Module 1 : Introduction to robotics

Lecture 1 : Automation

Objectives

In this course you will learn the following

- Automation
- Robot

Automation

There are several examples of automation one comes across daily, simple examples being sewing machines, packaging machines. Such machines are generally equipped to perform in a specific way or to execute specific tasks. A sewing machine is designed to produce specific stitch lengths and likewise a packaging machine is designed to wrap a specific size of the product. When product sizes change some parts of the machine are to be manually changed to accommodate the new size. Such machines are essentially designed to package millions of products of a specific size and are hence special purpose machines. The cost of such a machine is distributed over large sales volumes.

More recently there is a demand for variety. A good example is shirts of a size suiting a given individual. Likewise there is a demand for soaps of various sizes and shapes. This requires machines that can handle various shapes and sizes and every time such a requirement arises one has to stop the machine and readjust or reset some of the links or components to handle the new product. This is a task that is not only time consuming but also requires skill.

Human beings, unlike machines can not only handle tools and products of different sizes and shapes but are also capable of executing a variety of tasks. Engineers have often sought similar capabilities in machines and this has been possible now with the availability of inexpensive microprocessors.

Used in conjunction with special servo-motors, actuators and sensors, the microprocessor has revolutionized automation. It is now possible to build automation devices that can be operated under the guidance of a program. A familiar example is a printer that can be programmed to print the alphabet. A few key strokes would enable the user to change over to a program that enables one to draw diagrams. This capability is extended further through the use of sensors. For example a sensor in the printer does not permit the printing to begin unless a paper is present. These capabilities are extended further and when the machine is able to change its activity to suit a given situation it is called “autonomous”.

Robots

An important part of the automation scene is the area of “Robotics” a multidisciplinary field that involves mechanical, electronics and several other engineering disciplines. Though the ultimate aim is to attempt emulate human activities, something which is extremely difficult to attain, these attempts have resulted in development of robots. These are beneficial in handling hazardous tasks and for operating in hazardous areas like chemical or nuclear plants. Examples of such tasks include plates being x-rayed for inspection of internal cracks and flaws, a routine but hazardous operation.

Where complex movements are involved as in welding along a 3D profile, robots can be used for assuring quality and consistency. In assembly operation of precision and tiny parts, like in watches, robots perform with accuracy

and repeatability. (The SCARA robot developed in Japan is one such robot specifically suit5able for precision assembly tasks.) Painting is hazardous to humans and also complex movements are involved (for example in painting a car body) and in such applications robots may replace human beings.

Robots have certain inherent capabilities and limitations, just as any other machine or human being does, and these should be borne in mind when attempting to use them in a given application. A lathe is best used for generating cylindrical objects and milling machines are ideal for producing prismatic parts. One would not attempt to use a lathe for manufacture of prismatic parts or a milling machine to produce cylinders. Thus manufacturing processes are chosen to suit the product and conversely, products should be designed to suit the manufacturing process. This philosophy applies to robotics also. One cannot expect a given robot to execute any arbitrary task or handle any product. Some times it may be beneficial to redesign the product to enable robots to handle them with ease. A wellknown example of designing a product to suit robots is the SONY “Walkman” which has been designed for ease of assembly by robots.

Today robot finds applications in industries, medical and other fields. For example, in eye surgery (replacement of retina), where a cylindrical portion needs to be replaced, the operation is best done by robots. Mobile robots like walking machines, hopping machines are examples of robots, and so also are robotic aircraft and ships. Nuclear and power plants uses fish like robots which move inside pipes for purpose of inspection

Computers are required for higher level control of such complex systems. Computers convert higher level commands to lower level commands for purpose of interpreting sensor outputs and controlling motors in these machines. In autonomous robots, operating at remote locations, endurance of power supply (batteries) may be an issue.

Recap

In this lecture you have been briefly introduced to:

- Automation
- Robots

Congratulations, you have finished Lecture 1. To view the next lecture select it from the left hand side menu of the page