eNotes

INDUSTRIAL OF ROBOTICS

POLITEKNIK MALAYSIA
SULTAN MIZAN ZAINAL ABIDIN

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MECHANICAL ENGINEERING DEPARTMENT
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FIRST PUBLISHING 2022

PUBLISHING BY :

Department of Mechanical Engineering
Politeknik Sultan Mizan Zainal Abidin
KM 08. Jalan Paka, 23000 Dungun, Terengganu

ENOTES INDUSTRIAL ROBOTICS EDITION 2022

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Perpustakaan Negara Malaysia Cataloguing-in-Publication Data
Sullyfaizura Mohd. Rawi, Ts., 1983-
eNotes :INDUSTRIAL OF ROBOTICS/PREPARED BY :
Ts. SULLYFAIZURA BINTI MOHD RAWI, SYAZRIN AKLILI BINTI AB RAHMAN, NORAZLINA BINTI BADARUDDIN.
Mode of access: Internet eISBN 978-967-0047-03-4
Robots, Industrial
Robotics
Mechanical engineering
Government publications--Malaysia
Electronic books
Syazrin Aklili Ab. Rahman, 1984-.II.Norazlina Badaruddin, 1985-.
III. Title.670.4272

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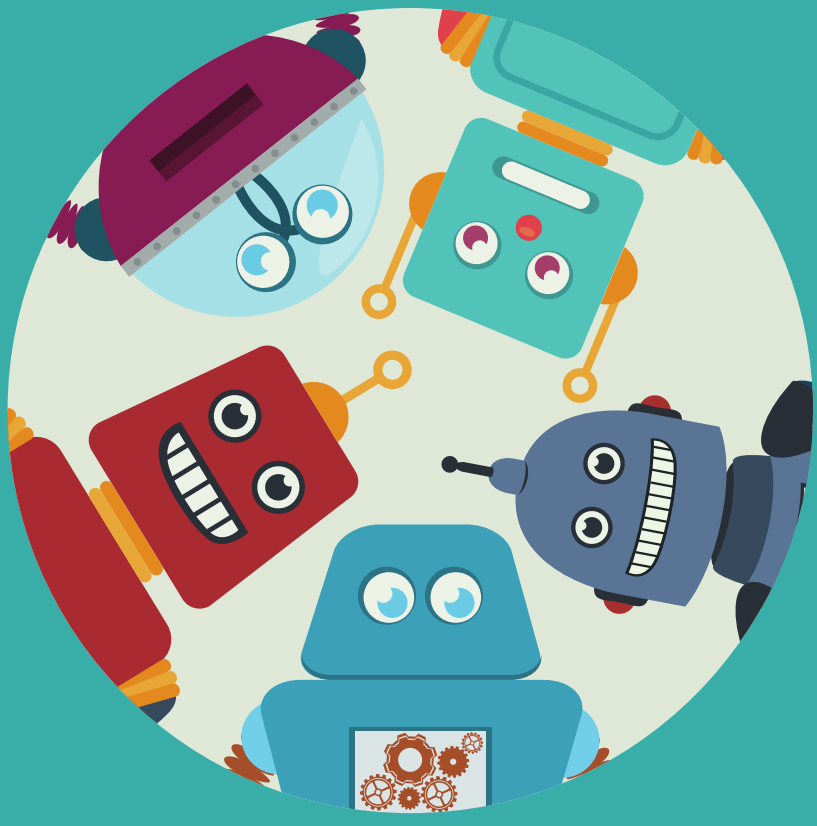
Politeknik Sultan Mizan Zainal Abidin
Dungun, Terengganu

eNotes :

2022 Edition

eNotes - Industrial Robotics is as general references and readings especially to lecturers and students of polytechnics and colleges Malaysian community to apply best practices in method implementation online teaching and learning



ACKNOWLEDGEMENT

Praise our gratitude to the presence of God Almighty. By His grace and guidance, the author was able to complete a scientific work entitled "Industrial of Robotic". Not forgetting the author to thank Mr. Roshaizul Nizam Bin Mohd Sani as an e-Learning coordinator who has assisted the author in producing this scholarly work. The author also thanks the friends who have contributed to the making of this scientific work. This scholarly paper provides guidance in the learning of Industrial Robotics especially for manufacturing and mechanical engineering. The author realizes there are shortcomings in this scientific work. Therefore, suggestions and criticism are always expected for the improvement of the author's work. The author also hopes that this scholarly work will be able to provide additional knowledge to students and anyone who wants to know the basics of the Industrial of Robotic in Manufacturing System.

ABSTRACT

Enotes - Industrial Robotics in Manufacturing system provides an overview of industrial robotics from the ground up in the manufacturing industry. It is intended for students at diploma level in manufacturing engineering, lecturers and industry practicing engineers who want an overview of the production using robotics in manufacturing systems. Enotes - Industrial Robotics has five topics that have been highlighted according to the operations of a manufacturing system. Thus, the subjects emphasized are : the definitions of industrial Robotics, robot of components, robot of design configuration, robot of programming, and robot of application. The enotes - industrial robotics attempts a compromise between theory and practice in all addressed industrial robotics issues, covering a long spectrum of issues from traditional manufacturing processes to innovative technologies using robotics system in manufacturing application such as welding, assembly painting and etc. This enotes acts as general references and readings especially to lecturers and students of polytechnics and colleges Malaysian community to apply best practices in method implementation online teaching and learning.

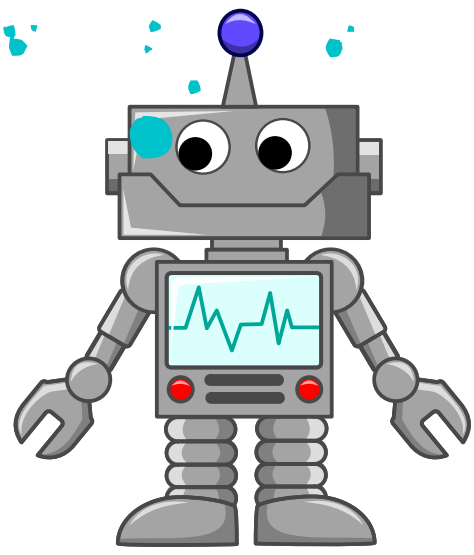
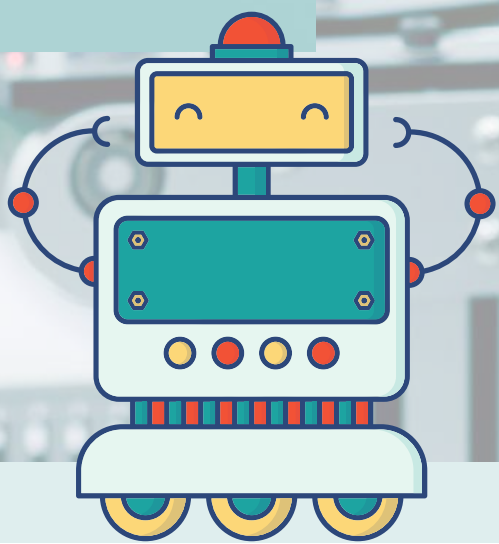


TABLE OF CONTENTS

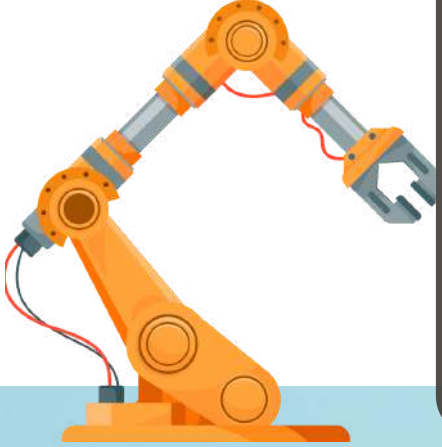
Industrial robotics describes the advantages and disadvantages of using robots, as well as the classification systems that are used with robots. Actuators, tooling, robot sensors, end effectors, and control systems are all being researched. Robot programming and robot application operations are also covered.



INTRODUCTION

This chapter includes the terms "robot," "robot features of system components," "robot configuration in the workspace," "robot programming," and "robot implementations in the manufacturing industry"

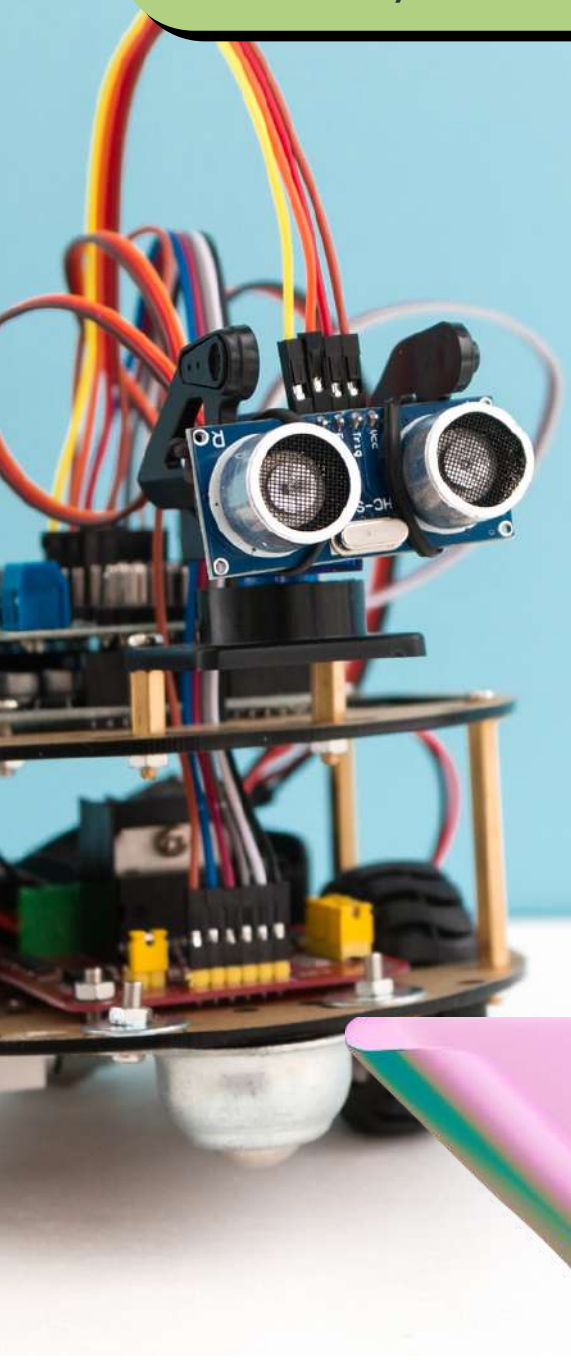
Industrial robots are robots that are widely used in automation systems to manufacture a variety of products. It is a generation of iron-collar workers who can work three shifts a day without stopping. Industrial robots are also a necessary tool that can catalyses current and future technological advancements.



DEFINITION IN INDUSTRIAL ROBOTICS

Term origin of the word "robot" :

The word in Czech is "robota" means "labour," and "robotnik" means "workman. "Rossum's Universal Robots" is a work that was written by Karel Capek in 1923.



British Robotic Association defines :

A robotic system is a re - programmable device that can move and carry parts, tools, or specific industrial implements using changeable programmed

ISO 8373:2012 defines industrial robots as follows:

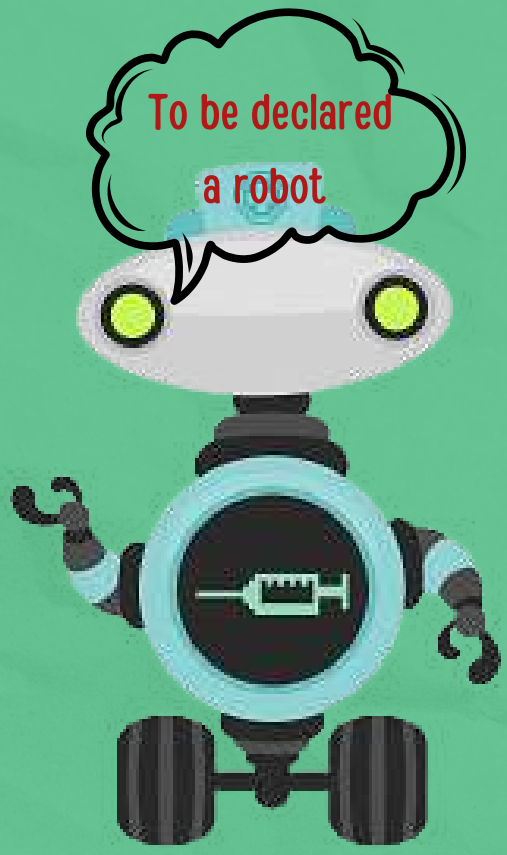
An automatically controlled, re-programmable, multifunction manipulator with three or more axes that can be fixed or portable in robotics systems.

