Robotics and Automation

1. Introduction

The field of robotics has its origins in science fiction. The term robot was derived from the English translation of a fantasy play written in Czechoslovakia around 1920. It took another 40 years before the modern technology of industrial robotics began. Today Robots are highly automated mechanical manipulators controlled by computers. We survey some of the science fiction stories about robots, and we trace the historical development of robotics technology. Let us begin our chapter by defining the term robotics and establishing its place in relation to other types of industrial automation.

1.1 Robotics

Robotics is an applied engineering science that has been referred to as a combination of machine tool technology and computer science. It includes machine design,production theory, micro electronics, computer programming & artificial intelligence.

1.2 Industrial robot

The official definition of an industrial robot is provided by the robotics industries association (RIA). Industrial robot is defined as an automatic, freely programmed, servo-controlled, multi-purpose manipulator to handle various operations of an industry with variable programmed motions.

2. Automation and Robotics

Automation and robotics are two closely related technologies. In an industrial context, we can dean automation as a technology that is concerned with the use of mechanical, electronic, and computer-based systems in the operation and control of production. Examples of this technology include transfer lines. Mechanized assembly machines, feedback control systems (applied to industrial processes), numerically controlled machine tools, and robots. Accordingly, robotics is a form of industrial automation.
Ex:- Robotics, CAD/CAM, FMS, CIMS.

2.1 Types of automation:

Automation is categorized into three types. They are,
(a) Fixed Automation
(b) Programmable Automation
(c) Flexible Automation

2.2 Fixed Automation

It is the automation in which the sequence of processing or assembly operations to be carried out is fixed by the equipment configuration. In fixed automation, the sequence of operations (which are simple) are integrated in a piece of equipment. Therefore, it

is difficult to automate changes in the design of the product. It is used where high volume of production is required Production rate of fixed automation is high. In this automation, no new products are processed for a given sequence of assembly operations.

Features

i) High volume of production rates,
ii) Relatively inflexible in product variety (no new products are produced).
Ex:- Automobile industries … etc.

2.3 Programmable Automation

It is the automation in which the equipment is designed to accommodate various product configurations in order to change the sequence of operations or assembly operations by means of control program. Different types of programs can be loaded into the equipment to produce products with new configurations (i.e., new products). It is employed for batch production of low and medium volumes. For each new batch of different configured product, a new control program corresponding to the new product is loaded into the equipment. This automation is relatively economic for small batches of the product.

Features

i) High investment in general purpose,
ii) Lower production rates than fixed automation,
iii) Flexibility & Changes in products configuration,
iv) More suitable for batch production.
Ex:- Industrial robot, NC machines tools… etc.

2.4 Flexible Automation

A computer integrated manufacturing system which is an extension of programmable automation is referred as flexible automation. It is developed to minimize the time loss between the changeover of the batch production from one product to another while reloading. The program to produce new products and changing the physical setup i.e., it produces different products with no loss of time. This automation is more flexible in interconnecting work stations with material handling and storage system.

Features
i) High investment for a custom engineering system.
ii) Medium Production rates
iii) Flexibility to deal with product design variation,
iv) Continuous production of variable mixtures of products.
Ex:- Flexible manufacturing systems (FMS)

Advantages:
1.High Production rates
2. Lead time decreases
3. Storing capacity decreases
4. Human errors are eliminated.

5. Labour cost is decreases.

Disadvantages:

(a) Initial cost of raw material is very high,
(b) Maintenance cost is high,
(c) Required high skilled Labour.
(d) Indirect cost for research development & programming increases.

3. Reasons for Implementation of Automated Systems in Manufacture Industries

The reasons for the implementation of automated systems in manufacturing industries are as follows,

(a) To Increase the Productivity Rate of Labour
(b) To Decrease the Cost of Labour
(c) To Minimize the Effect of Shortage of Labour
(d) To Obtain High Quality of Products
(e) A Non-automation nigh Cost is Avoided
(f) To Decrease the Manufacturing Lead Time
(g) To upgrade the Safety of Workers.

Need for using robotics in industries

Industrial robot plays a significant role in automated manufacturing to perform different kinds of applications.

1. Robots can be built a performance capability superior to those of human beings. in terms of strength, size, speed, accuracy…etc.
2. Robots are better than humans to perform simple and repetitive tasks with better quality and consistence's.
3. Robots do not have the limitations and negative attributes of human works .such as fatigue, need for rest, and diversion of attention…..etc.
4. Robots are used in industries to save the time compared to human beings.
5. Robots are in value poor working conditions

4. CAD/CAM & Robotics

CAD/CAM is a term which means computer aided design and computer aided manufacturing. It is the technology concerned with the use of digital computers to perform certain functions in design & production.

CAD: CAD can be defined as the use of computer systems to assist in the creation modification, analysis OR optimization of design.

Cam: CAM can be defined as the use of computer system to plan, manage & control the operation of a manufacturing plant, through either direct or indirect computer interface with the plant's production resources.

