The Survey on Industrial Robotics

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Abstract— A robot is a machine especially one programmable by a computer capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to how they look. These technologies are used to develop industrial revolutions that can substitute for humans and replicate human actions. Robots can be used in many situations and for lots of purposes. In this paper we examine that how the robotic technology used in industry, the different types of robots and their function.

Keywords: Robot, Robotics, Industrial Revolution, Types of Robots

OBJECTIVE

- To understand the concept of industrial robot.
- To know the functioning of robots in industries.
- To familiarize with parts of robot.

I. INTRODUCTION

A robot is a machine that resembles a living creature in being capable of moving independently (as by walking or rolling on wheels) and performing complex actions (such as grasping and moving objects).

Robots can be autonomous or semi-autonomous and range from humanoids such as Honda's Advanced Step in Innovative Mobility (ASIMO) and TOSY's TOSY Ping Pong Playing Robot (TOPIO) to industrial robots, medical operating robots, patient assist robots, dog therapy robots, collectively programmed swarm robots, UAV drones such as General Atomics MQ-1 Predator, and even microscopic nano robots. By mimicking a lifelike appearance or automating movements, a robot may convey a sense of intelligence or thought of its own. Autonomous things are expected to proliferate in the coming decade, with home robotics and the autonomous car as some of the main drivers.

An industrial robot is a robot system used for manufacturing. Industrial robots are automated, programmable and capable of movement on three or more axis. Typical applications of robots include welding, painting, assembly, pick and place for printed circuit boards, packaging and labeling, palletizing, product inspection, and testing; all accomplished with high endurance, speed, and precision. They can assist in material handling.

Fig. 1.1: Industrial Robot

II. THE FIRST INDUSTRIAL ROBOT

In 1961 the first industrial robot, Ultimate, created by American inventor George Devol, was in operation on a General Motors assembly line at the Inland Fisher Guide Plant in Ewing Township, New Jersey. The 4000 pound robotic arm transported die castings from an assembly line and welded these parts on auto bodies, a dangerous task for workers, who could be poisoned by exhaust gas or lose a limb if they were not careful. The first Unimate prototypes were controlled by vacuum tubes used as digital switches though later versions used transistors. Further, the "off-the-shelf" parts available in the late 1950s, such as digital encoders, were not adequate for the Unimate purpose, and as a result, with Devol's guidance and a team of skilled engineers, Unimation designed and machined practically every part in the first Unimates. They also invented a variety of new technologies, including a unique rotating drum memory system with data parity controls.

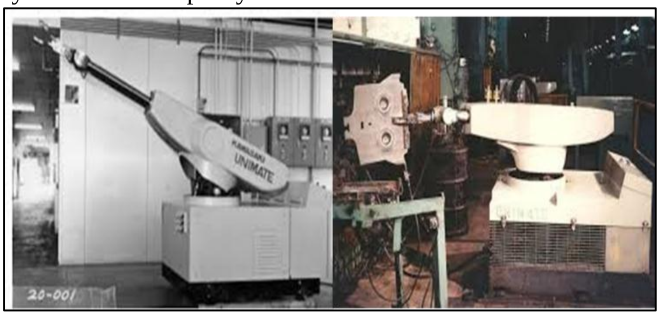

Fig. 2.1: First Industrial Robot (UNIMATE)

III. TYPES OF INDUSTRIAL ROBOTS

The most commonly used robot configurations are articulated robots, SCARA robots, delta robots and Cartesian, (gantry robots or x-y-z robots). In the context of general robotics, most types of robots would fall into the category of robotic arms (inherent in the use of the word manipulator in ISO standard 1738). Robots exhibit varying degrees of autonomy.

A. *SCARA Robots*

The SCARA acronym stands for Selective Compliance Assembly Robot Arm or Selective Compliance Articulated Robot Arm.

In 1981, Sankyo Seiki, Pentel and NEC presented a completely new concept for assembly robots. The robot was developed under the guidance of Hiroshi Makino, a professor at the University of Yamanashi. The robot was called Selective Compliance Assembly Robot Arm, SCARA. Its arm was rigid in the Z-axis and pliable in the XY-axes, which allowed it to adapt to holes in the XY-axes. By virtue of the SCARA's parallel-axis joint layout, the arm is slightly compliant in the X-Y direction but rigid in the 'Z' direction, hence the term: Selective Compliant. This is advantageous for many types of assembly operations, i.e., inserting a round pin in a round hole without binding.

