ROLE OF AUTOMATION IN MANUFACTURING INDUSTRIES

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Abstract

In the last decades, industrial automation has become a driving force in all production systems. Technologies and architectures have emerged alongside the growing organizational structures of production plants. Industrial automation plays an important role in industrial and manufacturing environment. Industrial automation means automatically control of industrial appliances which save money, time also reduce human efforts. Automation devices such as controllers and data systems and/or services. Systems and methods are provided that receive statements or other unit of data interaction from an automation device, provide the statements to an appropriate system or service for processing, and optionally return a response such as a result set. In this paper brief study about the automation, level of automation, Industrial automation and types of industrial automation etc.

Key words: Automation, Levels of automation, CNC, CAM & FMS

1- INTRODUCTION

1.1 Automation

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 reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated. Automation plays an increasingly important role in the global economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities. Many roles for humans in industrial processes presently lie beyond the scope of automation. Human-level pattern recognition, language recognition, and language production ability are well beyond the capabilities of modern mechanical and computer systems. Automation is the conversion of a work process, a procedure, or equipment to automatic rather than human operation or control. Automation does not simply transfer human functions to machines, but involves a deep reorganization of the work process, during which both the human and the machine functions are redefined. Early automation relied on mechanical and electromechanical control devices; during the last 40 years, however, the computer gradually became the leading vehicle of automation. Modern automation is usually associated with computerization.

1.2 Strategies for automation

Following are some important strategies for automation:

1. Specialization of operations
2. Combined operations
3. Simultaneous operations
4. Integration of operations

5. Increased flexibility
6. Improved material handling and storage
7. On-line inspection
8. Process control and optimization
9. Plant operations control
10. Computer-integrated manufacturing (CIM)

1.3 Advantages of Automation

Following are some of the advantages of automation:

- Increased productivity, quality and robustness of product or process.
- Highly improved consistency of output.
- Reduced operation and material or work handling time.
- Reduced human labour costs and expenses.
- Replaces human task involving hard and tedious work.
- Replaces human tasks in hazardous environment such as fire, space, nuclear plants, underwater, etc.
- Automation provides higher-level jobs in testing

1.4 Disadvantages of Automation

Following are some of the disadvantages of automation:

- Initial costs are relative high.
- A skilled maintenance department is often required to service and maintain the automation system in proper working order. Failure to maintain the automation system will ultimately result in lost production and/or bad parts being produced.
- The automation of a new product required a huge initial investment in comparison with the unit cost of the product, although the cost of automation is spread in many product batches.
- The development and research cost of an automation is higher and unpredictable.
- Automation causes unemployment by replacing the human labour.
- An automated system may have security threats.

2-LEVELS OF AUTOMATION

The concept of automated systems can be applied to various levels of factory operations. One normally associates automation with the individual production machines. However, the production machine itself is made up of subsystems that may themselves be automated. We can identify five possible levels of automation in a production plant.

1. **Device level:** This is the lowest level in our automation hierarchy. It includes the actuators, sensors, and other hardware components that comprise the machine level. The devices are combined into the individual control loops of the machine; for example, the feedback control loops for one axis of a CNC machine or one joint of an industrial robot.
2. **Machine Level:** Hardware at the device level is assembled into individual machines. Examples include CNC machine tools and similar production equipment, industrial robots, powered conveyors, and automated guided vehicles. Control functions at this level include performing the sequence of steps in the program of instructions in the correct order and making sure that each step is properly executed.
3. **Cell or system level:** This is the manufacturing cell or system level, which operates under instructions from the plant level. A manufacturing cell or system is a group of machines or workstations connected and supported by a material handling system, computer. and other equipment appropriate to the manufacturing process. Production lines are included in this level. Functions include part dispatching and machine loading. Coordination among machines and material handling system, and collecting and evaluating inspection data.

4. **Plant level:** This is the factory or production systems level. It receives instructions from the corporate information system and translates them into operational plans for production. Likely functions include: order processing, process planning, inventory control, purchasing, material requirements planning, shop floor control, and quality control.
5. **Enterprise level:** This is the highest level consisting of the corporate information system. It is concerned with all of the functions necessary to manage the company: marketing and sales, accounting, design, research, aggregate planning, and master production scheduling.

