ASSIGNMENT- 1

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1. Sketch and explain the 4 basic robot configurations classified according to the co-ordinate system.

CO-ORDINATE SYSTEM

A Co-ordinate system defines a plane or space by axes from a fixed point called the origin.

Robots are mostly divided into 4 major configurations based on their appearances, sizes, etc such as:

1) Cylindrical Configuration

* Has one rotary joint and two linear joints.
* Incorporates 3 degree of freedom or 3 axes.
* Work Envelope is cylindrical
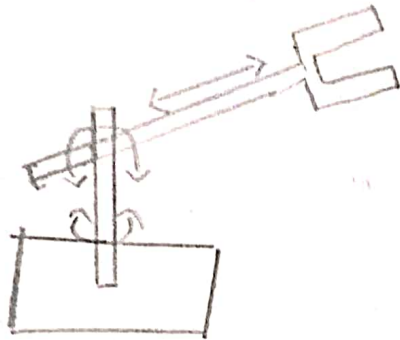* Mostly used in the pick & place arms for parts feeding & assembly.
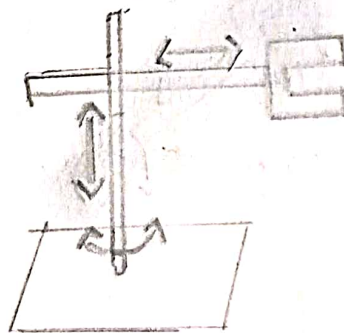
Advantages
* Rigid Structure
* Easy to program offline

Disadvantages
* Lower mechanical rigidity
* More sophisticated control system is required.

2) Polar Configuration

* Has 2 rotary joints and 1 linear joint.
* Work Envelope is cylindrical
* Also Called as Spherical co-ordinate system.

Advantages

* Large work envelope compared to cylindrical or cartesian co-ordinate system.

* Vertical structure posses less space

Disadvantages

* Repeatability & accuracy lower in direction of rotary movement.

* More sophisticated control system is required.

3) Joint Arm Configuration

* Similar to Human arm.

* These components are connected by 2 rotary joints corresponding to shoulder & elbow.

* A wrist is attached to the end of the forearm.

* SCARA is a special type of joint arm configuration.
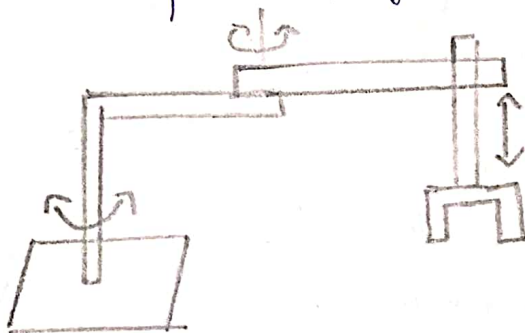
Advantages

* Large work envelope

* More flexible & versatile configuration.

Disadvantages

* Difficult to program offline

* Complex arm system required.

Cartesian co-ordinate Configuration

* Uses 3 perpendicular slides to construct x, y and z axes.
* Also called as rectilinear or gantry robot.
* Work Envelope is rectangular.
* Movement along all 3 axes can occur simultaneously.
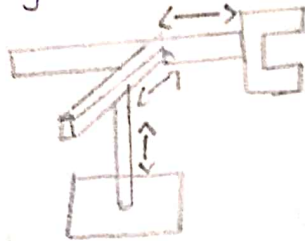
Advantages

* Rigid Structure
* Good accuracy and repeatability.

Disadvantages

* Limited in movement
* Requires large floor space.

2. Briefly explain the different types of robots

Robotics is the intersection of science, engineering and technology that produces machines called robots that replicate or substitute for human actions.

TYPES OF ROBOTS

• AEROSPACE

* This is a broad category.
* Includes all sorts of flying robots - the small bird robotic seagull.
* Also robots that can operate in space such as Mars rovers and NASA's Robonaut, the humanoid that flew to the International Space Station and is now back on Earth.

- CONSUMER

    * These are robots you can buy and use just for fun or to help humans with tasks and chores.