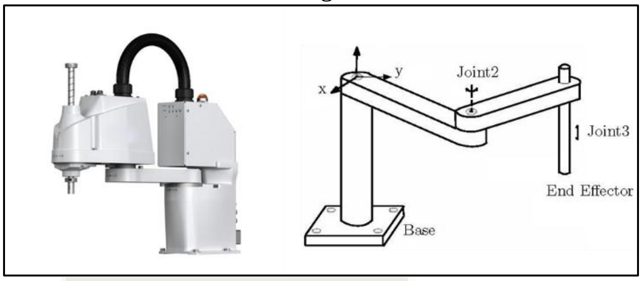

Fig. 3.1.1: SCARA Robot

B. *Articulated Robot*

An articulated robot is a robot with rotary joints (e.g. a legged robot or an industrial robot). Articulated robots can range from simple two-jointed structures to systems with 10 or more interacting joints. They are powered by a variety of means, including electric motors. Some types of robots, such as robotic arms, can be articulated or non-articulated

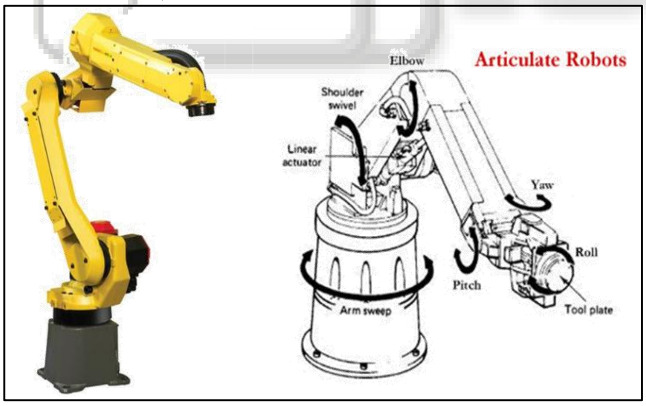

Fig. 3.2.1: Articulated Robot

C. *Cartesian co-ordinate Robots (Gantry Robot)*

A Cartesian coordinate robot (also called linear robot) is an industrial robot whose three principal axes of control are linear (i.e. they move in a straight line rather than rotate) and are at right angles to each other. The three sliding joints correspond to moving the wrist up-down, in-out, back-forth. Among other advantages, this mechanical arrangement simplifies the Robot control arm solution. Cartesian coordinate robots with the horizontal member supported at both ends are sometimes called Gantry robots; mechanically, they resemble gantry cranes, although the latter are not generally robots. Gantry robots are often quite large.

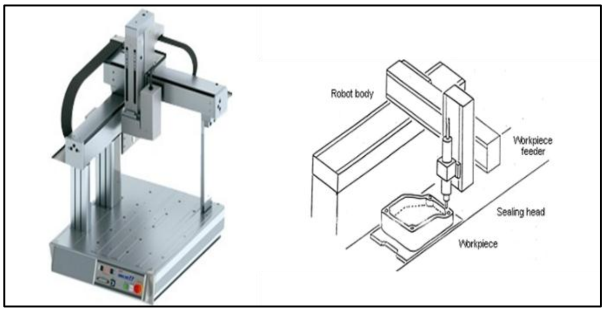

Fig. 3.3.1: Cartesian Robot

IV. TECHNICAL DESCRIPTION OF ROBOT

- Number of axes: two axes are required to reach any point in a plane; three axes are required to reach any point in space. To fully control the orientation of the end of the arm (i.e. the wrist) three more axes (yaw, pitch, and roll) are required. Some designs (e.g. the SCARA robot) trade limitations in motion possibilities for cost, speed, and accuracy.
- Degrees of freedom: this is usually the same as the number of axes.
- Working envelope: the region of space a robot can reach.
- Kinematics: the actual arrangement of rigid members and joints in the robot, which determines the robot's possible motions. Classes of robot kinematics include articulated, Cartesian, parallel and SCARA.
- Carrying capacity or payload: how much weight a robot can lift.
- Speed: how fast the robot can position the end of its arm. This may be defined in terms of the angular or linear speed of each axis or as a compound speed i.e. the speed of the end of the arm when all axes are moving.
- Acceleration: how quickly an axis can accelerate. Since this is a limiting factor a robot may not be able to reach its specified maximum speed for movements over a short distance or a complex path requiring frequent changes of direction.
- Accuracy: how closely a robot can reach a commanded position. When the absolute position of the robot is measured and compared to the commanded position the error is a measure of accuracy. Accuracy can be improved with external sensing for example a vision system or Infra-Red. See robot calibration. Accuracy can vary with speed and position within the working envelope and with payload (see compliance).
- Repeatability: how well the robot will return to a programmed position. This is not the same as accuracy. It may be that when told to go to a certain X-Y-Z position that it gets only to within 1 mm of that position. This would be its accuracy which may be improved by calibration. But if that position is taught into controller memory and each time it is sent there it returns to within 0.1mm of the taught position then the repeatability will be within 0.1mm.