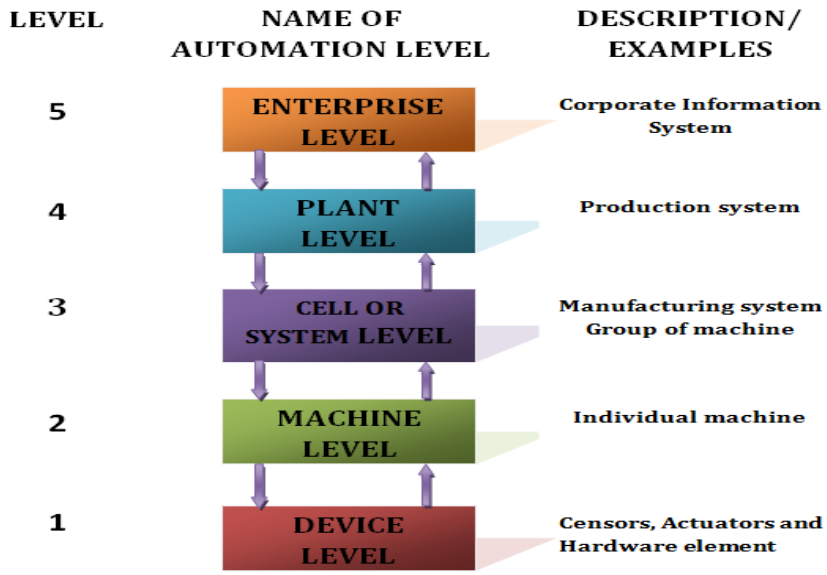

Figure:1 Level of Automation

3-INDUSTRIAL AUTOMATION

Industrial automation is the process of making industrial production processes more flexible and simpler at higher efficiencies. Automation integration to the industries results intelligent manufacturing solutions at improved product quality and productivity with reduced downtime and wastes. Industrial automation involves in usage of usage of various control devices such as PC/PLC's, various sensors and actuators, communication buses/modules, machine drives, HMI (Human Machine Interface) systems and other control equipments. This type automation is most popularly used in automotive, computer and electronics, medical, telecommunication, consumer goods and other industrial applications. The automation systems can be a fixed, programmed, flexible and integrated systems.

Figure: 2 Industrial automation (Example)

4- TYPES OF INDUSTRIAL AUTOMATION

Some of the types of industrial automation are given below.

4.1 Numerically Controlled Machines: These machines are of computer controlled machines which uses computers to perform the control operations by acquiring, processing, calculating and controlling the process variables. This automation is a programmed version of machine tools and also called as Computerized Numerical Controlled (CNC) Machines. These CNC machines are used in cutting and milling applications for high accuracy and accurate precision operation. Computer numerical control (CNC) is the automation of machine tools by means of computers executing pre-programmed sequences of machine control commands. This is in contrast to machines that are manually controlled by hand wheels or levers, or mechanically automated by cams alone.

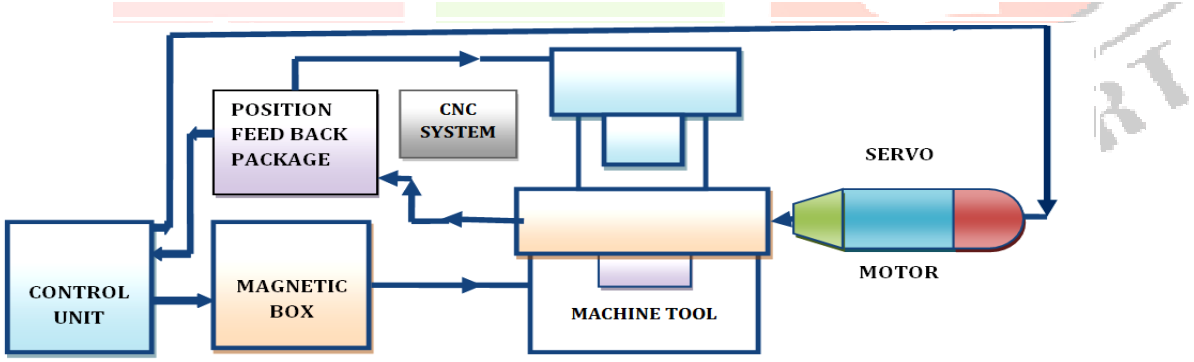

Figure: 3 CNC machine System

4.2 Computer Aided Manufacturing (CAM): In this, the entire manufacturing process (includes production, planning and control) is automated with the use of numerically controlled machines, industrial robots and other types of automation devices. These automation systems also make use of computers to plan, design and layout the various products. Examples of this automation systems are computer-aided design (CAD), computer-aided design and drafting (CADD) and computer-aided process planning (CAPP).

