

AUTOMATION & ROBOTICS

Automation

Is a technology based on the use of mechanical systems, electronics and computers in the operation and control of production processes

Example:

- Automatic material handling
- Automatic inspection systems
- Mechanized assembly machines
- Numerically controlled machine tools
- Computer systems for automatically transforming designs into parts.
- Industrial Robot

Robotics

Is the main component of manufacturing automation system.

1.0 AUTOMATION CONTROL SYSTEM

Introduction

Nowadays, Automation Control System is important in our life. Wherever we go, we were surrounded by this system, for example at home, on the road, in vehicle and in buildings. In industry, Automation Control System is badly wanted because it is able to improve quality and increase productivity. In other words, the automation control system much influence for future lifestyle

Automation Control System is a system that cope in controlling a process with minimum human help or without human help and capable to start, adjusting, display or variable measurement during a process and stop the process in order to get the a product.

1.1 NEEDS OF AUTOMATION CONTROL SYSTEM IN INDUSTRY

Automation Control System is needed because:

- It is a system that capable to control a process with minimum human help or without human help.
- Able to start, adjust, display/measure a variable in process and stop the process in order to get an output.
- The main purpose of Automation Control System in industry is to increase productivity in terms of:
 - i. Increase quantity of production.
 - ii. Improve quality of production.
 - iii. Effective cost control.

1.1.1 CLASSIFICATION OF AUTOMATION IN INDUSTRY

a). Fixed Automation Control System

- To perform specific task.
- Its control function is fixed and permanent.
- Work will be difficult if we want to do other work besides the already existing tasks in this type of control system.

Application:

- Suitable for high-volume production.
- Cost per number of units product low.
- High initial cost.
- Specially designed for the production of product.

Example:

- GE Lighting produces 2 billion light bulbs per year, using high-speed automation equipment.
- In the Automobile Industry

b). Programmable Automation Control System

- It is a Complex system and able to perform various task.
- Control circuit function is programmed by the user and can be modified.
- The change only needs to be done by making modifications to the machine control program when the task to be performed by a machine changes.

Applications:

- Suitable for medium-volume production.
- For the production of various products.

- Machine can be programmed.
- Products produced in batches

Example:

- Production of the same product but with a different content (shampoo / soap)

c). Flexible Control System

- Production of various products at the same time. Medium volume production.
- Having a variety of product configurations.
- Consist of work stations connected to the material handling and storage systems.

Example:

- HONDA using Flexible Automation, introducing 113 changes in the production of motor production line in 1970s.

1.1.2 COMPARISON OF THE TYPES OF AUTOMATION:

Type Features	Fixed Automation	Programmable Automation	Flexible Automation
Function	Perform specific task	Perform various task	Perform various task
Changes/ Improvement	Difficult	Easy	Easy
Maintenance	Difficult	Easy	Easy
Capability	Depend on design and manufacture	Very High capability	Very High
Speed	Slow	Fast	High
Economic Efficiency	Suitable for small system	Suitable for all types of system that related to the same programming system.	Suitable for all types of system.

Table 1: Comparison

Example:

i. Fixed Automation Control System:

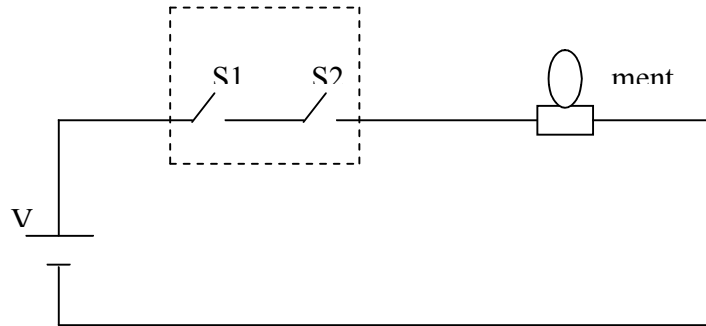


Figure 1: Hard-Wired Lamp Control System

ii. Programmable/ Flexible Automation Control System

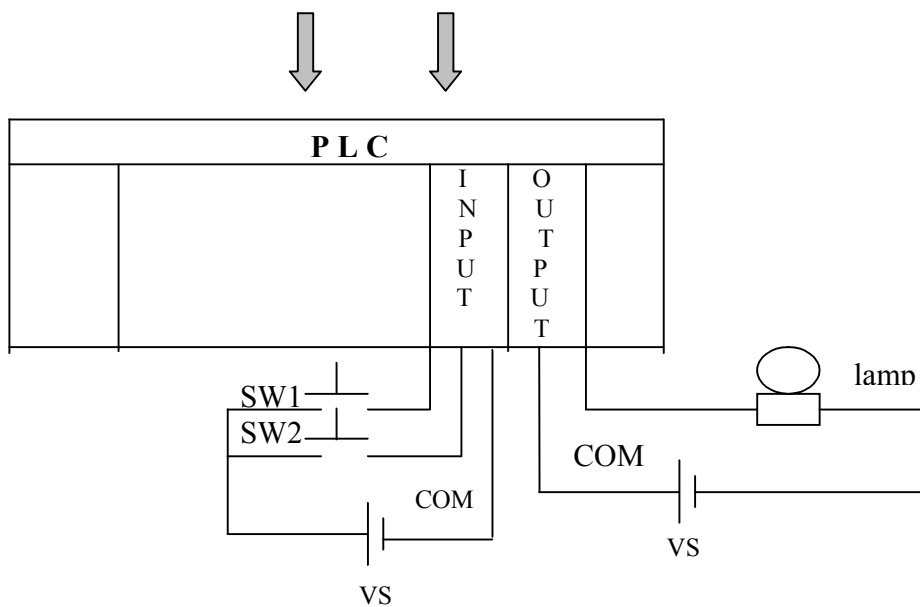
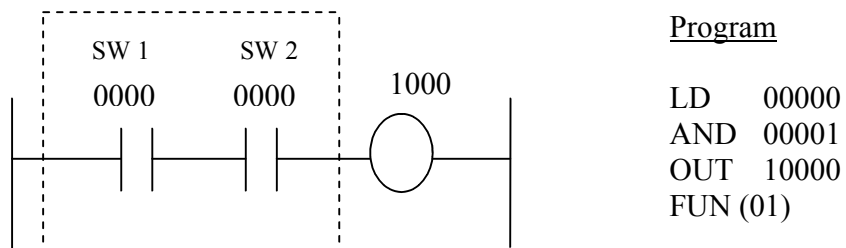


Figure 2: Programmable/ Flexible Automation Control System Using Programmable Logic Controller (PLC)

1.1.3 CONTROL SYSTEM BASED ON SUPPLY

There are three (3) of the control system based on supply. These systems are as follows:

- i. Pneumatic Control System
- ii. Hydraulic Control System
- iii. Electric Control System

a. Pneumatic Control System

Pneumatic control system is a system that uses compressed air to generate power or energy to work. Pneumatic systems found in many industrial systems such as the food industry, petrochemical and industrial use of robotics. In general, a pneumatic system requires:

- i. Compressed Air Supply
- ii. Control Valve
- iii. Connecting Tube
- iv. Transducer

Basically, pneumatic system is widely used in electronic, food, petrochemical and automotive industry. The uses of pneumatic system are:

- Transferring of materials
- Drilling system.
- Material handling (clamping, shifting, positioning, orienting)
- Stamping
- Packaging
- Automation

Pneumatic control system can be controlled manually and automatically. These systems can be represented by the basic block diagram in Figure 3 and Figure 4.

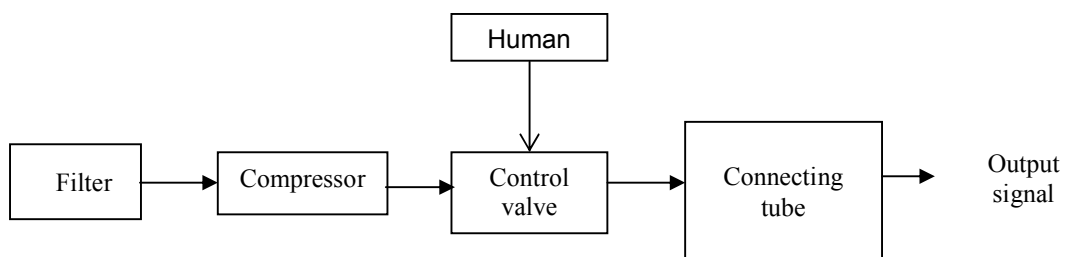


Figure 3: Manual Pneumatic Control System.