4.1 Overview of Robotics

"Robotics" is defined as the science of designing and building Robots which are suitable for real life application in automated manufacturing and other non manufacturing environments. It has the following objectives,

1.To increase productivity
2. Reduce production life
3. Minimize labour requirement
4. Enhanced quality of the products
5. Minimize loss of man hours, on account of accidents.
6. Make reliable and high speed production.

5. Types of Drive Systems

1. Hydraulic drive
2. Electric drive
3. Pneumatic drive

5.1 Hydraulic drive

Hydraulic drive and electric drive arc the two main types of drives used on more sophisticated robots. Hydraulic drive is generally associated with larger robots, such as the Unimate 2000 series. The usual advantages of the hydraulic drive system are that it provides the robot with greater speed and strength. The disadvantages of the hydraulic drive system are that it typically adds to the floor space required by the robot, and that a hydraulic system is inclined to leak on which is a nuisance.
This type of system can also be called as non-air powered cylinders. In this system, oil is used as a working fluid instead of compressed air. Hydraulic system need pump to generate the required pressure and flow rate. These systems are quite complex, costly and require maintenance.

5.2 Electric drive

Electric drive systems do not generally provide as much speed or power as hydraulic systems. However, the accuracy and repeatability of electric drive robots are usually better. Consequently, electric robots tend to be smaller. Require less floor space, and their applications tend toward more precise work such as assembly. In this System, power is developed by an electric current. It required little maintenance and the operation is noise less.

5.3 Pneumatic drive

Pneumatic drive is generally reserved for smaller robots that possess fewer degrees of freedom (two- to four joint motions). In this system, air is used as a working fluid, hence it is also called air-powered cylinders. Air is compressed in the cylinder with the aid of pump the compressed air is used to generate the power with required amount of pressure and flow rates.

6 The Present and Future Application of Robotics

6.1 The present application of robotics

(i) Material transfer applications
(ii) (ii) Machine loading and unloading
(iii) Processing operations like,

(a) Spot welding
(b) Continuous arc welding
(c) Spray coating
(d) Drilling, routing, machining operations
(e) Grinding, polishing debarring wire brushing
(g) Laser drilling and cutting etc.

(iv) Assembly tasks, assembly cell designs, parts mating.
(v) Inspection, automation.

6. 2 Future Applications of Robots

The profile of the future robot based on the research activities will include the following,

(i) Intelligence
(ii) Sensor capabilities
(iii) Telepresence
(iv) Mechanical design
(v) Mobility and navigation (walking machines)
(vi) Universal gripper
(vii) Systems and integration and networking
(viii) FMS (Flexible Manufacturing Systems)
(Ix) Hazardous and inaccessible non-manufacturing environments
(x) Underground coal mining
(xi) Fire fighting operations
(xii) Robots in space
(xiii) Security guards
(xiv) Garbage collection and waste disposal operations
(xv) Household robots
(xvi) Medical care and hospital duties etc.

7. Automation Example Using Robotics

Then, let us look at an example of automation using robots. Let us take a real company job as an example. Suppose you have an employee at a company, and one of his jobs is to reflect the system of emails from essential customers immediately. In this case, if robot automation is applied, the following commands can be designed:

1. Log in to the corporate mail system
2. Read when a specific sender's mail arrives
3. Download attached file when specific word or form comes
4. Text excerpt in the specified location of the attached file
5. Company system login
6. Enter and save the extracted text in the company system
7. Send SMS or email to the person in charge in case of unexpected error
8. Write completion record after completion of work

The design and construction of such robotic automation start from imitating human behavior and, in other words, designing and imitating existing human behavior patterns as data. If this automation is fused with artificial intelligence, the dependence of data on human behavior and overall processes may increase. The procedure for

performing robot automation, designed as an example, was intended as a straightforward process. Still, in reality, it can be effectively applied to more complex and lengthy general

8. Areas That are Difficult to Apply Robotics

Although the robot's applicability is diverse, there are also limitations depending on the work's characteristics. Let us see what areas are difficult to automate using robots.

8.1 Customer's Service

Although it is possible to provide customer service such as simple customer counseling and question answering through chat-bots, emotional communication and communication with real customers can be said to be a field that humans must perform directly. Many companies use robots to support customer service, but it is unlikely that this change can replace all existing human service customer services. Communicating with customers and exchanging emotions would be difficult to expect from a robot of the current level.

8.2 Sales and Marketing

Simple repetitive tasks required for sales activities can be automated through robots, but establishing customer relationships, which are essential parts of sales, and in-depth communication with customers are areas that robots cannot perform at this time. Marketing activities that require creative thinking, such as planning the creative promotion of products, and building and setting brand images, are also areas that only humans, not robots, can be in charge of.

8.3 Human Resource and Management

Among the existing human resource work processes, repetitive and mechanical work can be automated through robots. However, the areas that require close relationships and thinking between humans, such as workforce education, leadership development, face-to-face interviews, and teamwork establishment, are areas that robots cannot perform. In addition to the previously introduced areas, in areas where human creativity, empathy, and cognitive ability are mainly required, it is not easy to expect complete automation of robots with the current technology level. In the future, if the remarkable growth of artificial intelligence creates human-like intellectual abilities and emotions, these areas may also be automated by robots.