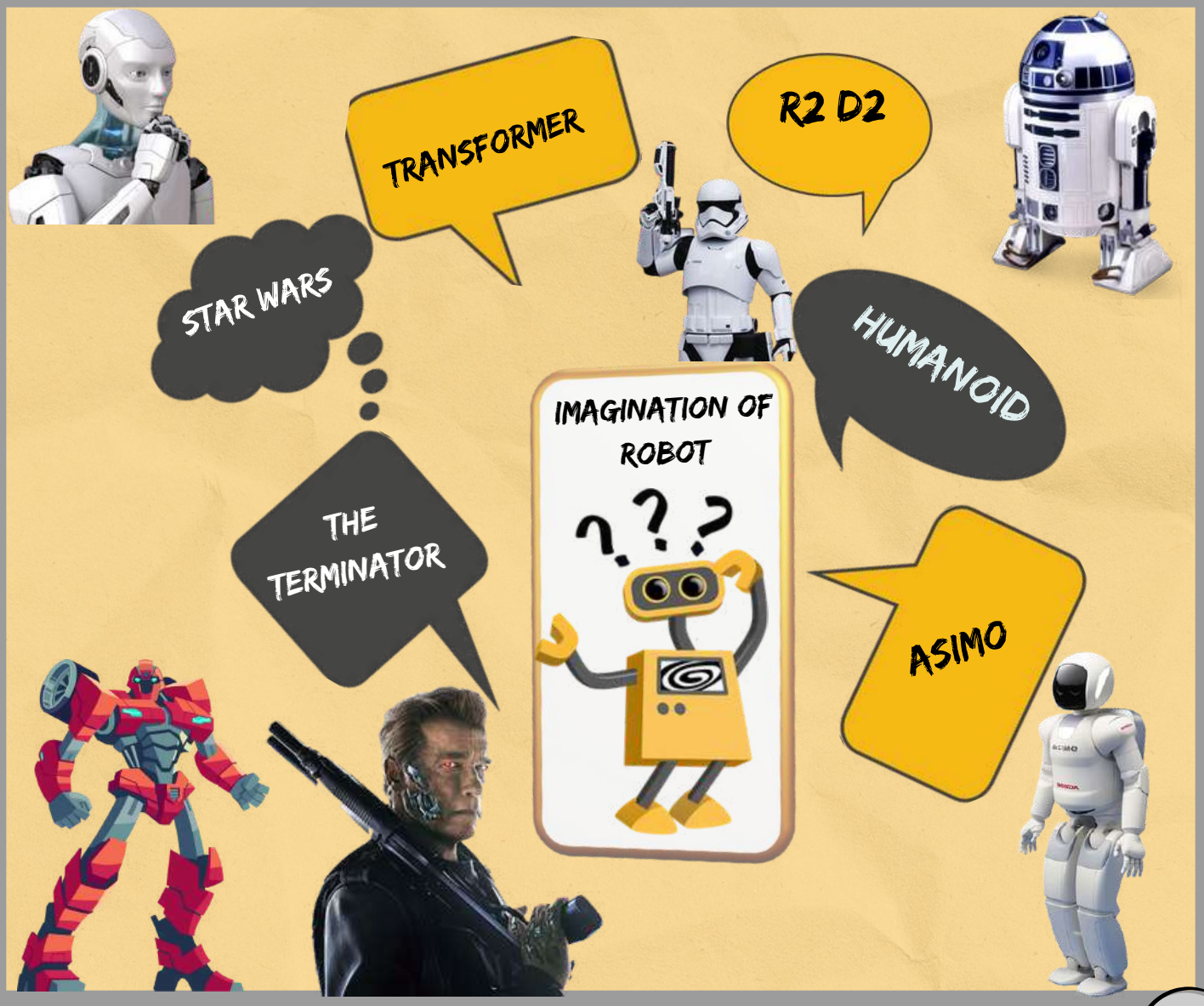
In general, the definition of a robot is: :

Machines that have been programmed and can simulate or imitate the appearance and actions of sentient entities such as humans or people.

To qualify a machine to be certified as a robot, it is necessary to do the following:

1. Perception & sensing: information can be gathered through the surroundings or environment.
2. Sensing and perception: gathering information from the environment
3. Diversity in performing tasks: manipulation and movement to do something physically, such as manipulating and moving an object.
4. It can perform a variety of functions and can be programmed for whenever needed.





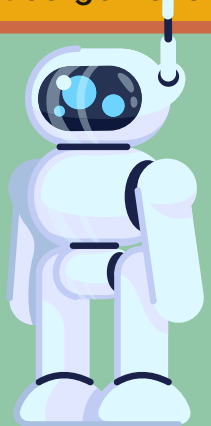
The history of robotics is intertwined with that of technology, science, and progress's fundamental ideas. Computing, electrical, and even pneumatic and hydraulics technology can all be regarded part of the robotics history.

TIMELINE OF HISTORIC ROBOT

part of the history of the timeline for industrial robots.

1951

Industrial robots and their applications in industry were pioneered by Joseph Engelberger and George Devol.



1961

Starting at the General Motors plant, the first industrial robot from Unimate from Unimation was inspired for the plant as a casting machine unloading machine.

1970

Unimation placed a PUMA (Programmable Universal Machine for Automation) robot in a GM plant. The importance of vision, tactile sense, and intelligent control becomes clear for research areas as the result.

1999

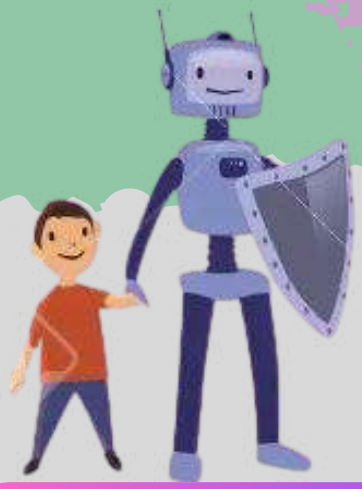
Sony launches its first artificial intelligence robot which is marked to consumer as a robotic pet

2010-2020

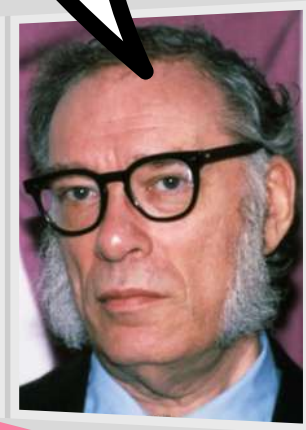
Dyson is working on technology to develop a robot with greater awareness. Nasa unveils Robonuts 2, which can perform tasks in space. It is guided remotely by an astronauts or mission control operator.

3 LAW OF ROBOT

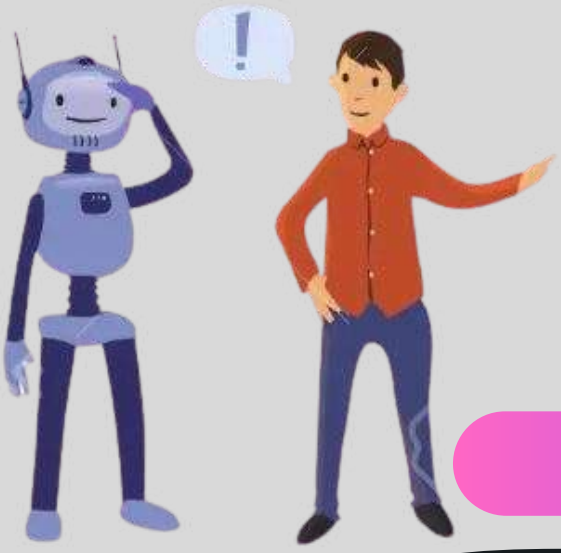
Isaac Asimov is a very famous robot figure. In 1981, he created a law to control living robots known as the 3 Robotic Law.



A robot shall not damage a person or, by doing nothing, permit someone to get hurt.

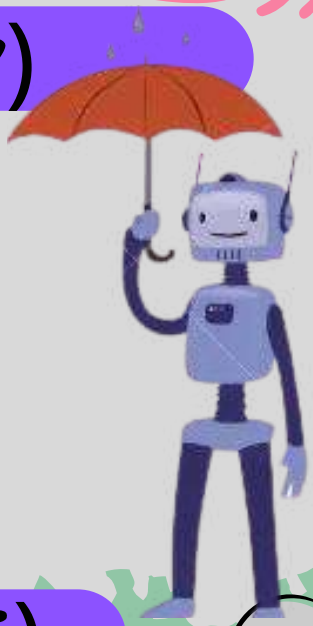


LAW 1 (PROTECT)

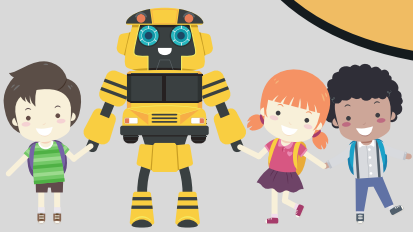


A robot is obligated to follow human commands unless doing so would violate the First Law

LAW 2 (OBEY)



A robot shall safeguard its own existence if doing so does not violate the First or Second Laws.

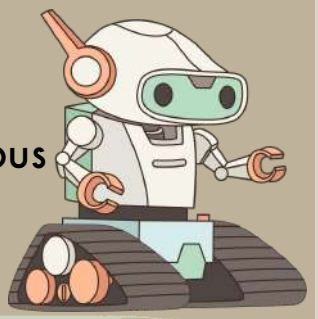


LAW 3 (SURVIVE)

"WHY USE ROBOT ?"

USE IN 4D SURROUNDINGS

- Difficult
- Dirty
- Dangerous
- Dull.



BOOST EFFECTIVELY

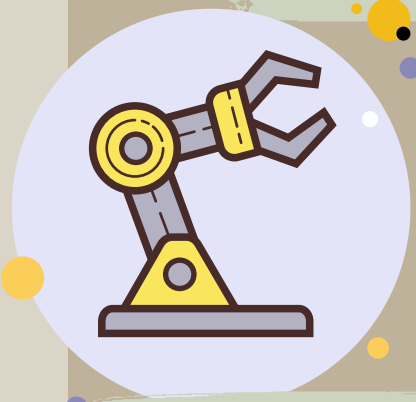
- can do work continuously without stopping and fatigue.
- No need to apply for leave

IMPROVED QUALITY OF PRODUCT

- Excellent preciseness
- Repetitive accuracy for inspection
- Product consistency in production.

SHORTEN MANUFACTURING

- lead times by responding quickly to design changes

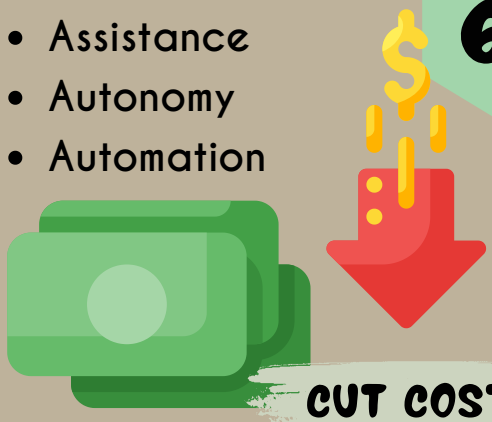


BOOST FOR SAFETY

- Work in a hazardous workplace
- Does not require the comfort of the environment (noise reduction, air conditioning)

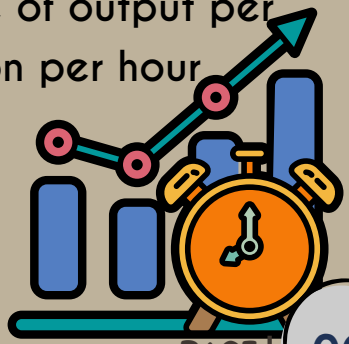
PERFORM TASK 4A

- Augmentation
- Assistance
- Autonomy
- Automation



BOOST PRODUCTIVITY

- increasing the value of output per person per hour



CUT COSTS

- lowering the scrap rate
- reducing in-process stock
- saving labor costs

TASK OF ROBOT

AEROSPACE

This covers a lot of ground. It features a variety of flying robots, such as the Raven surveillance drone and the robotic seagull Smart Bird.

DRONES

Drones, which are often referred to as unmanned aerial vehicles, are available in a range of sizes and levels of autonomy.

CONSUMER

Robots that you may buy and use for entertainment purposes or to assist you with chores and duties are known as consumer robots

EDUCATION

For usage at home or in classrooms, this broad category is intended for the upcoming generation of roboticists.

DISASTER RESPONSE

These robots carry out hazardous tasks like looking for survivors after a disaster.

ENTERTAINMENT

These robots are made to elicit an emotional response from us, such as making us laugh, feel surprised, or be in awe of them.

SELF-DRIVING CARS

Robotic vehicles are becoming increasingly common, and some can even drive themselves.

HUMANOID

Probably the majority of people picture robots like this when they think of them.

MEDICAL

Systems like the Da Vinci surgical robot and bionic prosthesis are examples of medical , health-care robots, & robotic exoskeleton

INDUSTRIAL

An arm with a manipulator serves as the basic component of an industrial robot in the classic sense.

MILITARY & SECURITY

Ground robots deployed by the military include the BigDog gear assister and the PackBot improvised explosive device scout from Endeavor Robotics.

UNDERWATER

These robots enjoy spending time in the water.

RESEARCH

In universities and industrial research labs, the majority of today's robots are created.

ADVANTAGES USING ROBOT IN MANUFACTURING INDUSTRY

DIRECT LABOR COSTS HAVE BEEN REDUCED

The use of robots can reduce the labour costs paid for workers who perform many tasks for production. The firm may use the skills, abilities, and expertise of its employees in areas like programming, maintenance and engineering.

SUSTAINING MANUFACTURING

Although it is now seen that many sectors use robots to replace workers in the workplace, most industrial robots need to be integrated in line with human expertise for certain tasks such as programming and maintenance.

IMPROVED SECURITY

Robots are capable of doing repeated work. This lowers the possibility of worker injuries, especially when production is done in a hazardous area. Furthermore, the process can be monitored by supervisors from remote areas or via the internet (online).

MAXIMUM & PRODUCTIVITY THROUGHPUT

Industrial robots can increase the speed of manufacturing operations by enabling non-stop manufacturing operations. Product production can be carried out 24 hours a day, 7 days a week. Scheduled breaks and shift changes for employees are not required for industrial robots.

IMPROVED CONSISTENCY AND QUALITY

Better production for more accurate and reliable production quality can be achieved with the use of industrial robots along with other technologies such as IoT and 3D printing.

DISADVANTAGES OF ROBOT

INVESTING ADVANCEMENTS WITH A LARGE CAPITAL

- The development of robots in an operation necessitates a significant upfront cost/ investment. Before purchasing a robot for a business, it is necessary to conduct study.
- A determination of all expenditures, including installation and configuration, must be evaluated. whether the robot is easily detachable for modification in the case of a change in operation is also required.

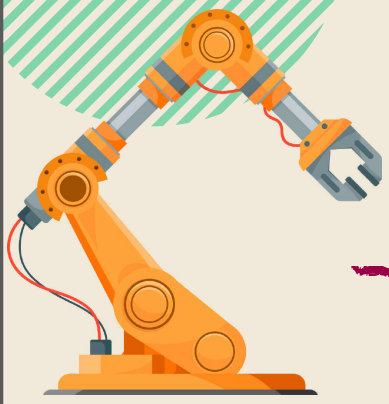
RECURRENT EXPENSES

- For the future, the ongoing expenditure of robots is necessary to be emphasised for the preparation of maintenance costs, although industrial robots can generally reduce some of the labour costs of manufacturing.
- In addition, one of the issues to consider is the cost of securing any IoT-related device that can be safeguarded from cyber threats.