4.3 Industrial Robots: Industrial robots are programmable, multi-function manipulators designed to automate tasks such as welding or the movement of materials through variable programmed motions. Robots are capable of performing a wide variety of tasks and are an integral part of automated manufacturing systems. Industrial robots consist of a number of rigid links connected by mechanical joints. The link assembly, or robot arm, is mounted onto a base and a controller runs the entire system. A wrist attached to the robot

arm uses an end effectors to facilitate gripping or handling. The complete motion of the end effectors is accomplished through a series of motions and positions of the links, joints, and wrist. The axes of movement that a robot has are referred to as degrees of freedom. These are mostly implemented in the areas that are highly dangerous or hazardous for humans.

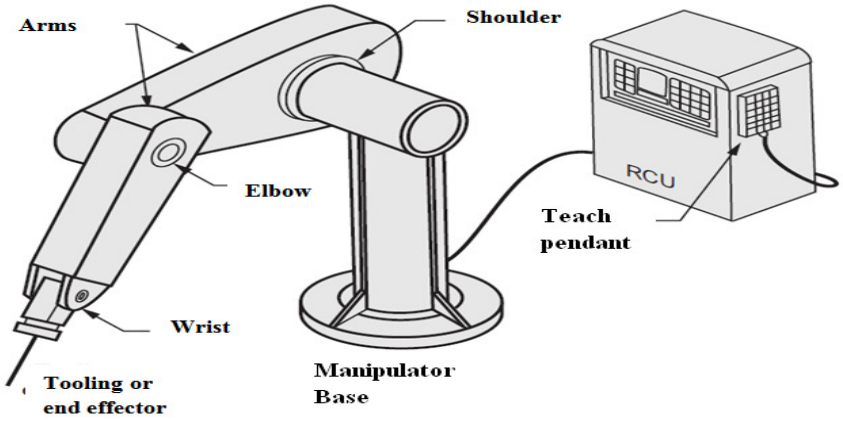

Figure:4 Industrial robot

1. **Performing dangerous tasks:** Robots perform tasks in unsafe environments, such as cleaning up hazardous waste. They reduce the risk of injury in the manufacturing industry, such as welding car bodies.
2. **Performing repetitive tasks**: Robots are able to repeat their actions accurately. They never become tired and can complete jobs requiring extreme precision. Robots will always perform their task in exactly the same way, such as drilling a hole in the same position.
3. **Operating in remote locations:** Robots are able to complete tasks in locations difficult for people to access, such as at the bottom of the ocean or in outer space. Robots are used to manufacture integrated circuits. The tiny components on a silicon chip require very precise placement that is difficult for humans.
4. **Saving labour costs:** Robots are able to work 24 hours a day, without lunch breaks, sick leave or holidays. Robots are expensive to design and install but when operational reduce labour costs.
5. **Exploration—**involves robots exploring dangerous or remote locations. Remote robots are commonly used for this task. The robot is partly controlled using radio or infrared signals. The operator directs the robot to go to a certain spot then the robot uses its sensors to find its own way. Robots are used to explore inside volcanos, other planets or to seek out landmines.
6. **Assembly line—**a series of workstations that gradually produce a product. Robots are used at these workstations to perform a physical task such as welding, painting or part fitting. Robots and people usually work together on the assembly line.
7. **Maintenance and repair—**robots fix equipment in many industries, such as a nuclear power plant, aircraft servicing and underwater facilities. Robots are chosen for this work because of their precision or because the location is dangerous or remote.

4.4 Flexible Manufacturing Systems: This automation is of fully automated one. Starting from planning and designing process to dispatching of products, the whole system is completely integrated to be automated. This automation combines numerically controlled machines, industrial robots and other automation equipment's into one integrated system.

Advantages of flexible automation

- Continuous production without downtime
- Flexibility to deal with product design variations
- Produced Customized product

Advantages of flexible automation

- High investment for a custom-engineered system
- High unit cost relative to fixed and programmable automation
- Large initial investment

5-CONCLUSIONS

Nowadays we need everything computerized and automated. Earlier we can only monitor the situations with the help of cameras. In industries to reduce manual overhead we have implemented Internet of things in Industry to monitor as well as to inform the responsible person to take appropriate measures, but this will partially fulfill our requirement. As sometimes it will be late in this process and it will harm to property as well as life. For this purpose we are developing a system for Industrial Automation using Internet of things with the help of Artificial Intelligence to make system automated which will take intelligent decisions.

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