Industrial Automation

1. Industrial Automation

The Greek word automation means self dictated and is the use of control systems such as computers to control industrial machinery and processes, with the goal to replace human operators. In the scope of industrialization, automation is the step after mechanization. Whereas mechanization provides machines to assist the human operator and automation greatly reduces the need of human requirements as well.

The purpose of industrial automation is the increase of productivity or quality and the reduction of costs or the work in hazardous environments. For example in chip production where the dimensions are too small for the precision of a human hand robots are irreplaceable. But what is with simple assembly line work, like welding or packing, which could be done easily by "unskilled workers". There is an increase in automation and so more and more of these jobs get lost. But automation offers also new job possibilities, because there are high qualified people for programming and maintaining these production lines needed.

Industrial automation formerly came into sight of view with the invention of robots.

2. Industrial Robots

Industrial Robots are automatically controlled, reprogrammable robots designed for special purposes. Typical applications of industrial robots include welding, painting, pick and place, assembly and testing. The big advantages of these robots over humans are speed, precision, power and non-stop working. A robot could do the same action thousand of times the same way with and aberrance of about +0.15 millimetres. Though there are many jobs where the ability of the human senses is required and a robot could never replace it. Think of art, social jobs or the need of pattern and voice recognition. A six-axis robot costs about €60.000 and the more interesting thing is that programming and installing the robot costs another €200.000. The first patent for robotics was received by Georg Devel in 1954. But first automation was used in large scale was in the 1970s where many companies entered the field, but only a handful of American and European companies already exists. One of these manufacturers is the Austrian igm Robotersysteme AG.

2.1. Defining parameters

There are several parameters that define the abilities and power of robots.

- **number of axes**
  There are two axes needed to reach points in a plane and three are required to reach any point in space. To fully control the orientation of the end of the arm there are three more axis needed (roll, pitch and yaw).
  roll = turn round and round
  pitch = move up- and downwards
  yaw = to turn in an angle
- **kinematics**
  Kinematics (branch of mechanics which studies pure motion) defines all possible motions of the robot.

- **working envelope**
  The Working envelope specifies the region of space a robot can reach.
- **carrying capacity**
  Specifies the weight a robot can lift.
- **speed**
  The Speed specifies how fast the robot can position the end of its arm.
- **accuracy**
  Accuracy is the precision of the robot, or how closely a robot can reach a commanded position.
- **power source**
  Robots could be driven by electric motors or hydraulic actuators. The former are fast and the later are stronger and used in applications where a spark could set off an explosion.

2.2. Types

There are three main types of industrial robots for different tasks, which are mentioned in the next 3 paragraphs.

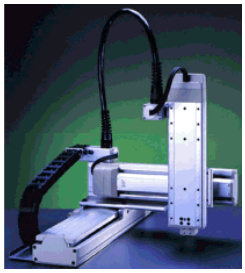
2.2.1. Robot Arm

Robot arms are the most flexible type of industrial robots. These robots are commonly six-axis robots and have the tool installed at the top end of the arm. The great advantage of this type of robot is the great flexibility and the 3d-motion in space but exactly this motion in space makes these type of robot extremely difficult to program. There are in total six parameters needed to control the arm, three for the axis (x,y,z) and three for the orientation (roll, yaw, pitch). These robots are used for welding, painting or handling materials.

2.2.2. SCARA robot

SCARA robots are the wide spread form of robots. These robots operate in the horizontal plane, given x-y position and orientation parallel to the plane. This is the typical “pick and place” robots. When combined with a vision system it can be used on a conveyer belt to package at a very high rate of speed.

2.2.3. Cartesian robot



Cartesian robots can operate in a plane in x-y-z direction. This type of robot is commonly used for surface mounted circuit board assembly where parts could be picked up on a pre-defined place and mounted on another place that is every time the same.

3. Future

In future the automation market is growing. Companies are going to build fully automated factories, where humans are only needed to program, control and maintain robots. But these are very expensive and inflexible production lines and so these fully automated lines could only be used for products that are produced over a long period of time in always the

same way. Smaller companies are going back to replace robots with workers, because these workers are more flexible and so new production processes could be easily adopted and the production process get more efficient and more flexible. But robots will also play a role in these production processes, but only as helpers to hand over parts or for work steps which need constant accuracy like welding or for work in hazardous environments. But all in all industrial robots get more and more.

4. References

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