EXPERT KNOWLEDGE CAN BE HARD TO OBTAIN

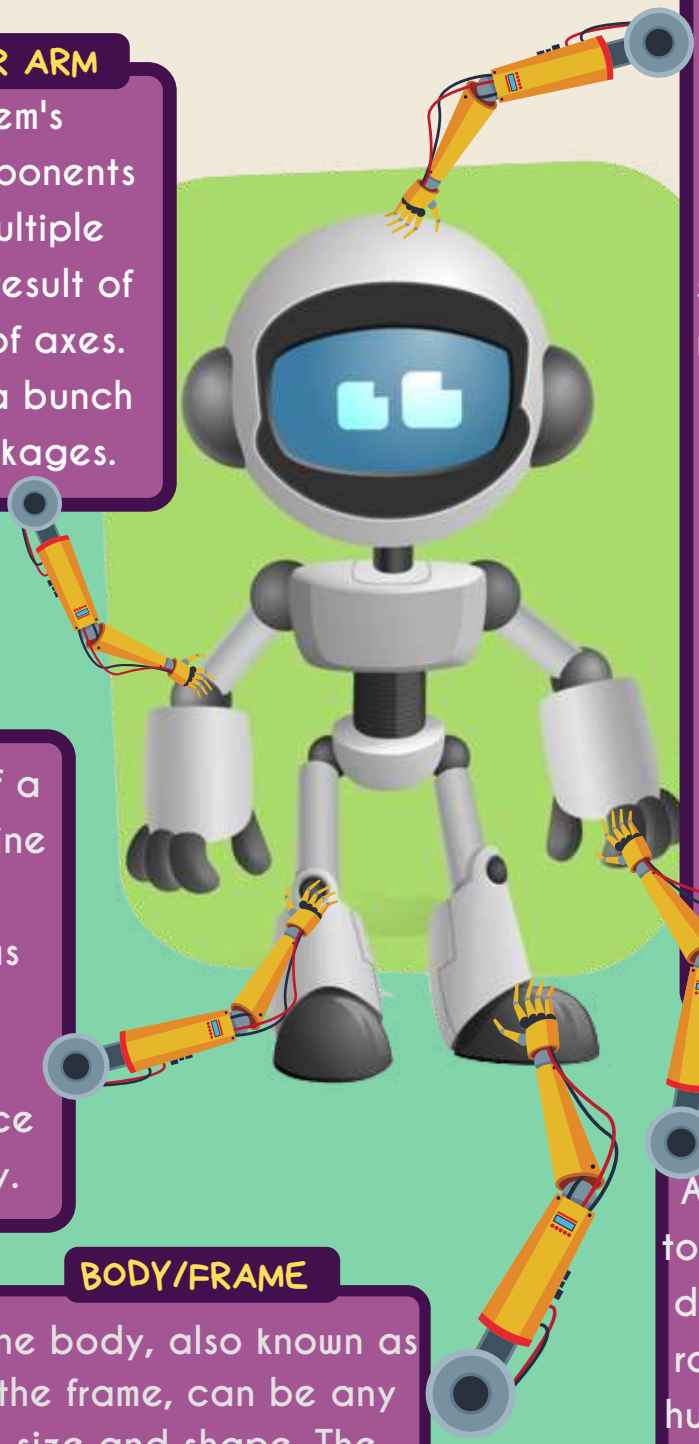
- Starting at the General Motors plant, the first industrial robot from Unimate from Unimation was inspired for the plant as a casting machine unloading machine.
- Therefore, it is important for organisations to train employees and consider existing staff to enhance expertise in the field.

ROBOT COMPONENT



MANIPULATOR ARM

A robot system's mechanical components may move in multiple directions as a result of a combination of axes. It's made up of a bunch of joints and linkages.



SENSOR

A device that responds to physical stimuli such as pressure, heat, light, magnetism, motion, sound, and so on. The response will send the resulting signal and data to provide measurements that handle the control or both. The response will send the resulting signal or data for the purpose of providing a measurement, controlling a device, or both.

ACTUATOR

a component of a device or machine that converts energy, such as air, hydraulic pressure into mechanical force and electrically.

END EFFECTOR

A robot's specialized tooling that allows it to do a certain task. The robot's analogue of a human hand, as well as the tooling that the hands grip to do a task.

BODY/FRAME

The body, also known as the frame, can be any size and shape. The structure of the robot is basically provided by the body/frame.

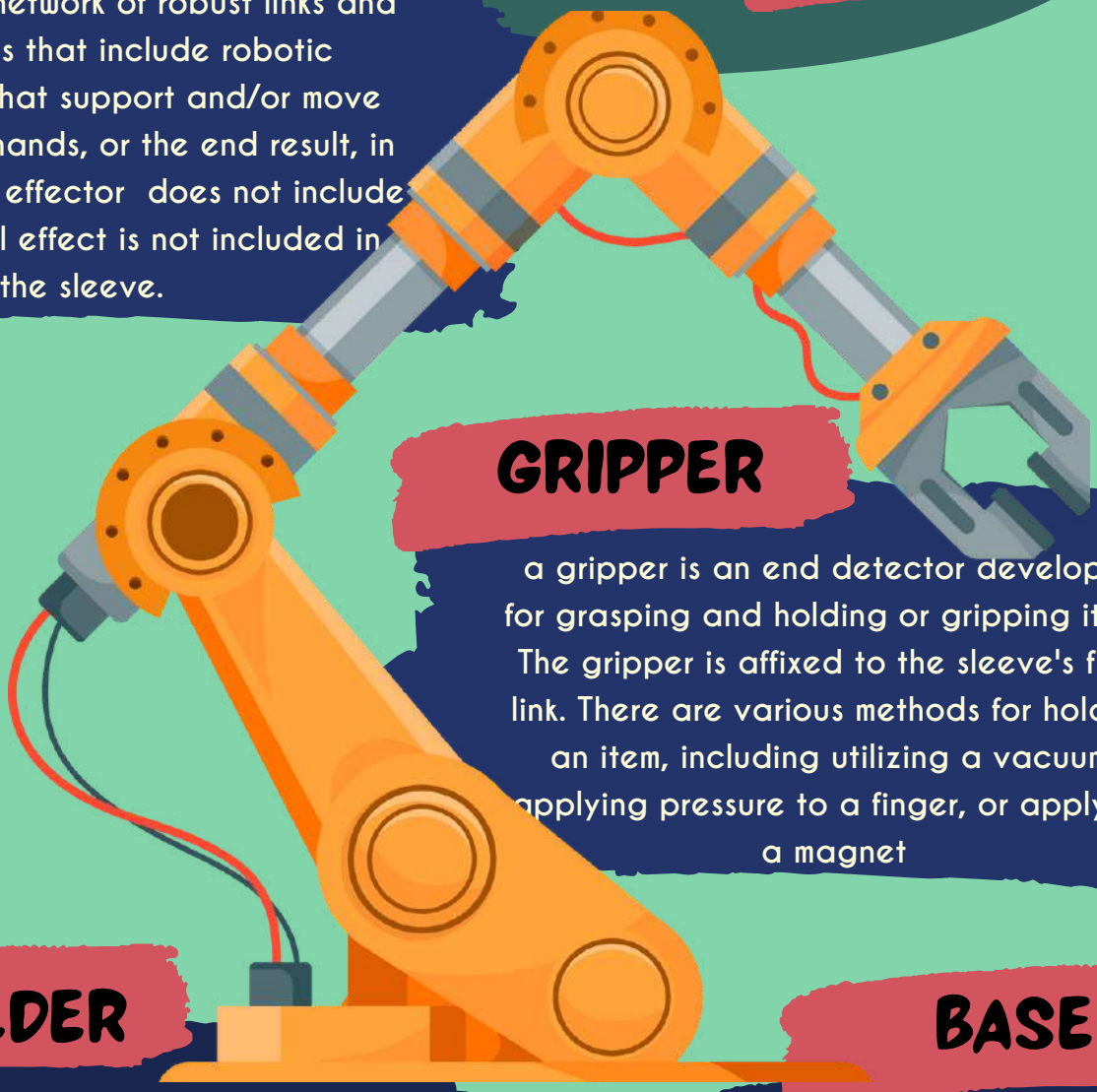
ROBOT INDUSTRY COMPONENT

A wrist joint is a group of joints that connect the arm to the robot's end effector and allow the end effector to be aligned with the workpiece. The wrist of the robot has a degree of flexibility, allowing it to grab items with orientations like pitch, yaw, and roll.

WRIST

ARM

An integrated network of robust links and connections that include robotic manipulators that support and/or move the wrists and hands, or the end result, in space. The end effector does not include in the arm final effect is not included in the sleeve.



GRIPPER

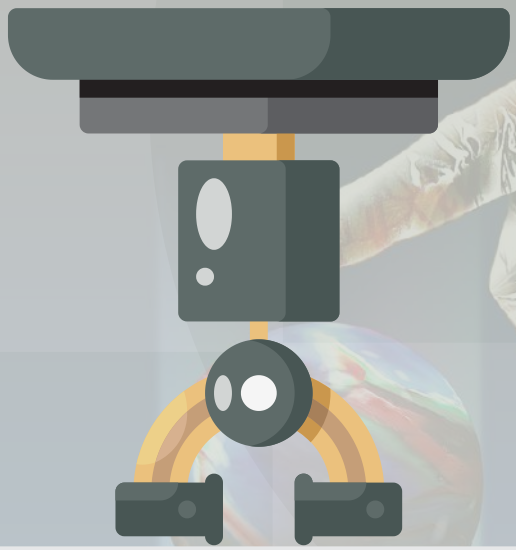
a gripper is an end detector developed for grasping and holding or gripping items. The gripper is affixed to the sleeve's final link. There are various methods for holding an item, including utilizing a vacuum, applying pressure to a finger, or applying a magnet

SHOULDER

Because it resembles a human shoulder, the first or second axis of a robot is always referred to as the axis on the shoulder. This term is often used to describe two-handed or examples of humanoid systems.

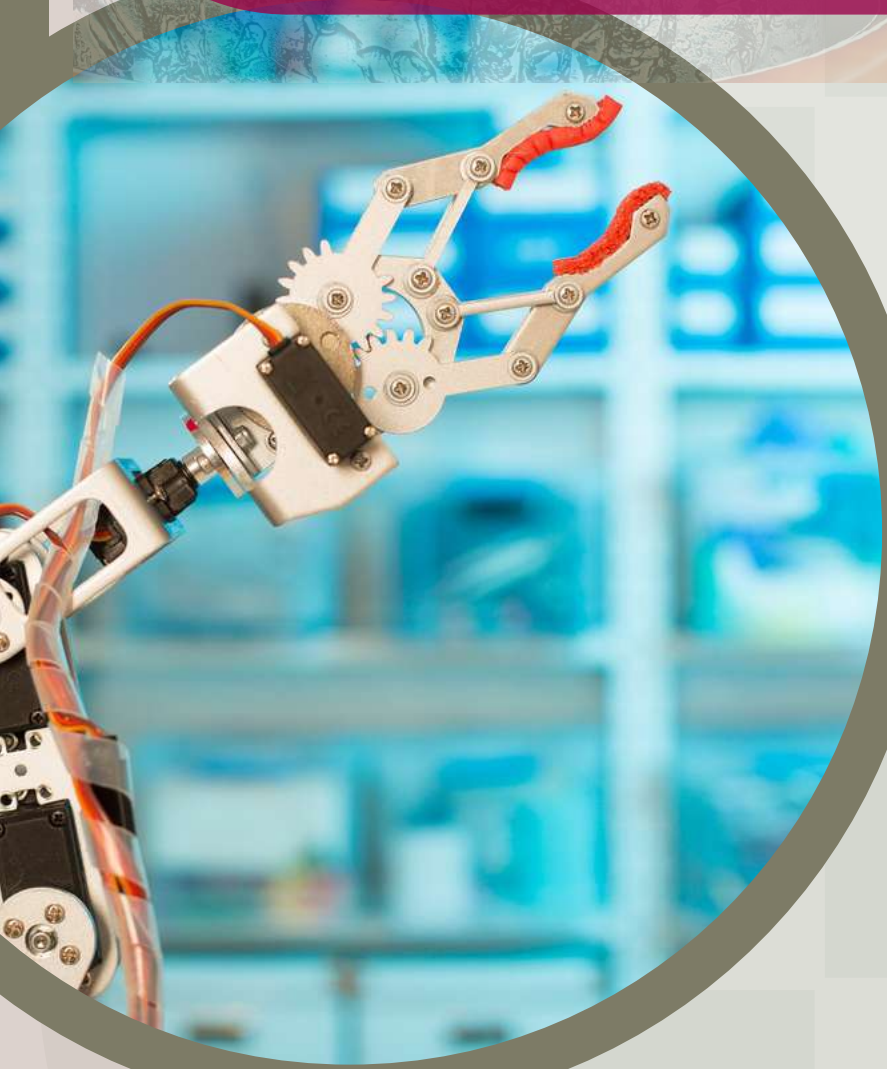
BASE

The installed robot arm makes the platform more stable refer for the base

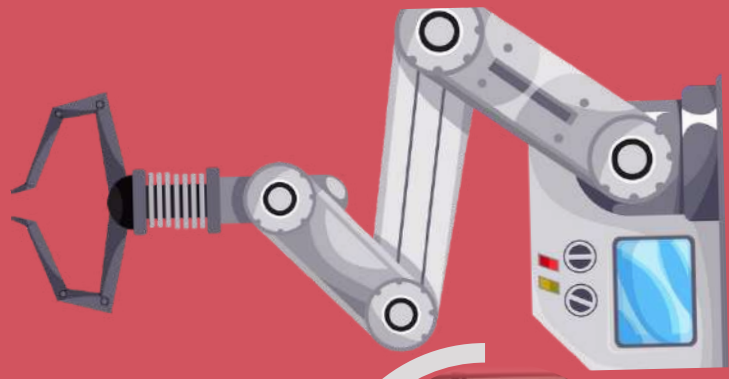


ROBOT MANIPULATOR

A manipulator is a tool used in robotics to manipulate objects without physical contact. It is an arm-like mechanism having a number of sliding or jointed segments that can grip and move things with a variety of degrees of freedom. Initially, the application was used to handle radioactive or biohazardous material with robotic arms or in inaccessible areas.



MANIPULATOR CLASSIFICATION



SPHERICAL MANIPULATOR

If all of the links in a manipulator make spherical motions around a common fixed point, it is termed a spherical manipulator.