    * Eg:
        Robot dog Aibo, the Roomba vacuum, AI powered robot assistants and a growing variety of robotic toys and kits.

- DISASTER RESPONSE

    * These robots perform dangerous jobs like searching for survivors in the aftermath of an emergency.
    * Eg: After an earthquake & tsunami struck Japan in 2011, Packbots were used to inspect damage at the Fukushima Doiichi nuclear power station.

- DRONES

    * Also called unmanned ariel vehicles, drones come in different sizes & have different levels of autonomy.
    * Eg: DJI's popular Phantom series and Parrot's Anafi.

- EDUCATION

    * Aimed for use at home or in classrooms.
    * Includes hands-on programmable sets from Lego, 3D printers with lesson plans and even teacher robots like EMYS.

- ENTERTAINMENT

    * These robots are designed to evoke an emotional response and make us laugh or feel surprise or in awe.

    * Eg: Robot Comedian Robo Thespian, Disney's theme park robots like NaviShaman and musically inclined bots like Partner.

- INDUSTRIAL

    * Traditional industrial robot consists of a manipulator arm designed to perform repetitive tasks.

* This category includes also systems like Amazon's warehouse robots and collaborative factory robots that can operate alongside human workers.

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3. Describe the industrial applications of robots.

Industrial robots have revolutionized the industrial workplace across industries since their introduction to the manufacturing landscape. Here are the specific tasks traditional industrial robots are designed to perform:

1) Arc Welding

One of the driving forces for switching to robot welding is improving the safety of workers from arc burn and inhaling hazardous fumes.

2) Spot Welding

Joins 2 contacting metal surfaces by directing a large current through the spot, which melts the metal and forms the weld delivered to the spot in a very short time.

3) Materials Handling

* Utilized to move, pack and select products.
* Direct labor costs are reduced y much hazardous activities performed by human labor are eliminated.

4) Painting

* Increases the quality and consistency of the product.
* Cost savings are also realized through less rework.

5) Assembly

Robots routinely assemble products, eliminating tedious and tiresome tasks. Increases output y reduce operational costs.

6) Mechanical Cutting, Grinding, Deburring and Polishing

   * Building dexterity into robots provides a manufacturing option that is otherwise very difficult to automate.

   * Polishing a hip joint by hand can normally take 45-90 mins while a robot can perform it in few minutes.

7) Gluing, Adhesive Sealing and Spraying Materials

   * Sealer robots are built with numerous robotic arm configurations that enable the robot to apply adhesive to any type of product.

   * Benefit - Increased quality, speed and consistency of the final product.

4. Discuss in detail the various parts and their functions of robot system.

Robot system consist of 6 major components and they are:

1) Robot arm or Manipulator

   * An industrial robot comprised of a robot manipulator, power supply and controller.

   * A robot can have shoulder, elbow and wrist/ finger.

   * Robot arm is created from a sequence of link and joint combination.

   * Links are rigid members connecting joints or axes. The axes are the movable components of the robot.

1) End Effector

* The End Effector mounted on the wrist enables the robot to perform specific tasks.
* Various types of end effectors are designed for the same robot to make it more flexible and versatile.
* 2 types - Gripper and Tools.

3) Power Source

* It is the Unit that supplies power to controller in the manipulator.
* Controller is operated by the AC servo motor.
* Manipulator is controlled by the hydraulic or pneumatic drives.

4) Actuators

* Used for converting hydraulic energy or electrical energy into mechanical energy.
* Can be used for lifting, tilting, clamping and special applications purposes such as conveyors etc...

5) Sensors

* It is an electronic device that transfer a physical phenomenon (temperature, pressure etc) into an electrical signal.

* Sensor helps the robot knowing its surrounding better.

6) Controller

Robot Controller performs three main functions:
* They initiate a terminate the motion of the individual components of the manipulator in a desired sequence and at specific points.

- They store position and sequence data in the memory.
- They permit the robot to interface with the outside environment via sensors.

The control system contained programs, data algorithms, logic analysis and various other processing activities which enable the robot to perform.

Joint (Actuator, transmission & sensors)

Manipulator

Camera

Gripper

End Effector

Sensor data

Controller

Power Unit