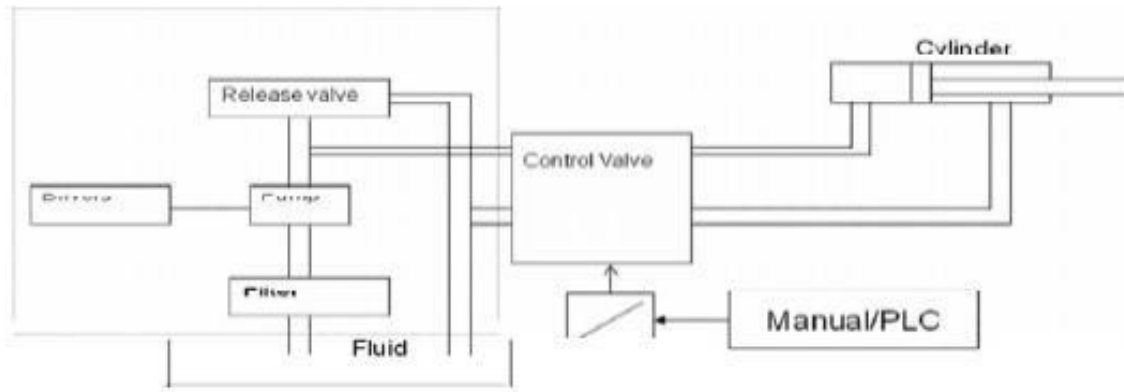


Figure 7.4 - Basic block diagram of an automatic hydraulic control system by Manual /PLC

c) Electrical control system

- A control system that uses an electric current; either direct current (DC) or current shuttle (AC) as a source of supply.

- Electrical control systems generally requires:

- a) Electricity (DC) or (AC)
- b) Input elements (switches, sensors, transducer, valves, electronic components, etc.)
- c) Output elements (motor, lights, etc.)
- d) Extension cable

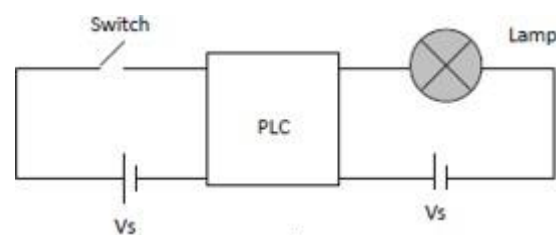


Figure 7.5 - Basic block diagrams of electrical control system using PLC

7.2.2 Comparison between pneumatic control systems, hydraulic control system and electric control system

i. Pneumatic control system

- a) Easy installation
- b) Simple design
- c) Use compressed air as a supply source to perform task.

ii. Hydraulic control system

- a) Complex to assemble
- b) Use fluid like oil as a supply source to perform task.
- c) Potential leakage will lead to pollution.

iii. Electric control system

- a) Simple system
- b) Use electricity as a supply source to perform task.
- c) Widely use either for home user or in industrial.

7.3 ADVANTAGES AND DISADVANTAGES OF AUTOMATION CONTROL IN INDUSTRY**The main advantages of automation are:**

- Replacing human operators in tasks that involve hard physical work.
- Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Performing tasks that are beyond human capabilities of size, weight, speed, endurance, etc.
- Economy improvement: Automation may improve in economy of enterprises, society or most of humanity. For example, when an enterprise invests in automation, technology recovers its investment; or when a state or country increases its income due to automation like Germany or Japan in the 20th Century.
- Reduces operation time and work handling time significantly.

The main disadvantages of automation are:

- Unemployment rate increases due to machines replacing humans and putting those humans out of their jobs.
- Technical Limitation: Current technology is unable to automate all the desired tasks.
- Security Threats/Vulnerability: An automated system may have limited level of intelligence, hence it is most likely susceptible to commit error.
- Unpredictable development costs: The research and development cost of automating a process may exceed the cost saved by the automation itself.
- High initial cost: The automation of a new product or plant requires a huge initial investment in comparison with the unit cost of the product, although the cost of automation is spread in many product batches of things