SPATIAL MANIPULATOR

A manipulator is considered a spatial manipulator if at least one of the mechanism's linkages may move in a broad spatial direction.

PLANAR MANIPULATOR

A manipulator is called a planar manipulator if all of its moving parts move on planes that are parallel to one another.

OPEN-LOOP MANIPULATOR

An open-loop manipulator (also known as a serial robot) is a manipulator whose linkages form an open-loop chain.

PARALLEL MANIPULATOR

If a manipulator is made up of a closed-loop chain, it is referred to as a parallel manipulator.

HYBRID MANIPULATOR

When a manipulator has both open and closed loop chains, it is referred to as a hybrid manipulator.

ROBOT END EFFECTOR

An end effector is a robotic device used to interact with the environment. It is located at the end of a robotic arm. It is an apparatus that is fastened to the manipulator's wrist.

Its work envelope is the area that the robot's end effector can access. The goal is to grab, hoist, move, manipulate, or work on the work item.

TYPES OF END EFFECTOR

1 VACUUM GRIPPER

Suction cups are used to keep flat items in place with a vacuum gripper

2 MAGNETIZED DEVICES

These are used to retain ferrous work components and are based on the principles of magnetism.

3 DUAL GRIPPERS

For machine loading and unloading, a mechanical gripper with two grasping devices in one end effector is used.

4 INTERCHANGEABLE FINGERS

A mechanical gripper with various fingers that may be fitted to accommodate varied work component sizes.

5 STANDARD GRIPPERS

Mechanical grippers that are commercially available, eliminating the need to custom-design a gripper for each individual robot application.

6 MECHANICAL GRIPPER

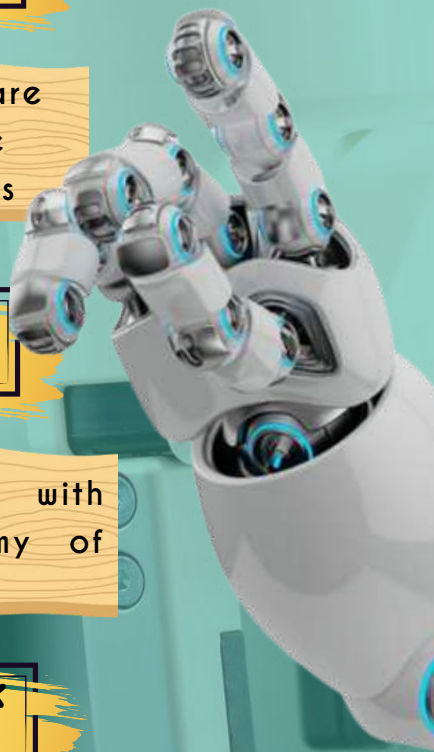
Two or more fingers that can be opened and closed on a work item using a robot controller

7 ADHESIVE DEVICES

These use adhesive chemicals to keep flexible materials like cloth together

8 SIMPLE MECHANICAL DEVICE

Hooks and scoops are examples of simple mechanical devices

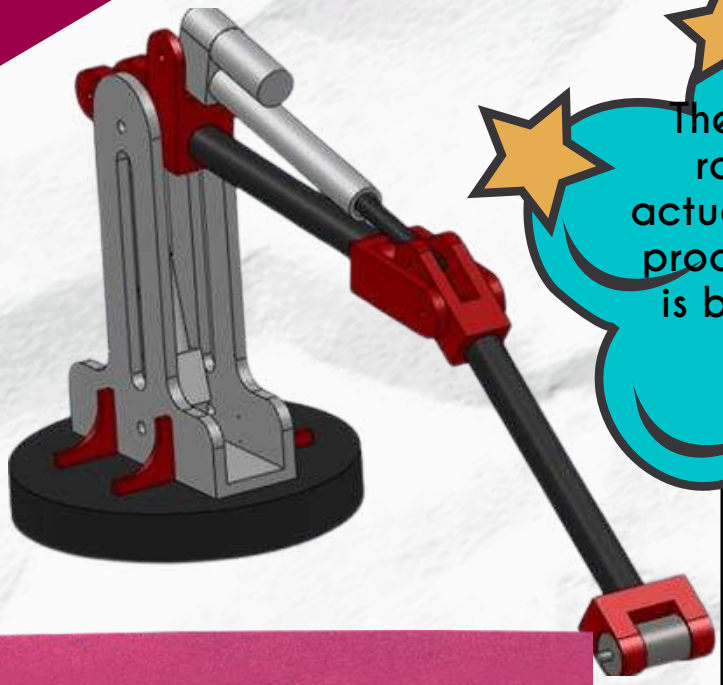


9 MULTIPLE FINGERED GRIPPER

Mechanical gripper with the general anatomy of the human hand.

10 SENSORY FEEDBACK FINGERS

Mechanical gripper having sensory feedback capabilities in the fingers to assist in identifying the work component and determining the proper grasp force to apply (for fragile work parts)



The equipment that moves the robot joints is known as an actuator. An actuator, which can produce rotary or linear motion, is best described as a device that causes motion

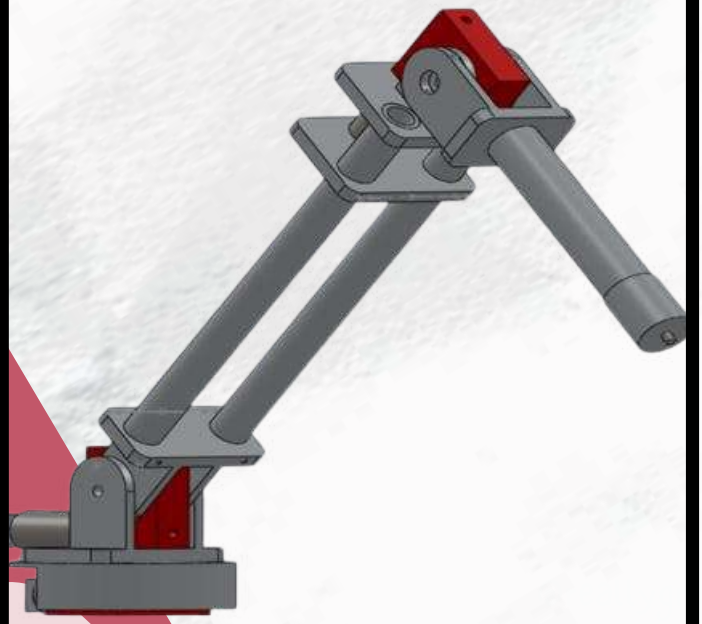
LINEAR ACTUATOR

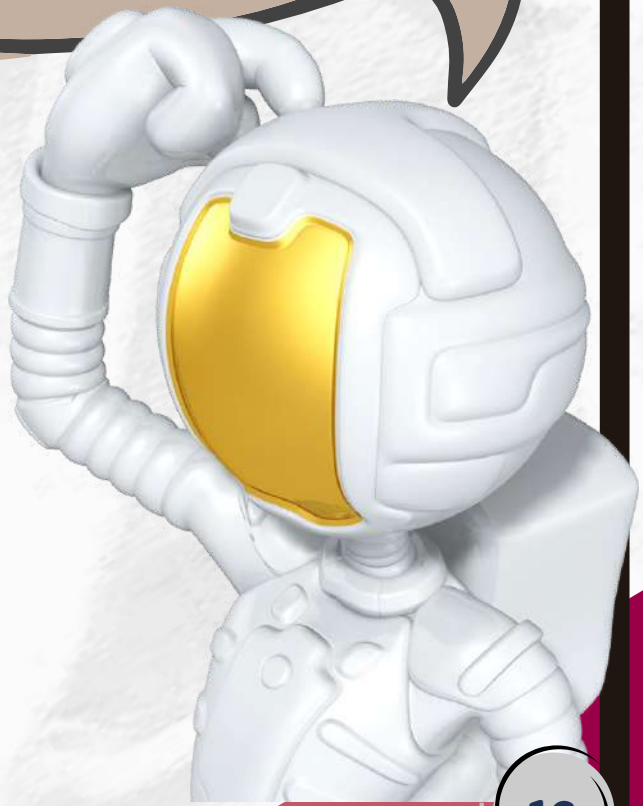
ACTUATOR

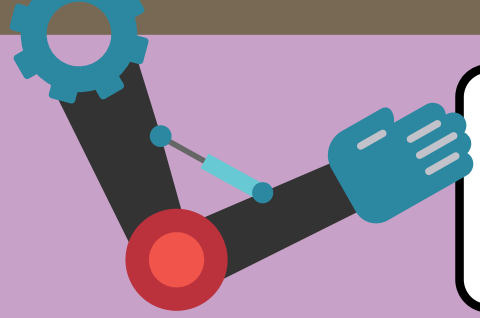
Human = Muscles =
Driving Force = Move body Joints

ROBOT ? = USE ACTUATOR

ROTATION ACTUATOR

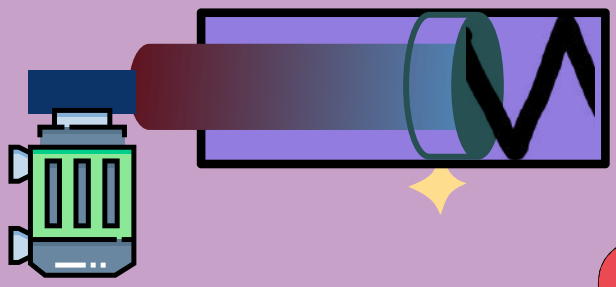






TYPES OF ACTUATOR

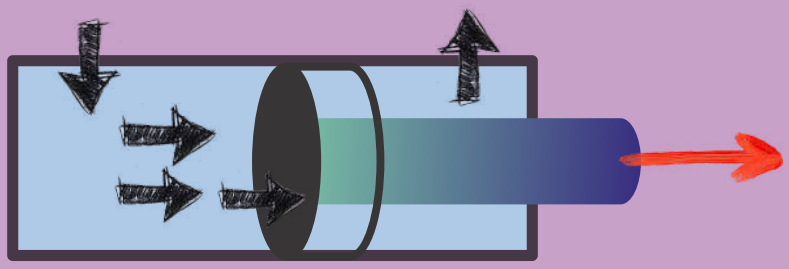
1 ELECTRIC



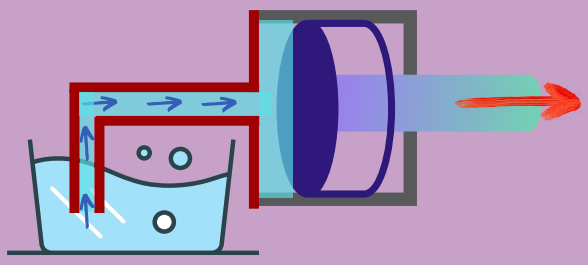
Divided into step motors, alternate current motors, and direct current motors or servomotors.

2 PNEUMATIC

A device that uses pressured air or gas to move objects or carry out work.



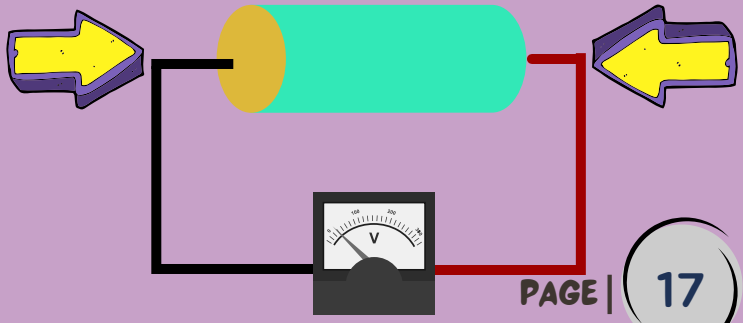
3 HYDRAULIC



which use hydraulic power to enable mechanical operation, is mainly composed of a cylinder or fluid motor.

4 PIOZOELCTRIC

Using the piezoelectric effect to generate motion, Electricity causes a physical deformation to proportionate to the applied electric field when it passes through a piezoelectric material.



ADVANTAGES

DISADVANTAGE

ELECTRIC ACTUATOR

- Smooth control and movement
- Low installation costs and operating expenses
- Maximum repetition (long life)
- There is always a source of electricity
- No pollution exists in the workplace.

- high costs for maintenance
- sensitive machinery
- a static situation of overheating
- In a combustible atmosphere, additional protection is required.

HYDRAULIC ACTUATOR

- Superior skill and strength
- Reduced noise
- Cleaner and less difficult to maintain
- Dependable and simple to use

- High price and sluggish motion
- To keep the oil in good condition.
- Environmental issue caused by fluid leakage
- Inappropriate hydraulic fluid can harm system components.

PNEUMATIC ACTUATOR

- Minimal in weight
- Cheap
- Quick, secure, and simple to use
- Decreased environmental pollution

- Clean and lubricated air is necessary.
- Confined to simple jobs
- Complicated movements and controls (use cylinders for circular motion)

PIEZOELECTRIC ACTUATOR

- High levels of dynamics (up to 40 kHz)
- High force and limitless resolution
- Low electricity use,
- Built in a very little space.

- Its expansion and contraction generate minute oscillating movements.

SENSOR

- Assess the surroundings and the robot's configuration or condition and send these details as electrical impulses to the robot's controller. (example : presence of toxic gas, arm position).

- Sensors are simply measuring devices that capture information about things like position, velocity, force, torque, proximity, temperature, etc.

- if the robot does not have a component similar to the sense organs of the human body, the controller (the computer) cannot perform any meaningful work

- Real-time data on the job environment is provided by sensors. Robots have tactile sensors that replicate the mechanical characteristics of touch receptors found in human fingerprints, and vision sensors that are used to determine the depth of the surroundings.

Information that is not available to humans through their five senses is commonly needed by robots

Robotic abilities include the detect extremely small amounts of invisible radiation or quantify movement that is too small or fast for the human eye to notice and also ability to see in the dark

TYPES OF SENSOR

VISION SENSOR

Using a 3-D vision sensor, a robot can handle parts of In-Sight Vision Sensors work that are stacked arbitrarily. An automatic system can be built at a minimal cost because alignment operation, a specialized components feeder, and an alignment pallete are not needed.