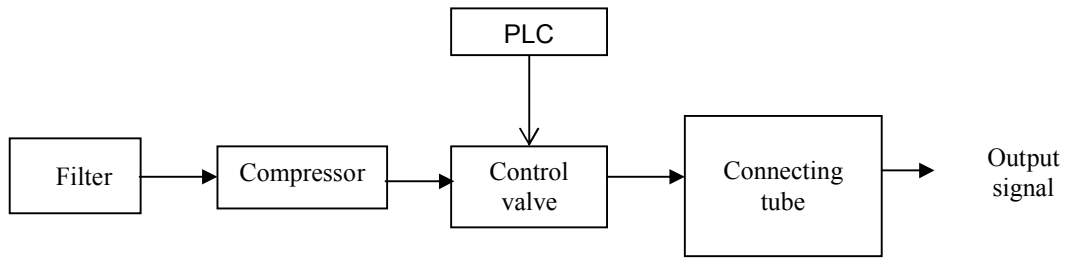


Figure 3: Automatic Pneumatic Control System.

b. Hydraulic Control System

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

In general, the Hydraulic control system requires:

- i. Hydraulic fluid supply
- ii. Control valve
- iii. Cylinder

Hydraulic control system can be controlled manually and automatically. These systems can be represented by the basic block diagram in Figure 5 and Figure 6.