V. EVOLUTION OF INDUSTRIAL ROBOTS

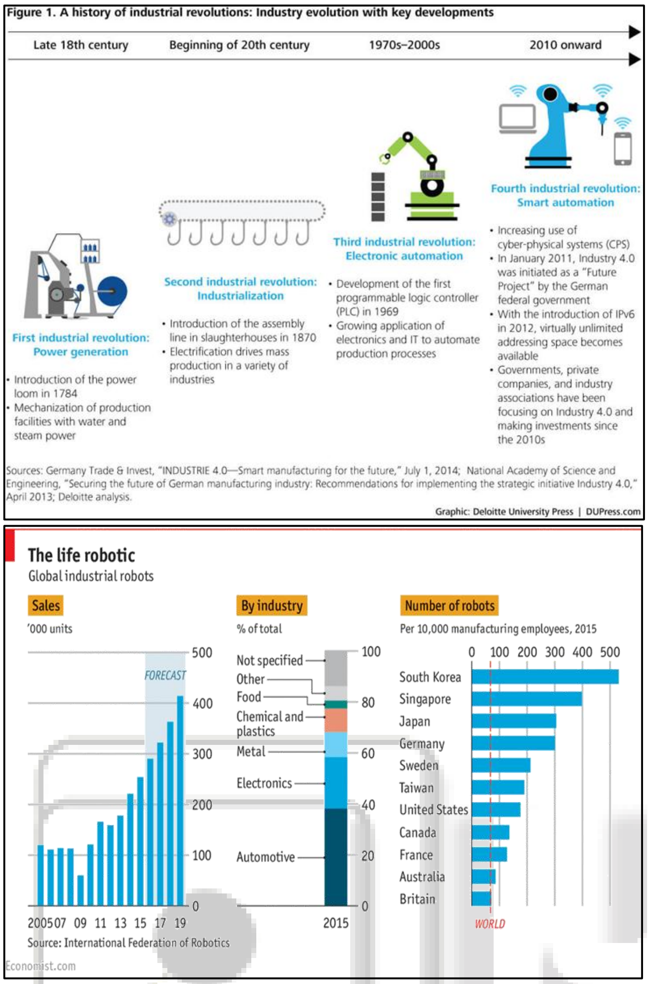

Fig. 5.1: Evolution of industrial robots

VI. ADVANTAGES

A. Decreased Production Costs:

A quick return on investment (ROI) outweighs the initial setup costs. With robots, throughput speeds increase, which directly impacts production.

B. Shorter Cycle Times:

A lean manufacturing line is crucial for increasing efficiency. An automated robot has the ability to work at a constant speed without pausing for breaks, sleep, or vacations, and ultimately has the potential to produce more in a shorter time than a human worker.

willing to do anything in their power to make sure your company can overcome some of these challenges.

C. Understanding the Big Initial Investment:

The initial investment to integrating automated robotics into your business can be significant, especially when business owners are limiting their purchases to new robotic equipment only. The cost of robotic automation should be calculated in light of a business' greater financial budget. Regular maintenance needs can have a financial toll as well.

D. Identifying Your Needs:

Incorporating industrial robots does not guarantee results. Devising a specific production plan from the beginning to the end is absolutely crucial. If a company has a bottleneck farther down the line, incorporating automation may not help achieve the goals needed. Here is a simple ROI calculator to help you decide if automating would be of benefit to your company.

E. Understanding the Importance of Training:

Employees will require training for programming and interacting with the new robotic equipment. This normally takes time and financial output. Fortunately, at Rootworm, we provide training, a warranty, and customer support.

F. Improved Quality and Reliability:

Applications are performed with precision and high repeatability every time. It ensures the product is manufactured with the same specifications and process every time. Repairs are few and far between.

G. Better Floor Space Utilization:

By decreasing a footprint of a work area by automating parts of your production line, you can utilize the floor space for other operations and make the process flow more efficient.
Reduced Waste: Robots are so accurate that the amount of raw material used can be reduced, decreasing costs on waste. Attract More Customers: Reduction in schedule and cost attracts customers. Automation helps provide the highest throughput with least amount of spending.

H. Increased Safety:

Robots increase workplace safety. Workers are moved to supervisory roles where they no longer have to perform dangerous applications in hazardous settings. Light screens or barriers are available to keep the operator out of harms way.

VII. CONCLUSION

In this paper, Industrial Robots are discussed. The paper begins with a description of its part. Next to this, the principle of operation and the working of an industrial robot are discussed. Special consideration in case of industrial robots and the possible types of robots used in industries are also noted down. The paper finishes with the discussion of the advantages of industrial robots.

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