FORCE SENSOR

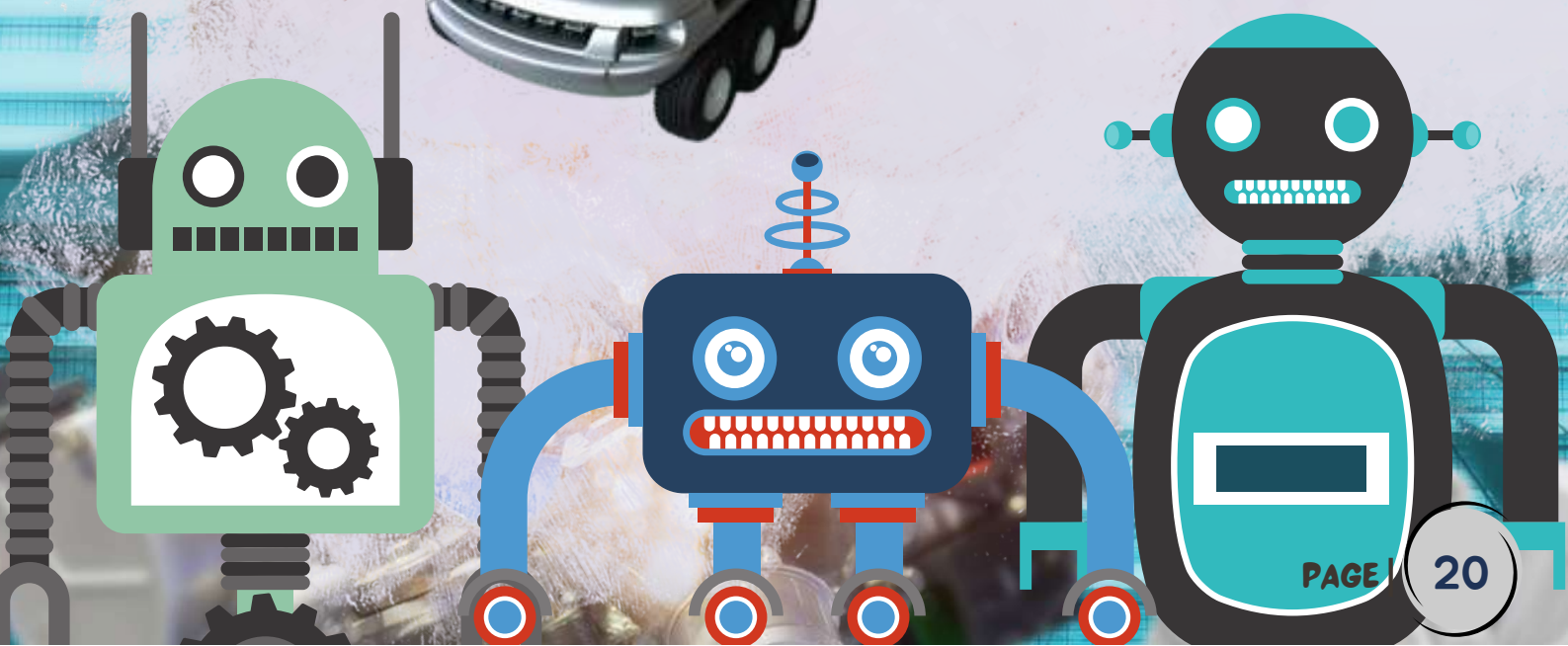
Using force sensors, robots can fit and insert machine parts precisely. In addition to merely inserting pieces, a robot can also insert parts that have the phases after matching their phases. High skill professions can be automated.

PROXIMITY SENSOR

Exploring large, open spaces with 6 ultrasonic sonar transducers. Wide range obstacle detection from 15 cm to 3 m. A "virtual bumper" made of infrared sensors enables maneuvering through confined spaces.

TILT SENSOR

are used in a variety of applications to determine the tilting position relative to gravity. They make orientation or inclination easy to discern. They may also go by the names tilt switches or rolling ball sensors, similar to mercury switches.

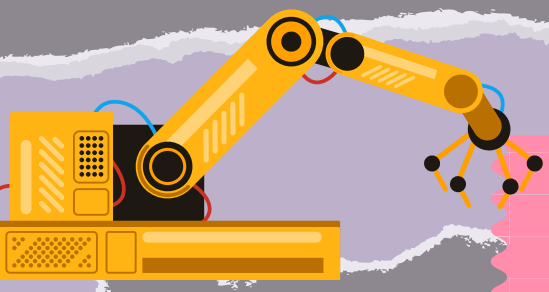


ROBOT DESIGN CONFIGURATION

In industrial robots, there are fundamentally two different types of joints:

PRISMATIC OR LINEAR JOINTS (P)

Joints that are sliding or linear that are prismatic (translational motion along an axis)



REVOLUTE (R)

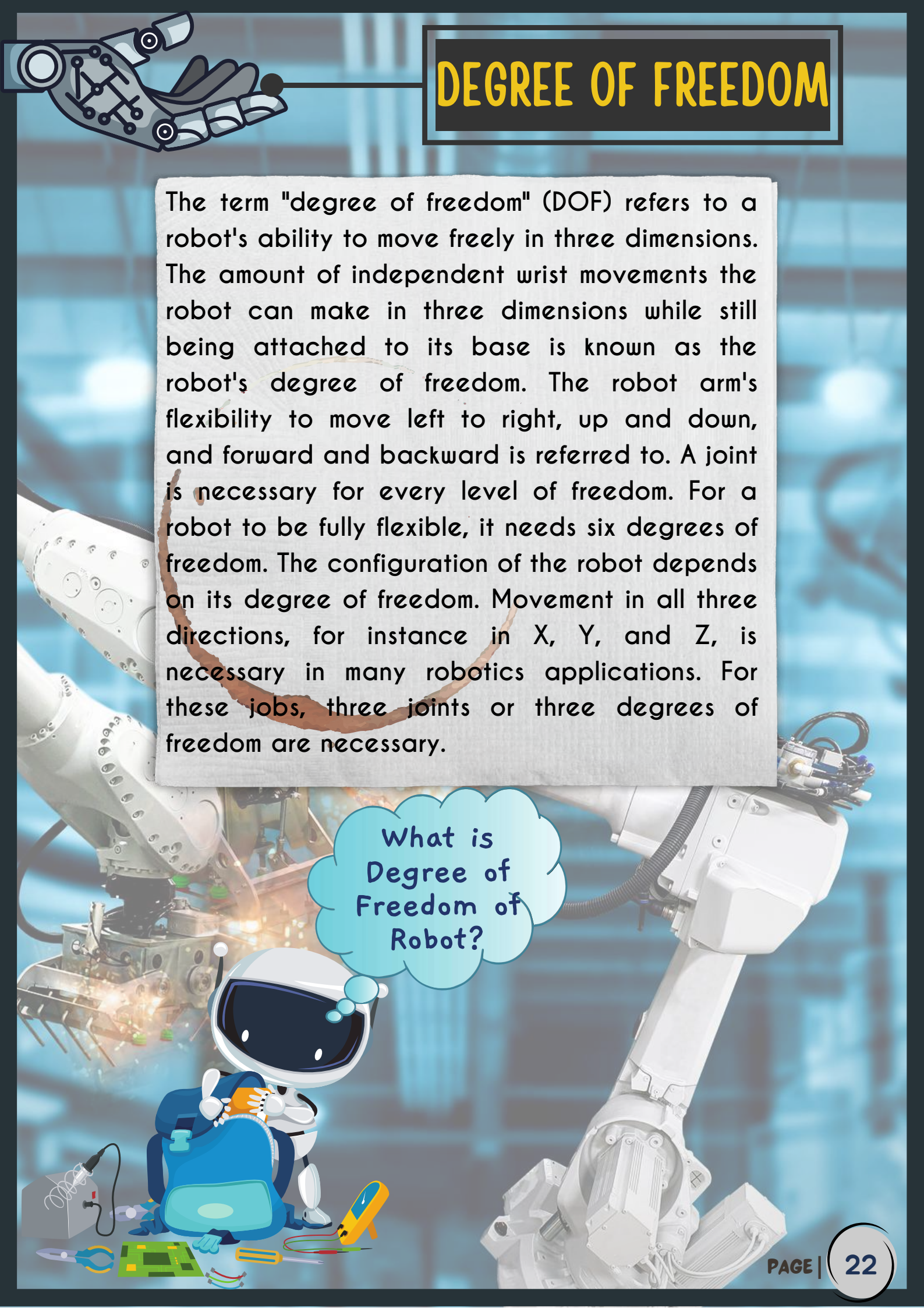
Anything that rotates around an axis. At this type of joint, the links are positioned perpendicular to one another.

Reminders

The physical configuration or composition of the prismatic joints or revolute for the three main axes results in a particular geometry of the work envelop.

DEGREE OF FREEDOM

The term "degree of freedom" (DOF) refers to a robot's ability to move freely in three dimensions. The amount of independent wrist movements the robot can make in three dimensions while still being attached to its base is known as the robot's degree of freedom. The robot arm's flexibility to move left to right, up and down, and forward and backward is referred to. A joint is necessary for every level of freedom. For a robot to be fully flexible, it needs six degrees of freedom. The configuration of the robot depends on its degree of freedom. Movement in all three directions, for instance in X, Y, and Z, is necessary in many robotics applications. For these jobs, three joints or three degrees of freedom are necessary.

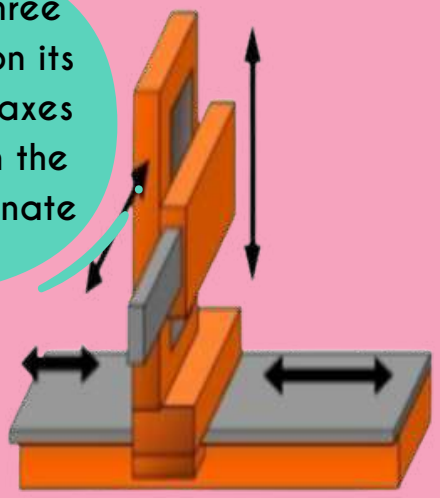


ROBOT OF CONFIGURATION

The main frame's coordinate system can be used to classify robots based on their structural characteristics.

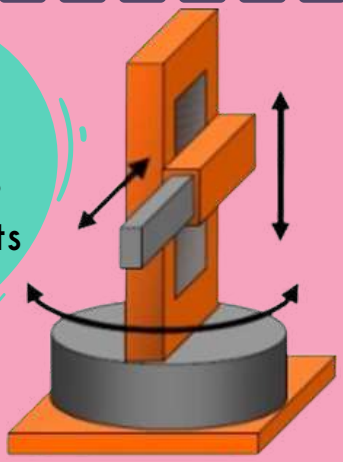
1 CARTESIAN ROBOT

Robot having three prismatic joints on its arm, and whose axes are aligned with the cartesian coordinate system



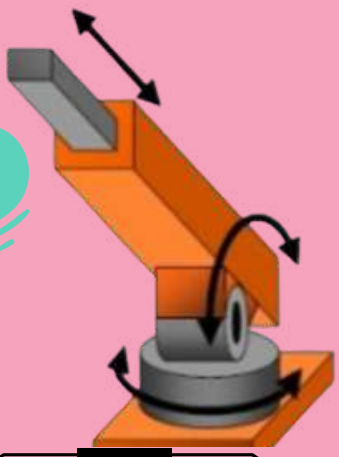
2 CYLINDRICAL ROBOT

robot with cylindrical coordinates created by its axis



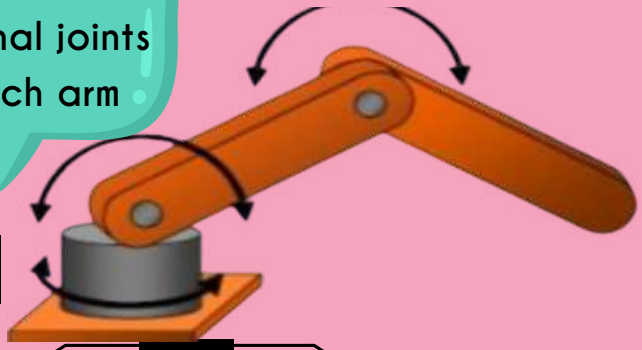
3 SPHERICAL ROBOT

The spherical robot's movement is controlled by three or more axes.



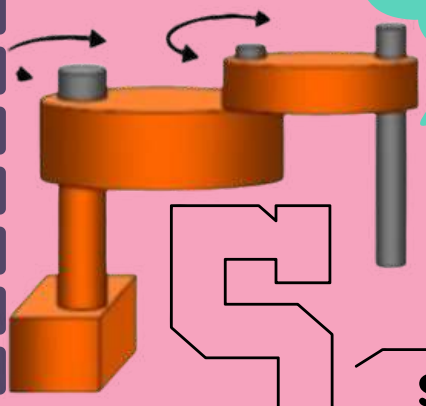
4 ARTICULATED ROBOT

Robot having at least three rotational joints on each arm

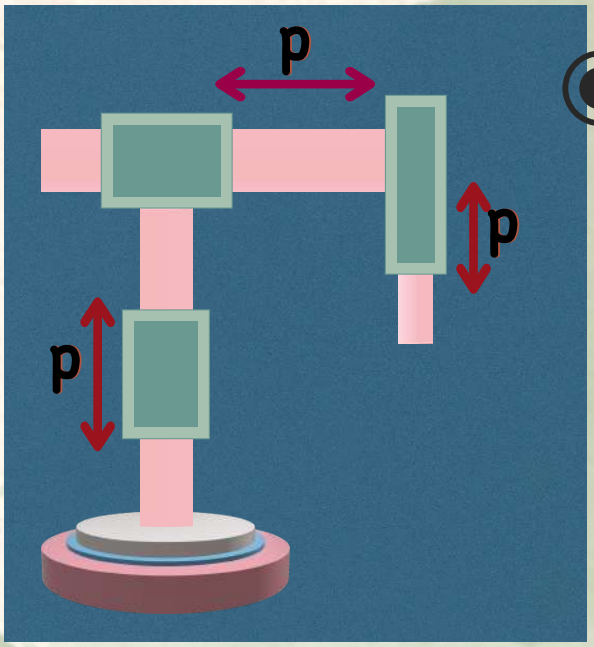


5 SCARA ROBOT

This robot that offers planar compliance and has two parallel rotary joints.