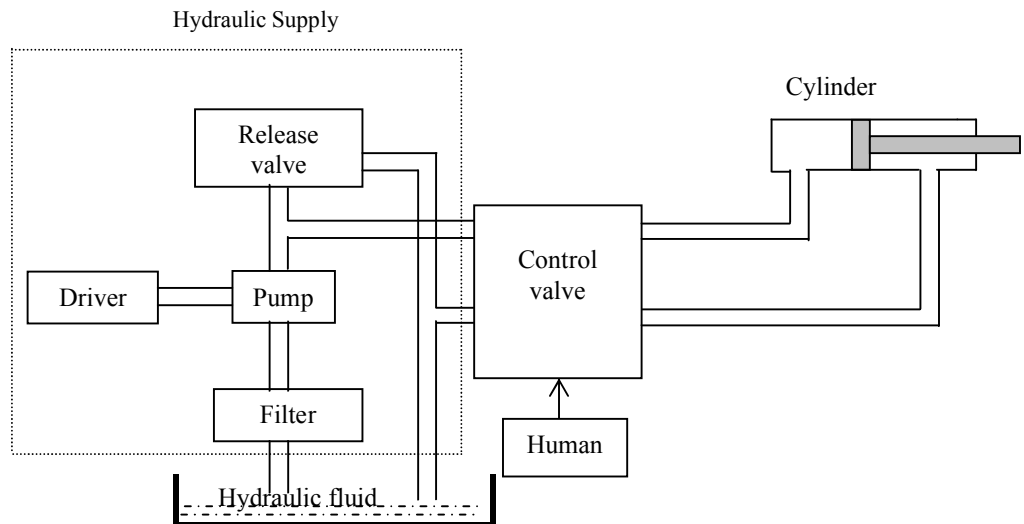


Figure 5: Manual Handling Hydraulic Control System

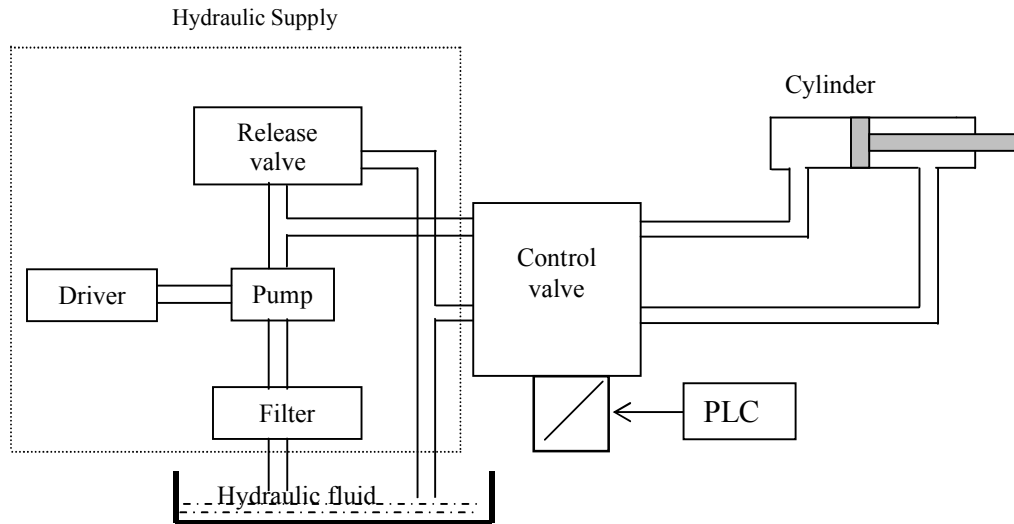


Figure 6: Automatic Hydraulic Control System

c. Electrical Control System

Electrical Control is a control system that uses electrical currents either Direct Current (DC) or Alternative Current (AC) as a source of supply. Generally Electrical Control System requires:

- i. DC or AC electric supply
- ii. Input Element (switches, sensors etc.)
- iii. Output Element (motors, lamp, buzzer, fan etc.)
- iv. Connecting cable

System can be controlled manually and automatically. These systems can be represented by the basic block diagram in Figure 7 and Figure 8.

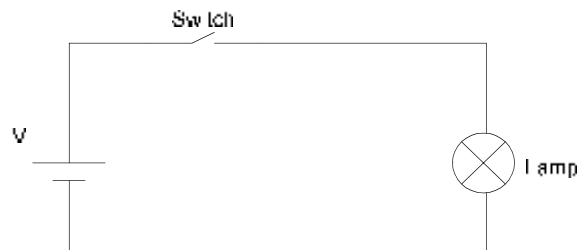


Figure 7: Electrical control system by manual handling.

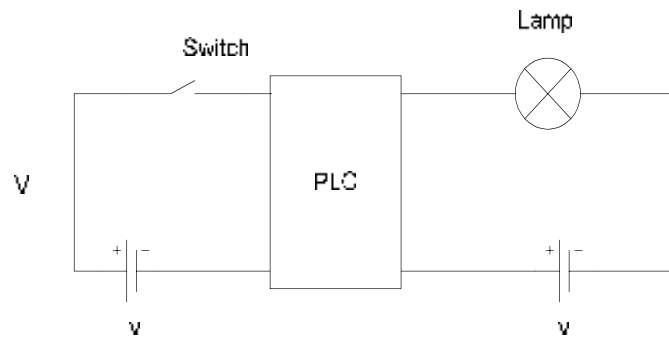


Figure 8: Automatic Electrical control system by using PLC.

1.1.4

COMPARISON BETWEEN PNEUMATIC CONTROL SYSTEM, HYDRAULIC CONTROL SYSTEM AND ELECTRICAL CONTROL SYSTEM.

Pneumatic Control System	Hydraulic Control System	Electrical Control System.
Easy installation system	Complex installation systems	A simple system.
Using compressed air as a supply source to do the job	Using a fluid such as oil as a source of supply for work	Using electricity as a source of supply for work.
a simple system design	If a leak occurs, it will cause the dirt.	Wide application

Table 2: Comparison of Pneumatic, Hydraulic and Electrical Control System.

1.1.5 ADVANTAGES AND DISADVANTAGES OF AUTOMATION CONTROL SYSTEM IN INDUSTRY

Advantages	Disadvantages
<ul style="list-style-type: none">• High quality of product• Repeatability• Reduced manufacturing lead time• Increase in production• Labour cost is reduced	<ul style="list-style-type: none">• Costly setup,• Skilled operators are required,• Does not guarantee results,• Maintenance is difficult.

Table 3 : Advantages and Disadvantages

References:

1. Programmable Logic Controller (E4800)
2. Modul Asas Sistem Kawalan (E3145)
3. Festo Didactic, Pneumatics Basic Level TP01, text book.
4. SMC Pneumatics (SEA) Pte. Ltd, Programmable Controller Technology, International Training.