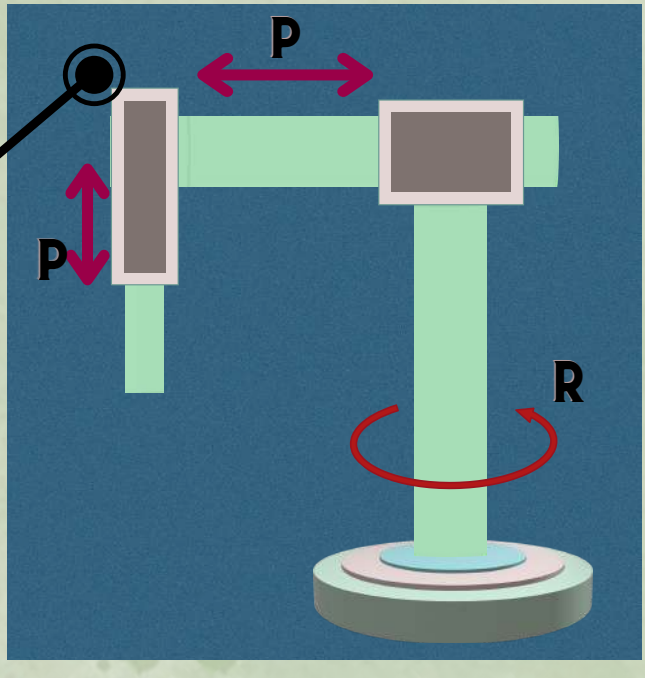


JOINT OF ROBOT



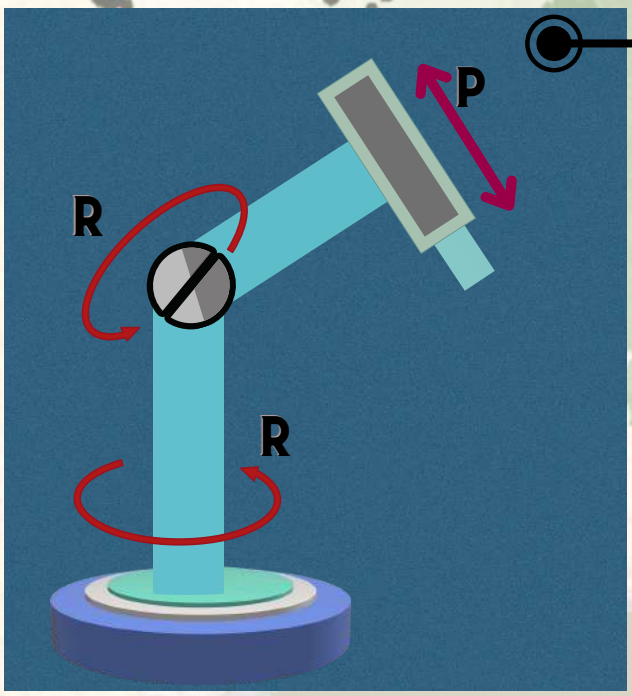
CARTESIAN ROBOT

Three linear joints are used in the design of the cartesian robots. The cartesian plane, which includes X, Y, and Z, has these joints. Additionally, these robots could have a connected wrist with simpler rotating joints. Another name for this particular type of robot is rectilinear or gantry.



CYLINDRICAL ROBOT

The cylindrical robot has a linear joint that connects the various links and a rotary joint that is linked to the base. Considering that cylindrical robots operate inside a cylindrically formed work area, rotational and linear motion are helpful in ensuring that accuracy is reached.



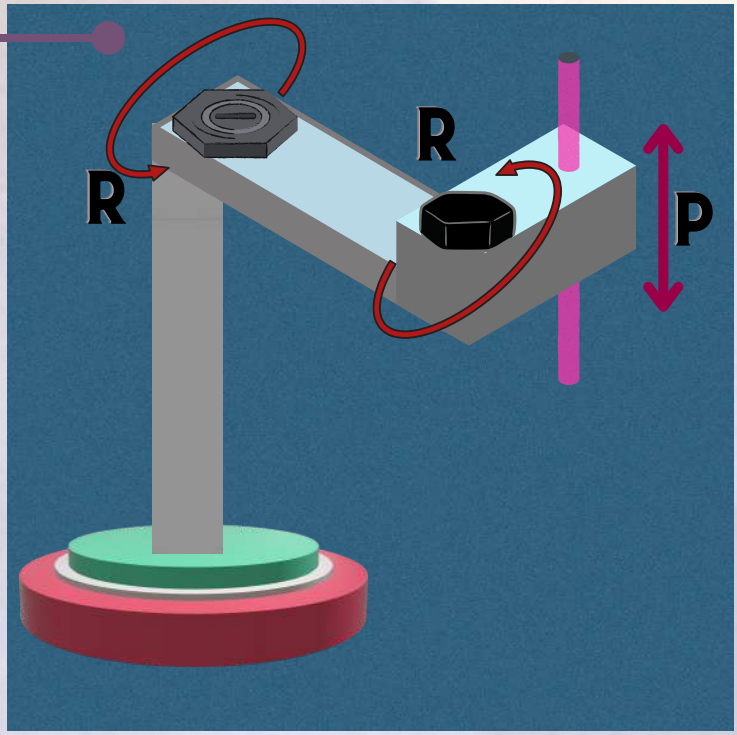
SPHERICAL ROBOT

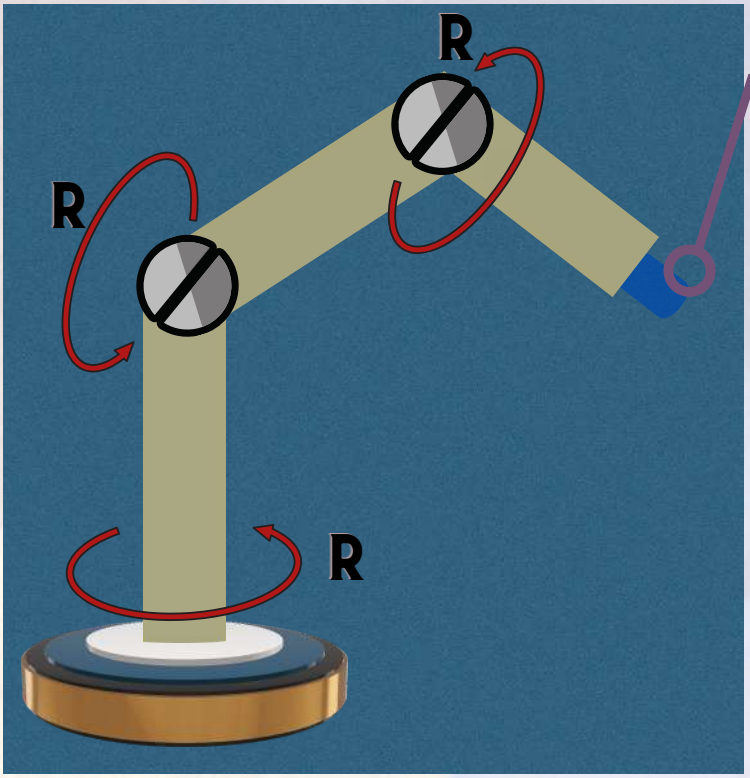
Robots with spherical designs include twisting joints connecting the arm to the base. There are other situations when two rotary joints and one linear joint are used together.Despite the spherical shape of the work to be shown, this robot is just as well-known as polar robots. This robot's axes combine to provide a spherical coordinate system that makes the manipulator easy to operate.

JOINT OF ROBOT

SCARA ROBOT

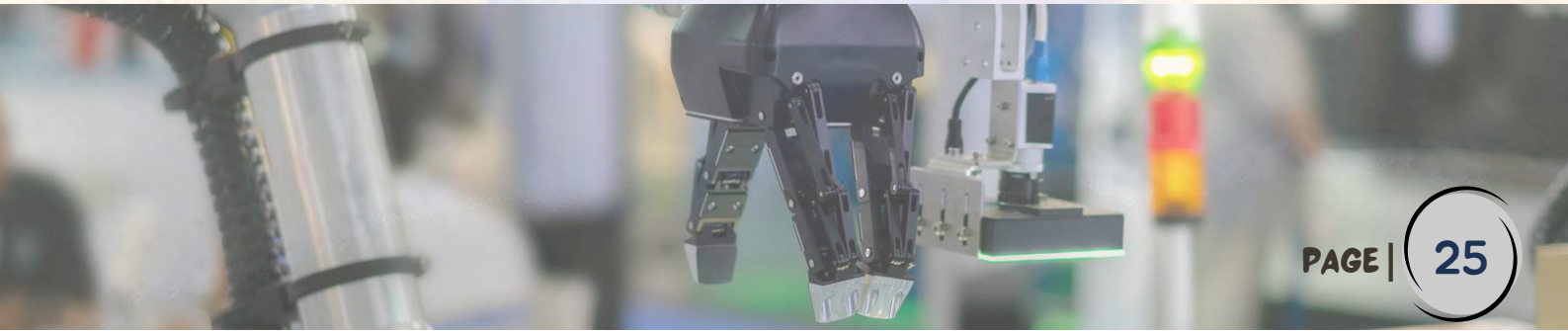
For firms wishing to automate their assembly operations, the SCARA robot is a common choice. Typically cylindrical in shape, this robot carries out essentially cylindrical tasks. Two parallel joints are used in it, and they are helpful while assembling the piece. During robot operation, these joints offer compliance in a chosen plane.

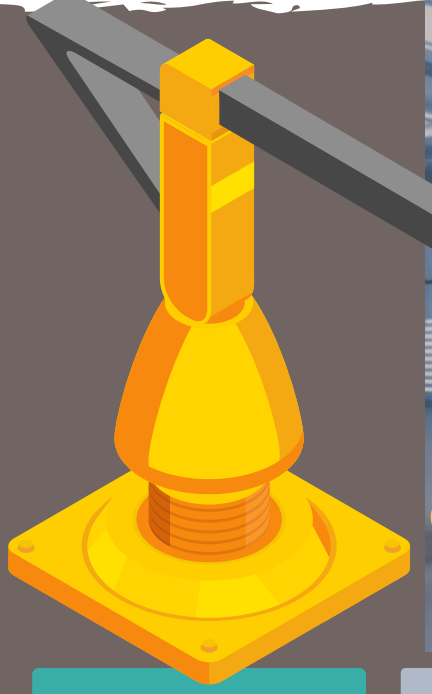


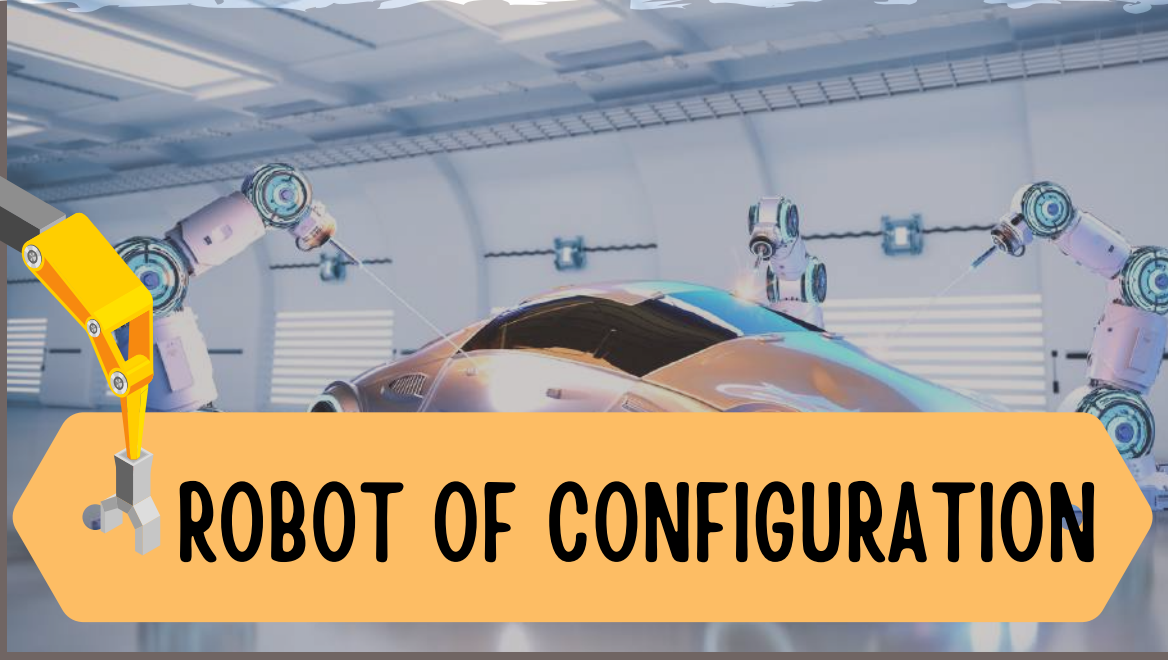


ARTICULATED ROBOT

The design of the articulated robot most likely includes several ranges and combinations of rotary joints. Simple constructions with two joints may be found in this range, which progresses to more sophisticated structures with ten or more joints. This design uses rotary joints to connect the links in the arm, while twisting joints connect the arm to the base.







ROBOT OF CONFIGURATION

CONFIGURATION	NUMBER OF AXIS	AXIS 1	AXIS 2	AXIS 3	TOTAL REVOLUTE
CARTESIAN	3	P	P	P	0
CYLINDRICAL	3	R	P	P	1
SPHERICAL	3	R	R	P	2
SCARA	3	R	R	P	2
ARTICULATED	6	R	R	R	3

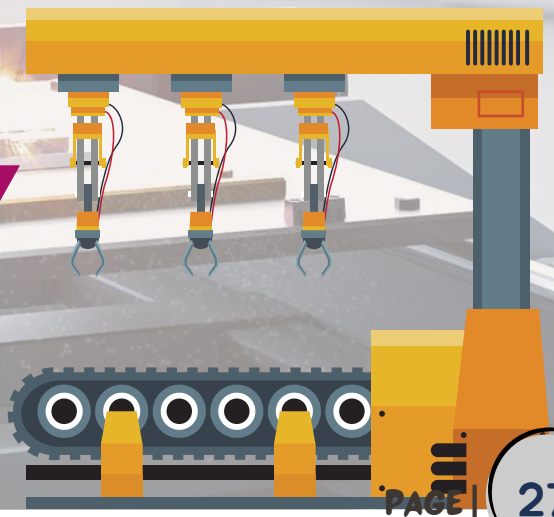
LEGEND : P: PRISMATIC/LINEAR
R : REVOLUTE/ROTATION

CARTESIAN ROBOT

- The links in a cartesian arrangement are connected by linear (p). Consequently, the final configuration is (PPP).
- The wrist can be moved in three directions: upward, outward, and backward. This is represented by the three joints.

ADVANTAGES	VS	DISADVANTAGES
Having the ability to move in many linear directions		Big operating volume is needed
The stiffest structure for a given length		Robot axes are challenging to seal
Programming and calculation are simple		Only able to control the item in front of it
Ability to place straight lines into furnaces		In a corrosive or dusty environment, exposed guiding surfaces must be covered.

Typically Used:
Assembly operation, Pick & Place for heavy load, Arc Welding and Handling Machine tool



CYLINDRICAL ROBOT

- A revolute joint in the RPP configuration is used to build the cylindrical coordinate robot by swapping out the first prismatic joint of the cartesian coordinate robot.
- The wrist is then moved by the prismatic joints in and out along a radial axis and up and down along a vertical axis.
- The arm is rotated at the revolute joint around a vertical base axis.

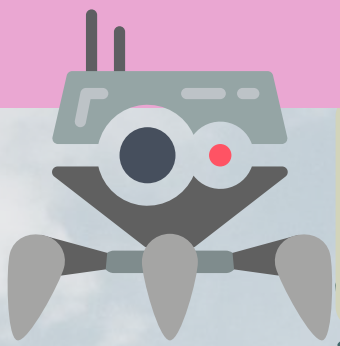
ADVANTAGES

- Programming is quite simple
- Can envelop itself completely
- Easily sealed rotational axis
- Adequate access to machine apertures and cavities
- Dependable enough to carry huge goods through a big operating area

DISADVANTAGES

- Will not maneuver around obstructions
- Unable to extend over itself
- It's difficult to seal linear axes.
- In the direction of the rotational action, their repeatability and precision are both constrained.
- Dust and liquid protection for exposed drives might be challenging.

Typically Used:
Spot Welding, Handling machine tool, Assembly operation and Handling at die casting machine



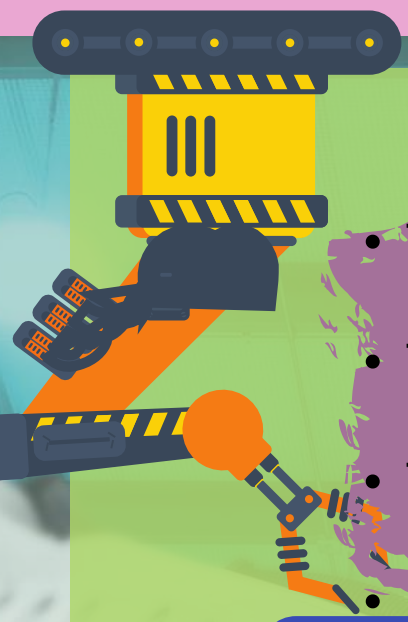
SPHERICAL ROBOT

- A revolute joint must be used in place of a cylindrical coordinate robot's second joint to construct a spherical coordinate robot (RRP).
- Around a vertical base axis, the first revolute joint swings the arm back and forth.
- The arm is raised and lowered around the shoulder's horizontal axis via the second revolute joint.
- The wrist may be rotated radially in and out at the prismatic joint.

ADVANTAGES	DISADVANTAGES
Greater work envelope than the cylindrical or reclining configuration	Application restrictions and offline programming challenges
Comparatively simple to program	Higher-level control system is necessary.
Low-space and high-speed vertical structures	In the direction of rotating motion, repeatability and accuracy are likewise decreased.

Typically Used:
Arc Spot Welding, Handling machine tool, Material handling at die casting or fettling machines,

SCARA ROBOT



- The arm is swung back and forth by the first revolute axis around the vertical shoulder axis.
- The second revolute joint allows the forearm to rotate around the vertical elbow axis.
- Thus, motion in a horizontal plane is controlled by two revolute joints.

ADVANTAGES

- extreme velocity
- Rigid height axis
- spacious work area on the floor
- Programming is moderately simple.

DISADVANTAGES

- Application is restricted
- Offline programming is challenging
- very sophisticated arm
- Two approaches to a goal

Typically Used:
High working speed assembly operation
Pick & Place Operation,

ARTICULATED ROBOT

- All of the joints in an articulated coordinate robot are articulating joints (RRR).
- The robot's first revolute joint swings it around its vertical base axis.
- The second joint raises and lowers the arm in relation to the shoulder's horizontal axis.
- In the third joint, the forearm is raised and lowered around the horizontal elbow axis.

ADVANTAGES

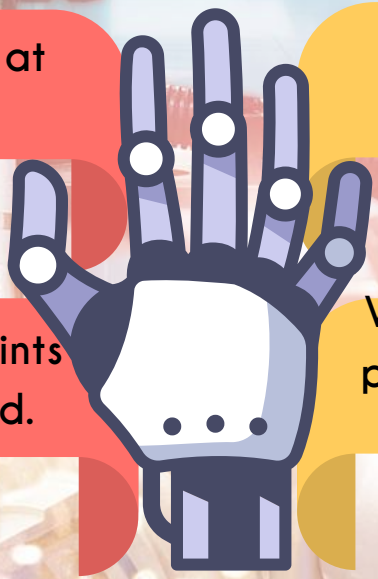
Flexibility is maximized at all rotational joints.

It is possible to seal all joints against the outside world.

DISADVANTGES

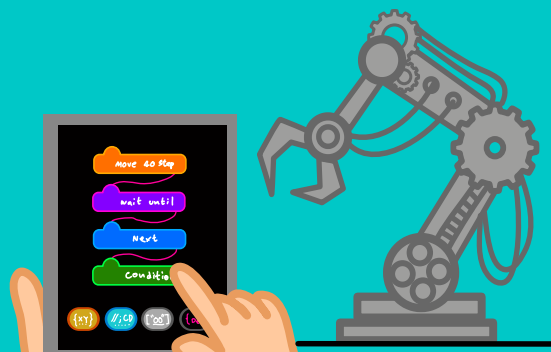
Coverage at a limited volume

Visualizing, controlling, and programming these robots is really challenging.



Typically Used:
Spray Painting, Weld sealing, Assembly Operation, and Handling casting/ Fettling Machine

ROBOT PROGRAMMING



Robots must detect, plan, and act in order to perform their missions. Robots employ a variety of sensors to get the data they require. This data is processed by software so that the robot may formulate a response. Then they take action to finish the task.

"The robot's instructions come from programming. The programme of a robot is a series of directives that specify what, how, and when to do certain tasks. The robot needs to be trained to finish a task before it can execute it. In order to do a job, a robot's task must be defined as a set of sequential, logically based instructions during programming."

A human being must direct robots in their actions. Programming is the process of instructing robots or computers to do certain tasks. For a robot to successfully execute a task, every action it does must be carefully designed. By analysing data, a robot "thinks" and gains knowledge, and then it utilises this knowledge to decide what to do next.

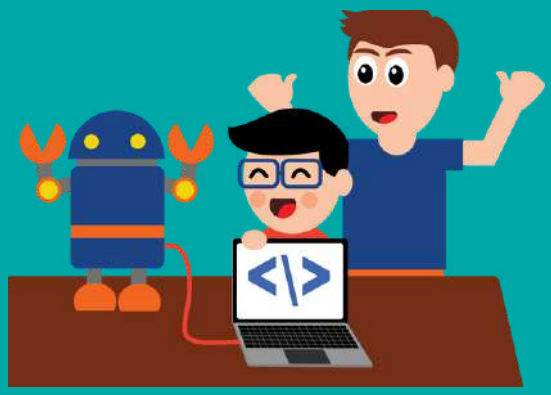
ROBOT PROGRAMMING OPERATION METHOD

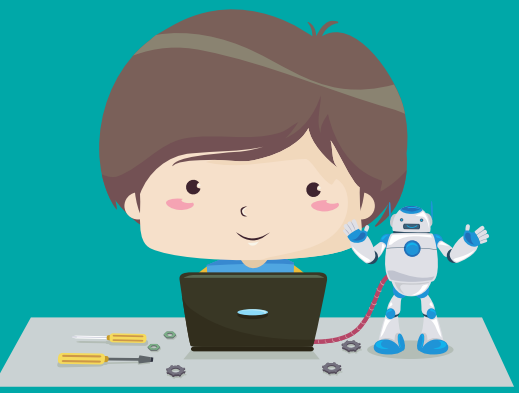
LEAD THROUGH PROGRAMMING

A form of programming in which the trainer instructs the robot through the many parts of the work while controlling it remotely with a teach pendant while the robot is in teach mode. To accomplish this, the manipulator must be guided through the numerous motions required to complete a task, entering the motions into the robot's computer memory. taught pendant programming is another name for it.

WALK THROUGH PROGRAMMING

A technique for programming in which the instructor physically moves the robot through various tasks. By gripping the tool linked to the robot's end-effector, the human operator "walks" the robot through the proper positions. . The robot will be able to repeat the trajectory back by interpolating the positions it records during the instruction phase.



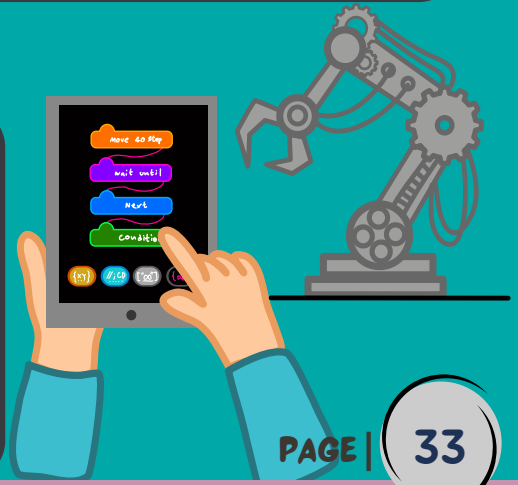


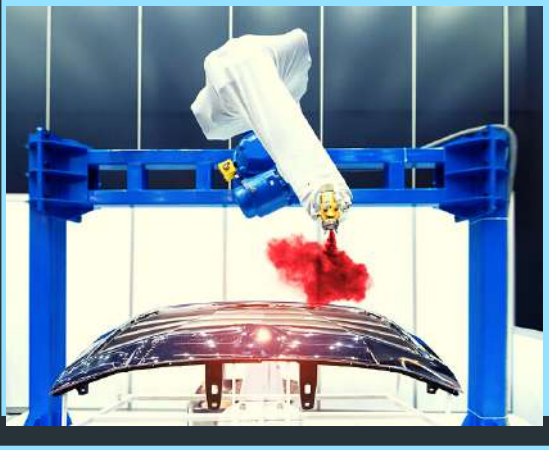
ONLINE THROUGH PROGRAMMING

The robot must first be put into "programming mode," which involves halting it from performing its useful work. Next, while the robot is connected to the internet, you build or update the program.

OFFLINE THROUGH PROGRAMMING

OLP is a programming technique where a trainer creates a program and updates it for the robot. Robot programming approach where the robot program is developed apart from the robot cell itself. The actual industrial robot is then used to execute the robot program. The robot cell is portrayed graphically in a 3D model in a simulator during off-line programming.





1. SPRAYING PROCESS
2. ASSEMBLY PROCESS
3. WELDING PROCESS
4. TESTING PROCESS
5. PICK AND PLACE PROCESS
6. PALLETIZING PROCESS
7. INSPECTION PROCESS

ROBOT APPLICATION IN MANUFACTURING

EXAMPLE OF ROBOT APPLICATION

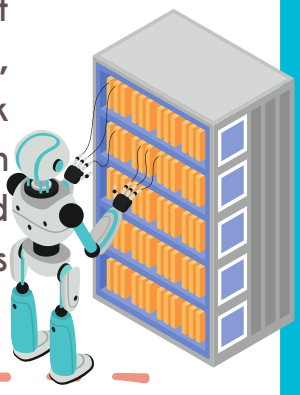
Numerous manufacturing industries, including factories and warehouses, use industrial robotics. Industrial robots are crucial in the automation industry in this new era of manufacturing, and as a result, there has been a big increase in output, production costs can be lowered, production can be accelerated, and quality can be raised

1 TESTING PROCESS

- The testing process is another aspect of quality control that is connected to the inspection function.
- Examining whether the work portion in the work cell is functioning properly incorporates environmental
- Example : fatigue testing, ,analogous techniques and other complicated testing

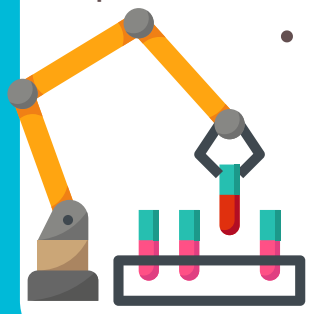
2 INSPECTION PROCESS

- It is necessary to handle parts during some inspection processes, and it may also be necessary to operate an inspection tool.
- To assess if a product meets quality criteria, inspection work frequently needs high levels of precision and patience as well as human judgment.



3 PICK & PLACE PROCESS

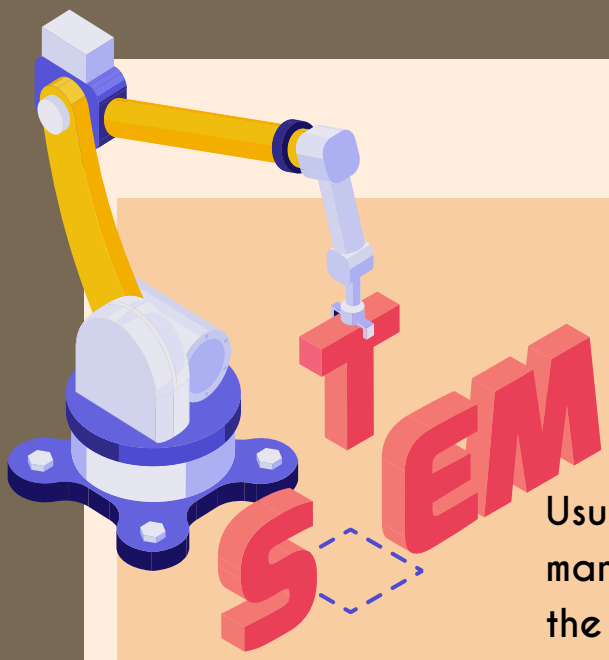
- In contemporary manufacturing settings, pick-and-place robots are frequently employed.
- The process of picking up components or products and placing them in new locations is sped up by pick and place automation.
- ·By doing repetitive tasks like picking up and placing goods, robots free up human workers to focus on more challenging tasks.



4 PALLETIZING PROCESS

- An automated system for stacking cases of goods or products onto a pallet is known as palletizing or palletizing.
- a process for stacking and shipping goods for storage and transit in bulk. With common tools like forklift trucks, it allows for uniform methods of handling loads.

EXAMPLE OF ROBOT APPLICATION



5 ASSEMBLY PROCESS

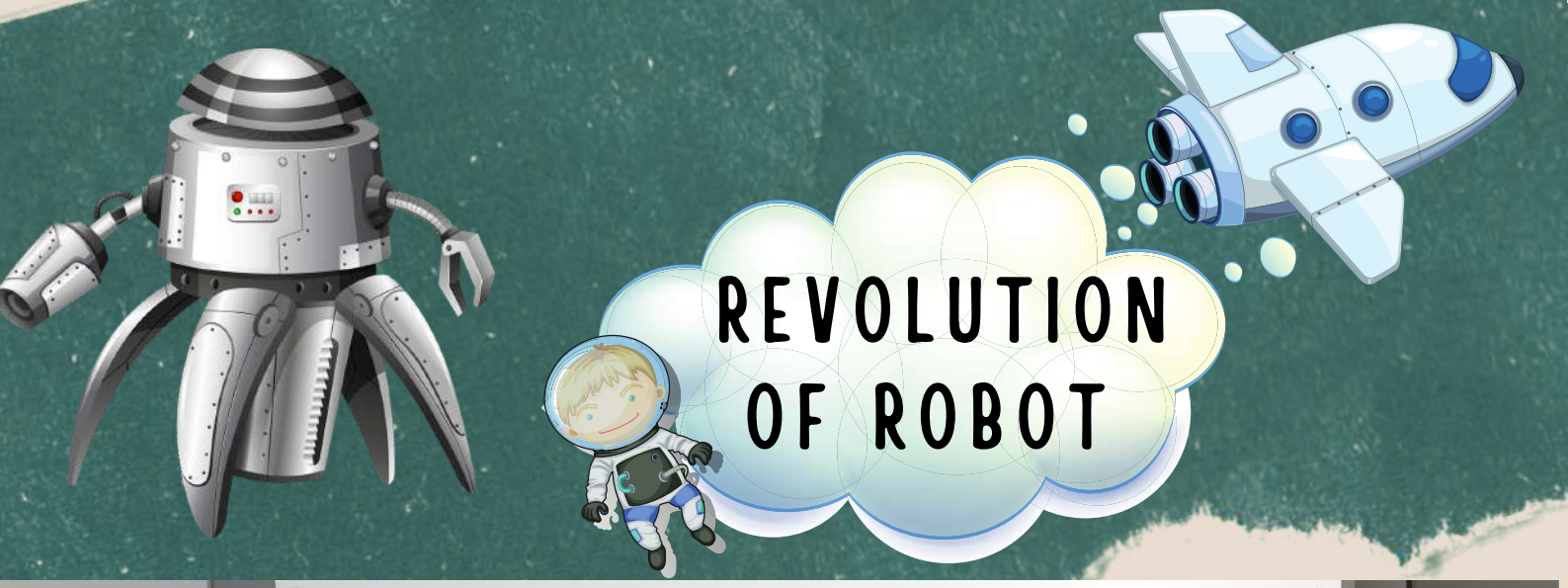
Usually, they have parts for both the product's manufacturing and material activities. Using the tool and moving around materials are both required for the application.

6 WELDING PROCESS

- In the production of earth moving and off-road hauling equipment, robotic arc welding is frequently employed in the heavy equipment manufacturing industries.
- Applications for welding are divided into three groups: gas, arc, and resistance.
- Only servo type robots are employed in each application area because path control is essential.

7 SPRAYING PROCESS

- Paint-spraying applications often only call only a little amount of automated technology.
- Robotics is used in a number of applications, including the lowering of parts into coating material reservoirs and removing them to let the excess material drain off the parts. In some circumstances, items are spun to remove extra coating material.



REVOLUTION OF ROBOT

The exposition is arranged into many sections that emphasize the distinctive qualities of robot revolutions, including:

- Collaboration: Robots are able to work together with humans and with other robots.
- Intelligence: Robots' programming gives them the ability to detect, plan, and act in order to achieve a goal.
- Skills: Robots are capable of a wide range of grasping, gripping, and physical interactions with their surroundings.
- Locomotion: Learn about a variety of surprising ways that robots may move about.
-

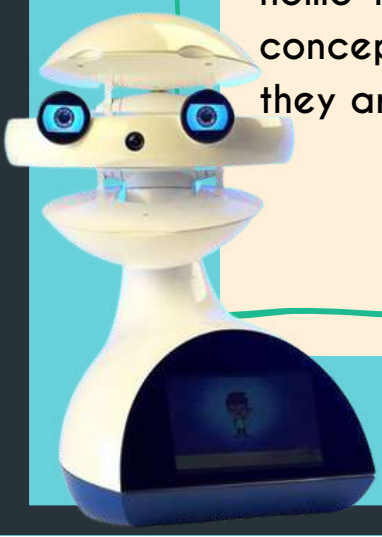
REVOLUTION OF ROBOT IN APPLICATION

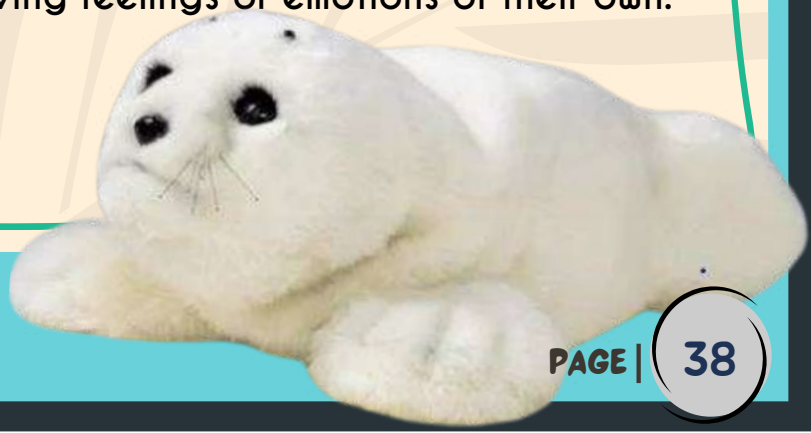
INDUSTRIAL

The world's largest manufacturers of industrial robots are robotic businesses like FANUC. A lot of robots, like the M-1iA Delta Robot, operate on assembly lines to speed up the manufacture of a product. When doing activities on an assembly line, humans require hand-eye coordination. Robots are extremely accurate and can perform tasks more quickly than humans because to their light arms, strong motors (actuators), and sharp vision. In the modern workplace, programming and operating a robot on an assembly line is more likely to be taught to a worker than actually performing the activity themselves.

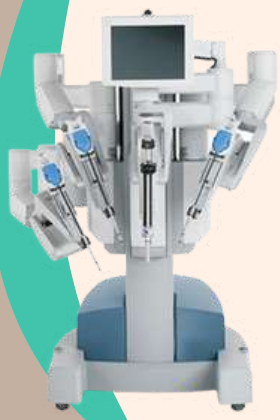
SOCIAL

The expressions on people'faces have long been the subject of scientific investigation. Our faces include several muscles that allow us to express a variety of emotions, including astonishment, rage, and delight. The capacity to recognise emotional cues from people is a feature of social robots like EMYS. As a comforting device, social robots are also possible. Paro, a newborn seal used for therapeutic purposes, can help someone in a hospital or nursing home relax. Using live animals as therapy is quite similar to this concept. These robots are able to recognise emotional cues, but they are not capable of having feelings or emotions of their own.

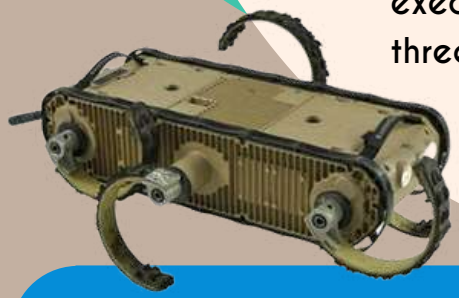




TELEROBOTICS



Some robots may be commanded from far away locations, including Mars and Earth! A group of engineers at NASA's Jet Propulsion Laboratory on Earth control the Curiosity rover, a remotely controlled robot on Mars. Each morning, the rover receives a particular list of chores to complete, including as snapping photos of the Martian landscape or gathering soil samples. The Da Vinci Surgical System is a remote-controlled robot that helps make major procedures minimally invasive without having to be located millions of miles away. While the surgeon meticulously directs every movement, incision, and suture from the Da Vinci console, its robotic arms meticulously carry out the operation on the patient's body. For the surgeon to view and control while executing the procedure, this console creates a three-dimensional, high-resolution picture.



MOBILE ROBOTS

Autonomous robots that move around and play soccer are known as soccer 'bots. Two positioned overhead cameras serve as the game's eyes, guiding the robots' movements with the aid of artificial intelligence (AI) software. These eyes collect and process data, which is subsequently sent to a main computer that houses the AI software. Robotics strategy is processed and devised by AI software. Finally, the player 'bots get orders from the AI programme, enabling them to participate in the game by kicking or blocking the ball. While mobile robots might be entertaining, they can also serve more important reasons. RHex can move across sand, rocks, and several other terrains. This robot is employed to do research in regions that are unsafe for people to enter or access. RHex can gather data for subsequent analysis by humans by affixing items like climate sensors.

QUIZ TIME

Instructions: Choose the correct answer by circling the appropriate letter

1. Robots are often used for 4D's. Tasks that are dirty, dangerous, or _____. or to help someone with a disability?

   A. Dull
   B. Diligent
   C. Difficult
   D. Descriptive

2. Which of the following is incorrect about robot?

   A. Robot is created to help human do menial, tedious and boring jobs
   B. Robot originated from Czech word 'Robota'
   C. Robot is produced to replace human workers so production costs could be reduced tremendously
   D. Robot is a programmable machine with certain anthropomorphic characteristics

3. What is the key component of a motion system which causes a mechanical system to move?

   A. Manipulator
   B. Actuator
   C. End of effector
   D. Sensor

4. According to the topics seen in class, a robot is .....

   A. A machine that replaces a human
   B A machine that looks like a human being
   C. A machine that is designed by people to do a specific job
   D. A machine that can do everything a person can do

5. A hotel guest has called the police because there is a suspicious backpack that has been left unattended on the floor of the hotel lobby. Which robot might be used to investigate if the backpack contains explosives?

   A. Educational robot
   B. Robot pets
   C. Warrior robot
   D. Search robot

Answer : 1. A, 2. C, 3. B, 4. C. 5. D

QUESTION

This section consists of structured questions. Answer ALL questions.

1. Define definition of industrial robotics.

2. Describe THREE (3) laws of robotics

3. Explain the trend of industrial robots revolution from 1995 to 2020.

4. There are five main components of an industrial robotics system. Briefly explain THREE (3) components of robot system.

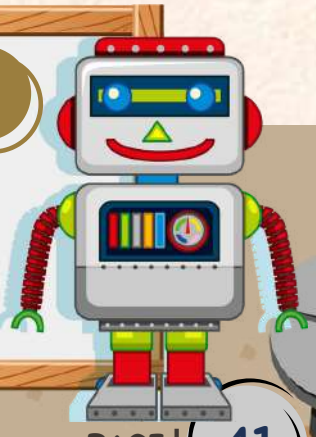
5. Identify the advantages of robots application in industry based on the following aspect:
   i. Production
   ii. Quality
   iii. Effectiveness
   iv. Environment

6. There are few robot configurations for the workspace manufacturing industries. Sketch FIVE (5) main types of robot configuration with ONE (1) example of an application for each sketch.

7. Compare THREE (3) major robot application in industry and give an example of each application

HINT ANSWER:

1. Page 2
2. Page 5
3. Page 4
4. Page 10
5. Page 8
6. Page 23
7. Page 34



ACTIVITY

1. Assemble the students into teams of three to four so they can collaborate. Give each group one robot card and one scenario card.

2. After reading through each case, groups should choose the two robots that fit the circumstance the best.

3. Assign two groups so that they may exchange presentations of their scenarios. Why did they chose the two robots that they did?

SCENARIO 1

Children recovering from surgery at the neighbourhood hospital are encouraged to feel more at ease. However, they may bring in robots and various forms of artificial intelligence to assist the young patients relax instead of living animals like a dog or a cat. Which kind of robot would you recommend to the hospital?

1. How exactly does the robot operate?
2. What is the advantage of your robot to the hospital's young patients?
3. Why is this robot the most advantageous alternative in comparison to the other robot choices?

SCENARIO 2

The Grand Canyon's rock formations are a topic of interest for scientists. They stumble to a cave while investigating and have reached the point where people can no longer fit through the aperture. They want to know how deep the cave is and whether there are any living plants or creatures within. What kind of robot would you suggest the scientists use to advance their research?

1. How does the robot operate?
2. How does your robot help scientists studying the Grand Canyon?
3. Why is this robot the greatest option when compared to the other robot choices?

SCENARIO 3

A brand-new manufacturer of electric vehicles has recently received funding, and construction on the plant where the vehicles will be made has begun. Although the firm has a large staff, they are soon realizing that some of the auto parts are too heavy for one person to lift. Which kind of robot would you recommend to the electric vehicle company?

1. How exactly does the robot operate?
2. What is the advantage of your robot to the electric vehicle company?
3. Why is this robot the most advantageous alternative in comparison to the other robot choices?

SCENARIO 4

The moon Europa of Jupiter is a subject NASA is interested in knowing more about. There is an ocean under the cold surface of Europa that scientists would want to explore and investigate. It has never been attempted to send a mission this far into outer space, but NASA is already making preparations for it. Which kind of robot would you recommend NASA use to land on Europa, the moon of Jupiter?

1. How exactly does the robot operate?
2. How does your robot help NASA studying the Jupiter?
3. Why is this robot the most advantageous alternative in comparison to the other robot choices?

Answer : 1. EMYS, 2. RHEX, 3. DELTA, 4. DA VINCI SURGICAL

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e ISBN 978-967-0047-03-4

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