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ASSIGNMENT 1

Ans 2-

1. Manipulator Robots

   Stanford Type Manipulator

   - This type of manipulator has an RRP type configuration.
   - It is a serial manipulator with a prismatic joint at the end and two revolute joints at the base.
   - https://www.youtube.com/watch?v=tDHb5ZAKEws

   Puma Type Manipulator

   - This type of manipulator has an RRR type configuration.
   - It is also a serial manipulator having all three revolute joints.
   - https://www.youtube.com/watch?v=tjOhGqOHfhg

2. Mobile Robots

   Autonomous Mobile Robots

   - In order to recognize, grip, and transport things from one place to another while avoiding obstacles, Autonomous Mobile Robots employ machine vision technology.
   - https://www.youtube.com/watch?v=_5GkeGn_I34

3. Aerial Robots

   Festo Air-Penguin

   - The wings of the flying penguins are composed of lightweight polyurethane foam and are connected by a strut to either side of the robot penguin's body.
   - The body parts of these penguins are comprised of flexible struts that are linked together with small rings, allowing the birds to twist and bend in nearly any direction.
   - https://www.youtube.com/watch?v=jPGgl5VH5go

4. Underwater Robots

   Soft Robotics Fish

   - It is the fastest moving fish because flapping has significant advantages over conventional propellers.
   - Since there is no external spinning or rotating component like propeller blades, It can withstand high pressure at depth without losing effectiveness.
   - https://www.youtube.com/watch?v=crEHoWgwXX0

5. Soft Robots

   Octobot

   - It is the first entirely soft autonomous robot and is created by the use of integrated 3D printing, molding, and soft lithography.

- It has no rigid components, so it looks and moves like octopuses.
- https://www.youtube.com/watch?v=3Y82gxAtPGs

6. Micro Robot
   Rolls Royce's SWARM robots
   - The SWARM robots are guided into place by a robotic snake and utilize small cameras to capture different sections of an engine that would otherwise be difficult to access.
   - This is incredibly beneficial for mechanics to find out what is wrong with a car engine since it allows them to work on it more easily.
   - https://www.youtube.com/watch?v=mze68DdxlvY

Ans 3 - Different types of motors:

1. Brushed DC motors
   - Brushes and commutators are used in these DC electric motors. They are used to connect a stationary and a revolving circuit. The motor's rotor winding is powered by conductive brushes.
   - Because of the constant moving of the brushes and the sparks created between them, brushed motors require frequent maintenance. However, they are expensive and simplistic in design.
2. Brushless DC motors
   - The brushless motor is the most common form of DC motor since it lacks carbon brushes and commutators.
   - It contains many stators windings, each at a different angle to create flux in various directions. The input is switched between the windings of the stators to create a magnetic field that pushes and pulls on the magnetic field of the rotor, forcing it to revolve in its direction.
   - Its speed depends on the frequency of the AC power supplied by the controller.

3. Stepper motors
   - A stepper motor, sometimes known as a stepping motor, is a brushless DC motor that divides its whole revolution into a series of equal steps. Instead of rotating continuously, such a motor rotates in increments.
   - Stepper motor, due to its precise positioning, is used in industrial machines used for automatic manufacturing of products, CNC-based machines.
4. Servo motors
   - Servo motors can be designed to operate on both AC and DC power supplies. A Servo motor that works on DC power is termed a DC servo motor. To enhance the torque, the motor features a controller and numerous gears.

- The controller compares the input signal and the sensor signal collected via the feedback system. A servo rated at 5kg/cm, for example, can raise a load of 5kg that is 1cm away from its shaft.

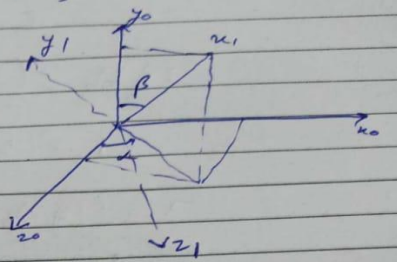
5. AC Synchronous motors
    - As the name indicates, such an AC motor operates at synchronous speed, which is a constant speed that solely depends on the frequency of the supply current.
    - It is employed for precise control and constant speed applications.
    - When an input of alternating current is applied to a synchronous motor, which has a similar stator design to an asynchronous motor (rotor design may differ) and produces a revolving magnetic field.

6. AC Asynchronous motors
    - Asynchronous speed refers to an AC motor that never works at synchronous speed.
    - It does not require any additional rotor excitation.
    - Its rotor speed is always lesser than its synchronous speed.

Ans 6.

(6)

$$R_0^1 = \begin{bmatrix} C_1 & C_2 & C_3 \\ i_1 \cdot i_0 & j_1 \cdot i_0 & k_1 \cdot j_0 \\ i_1 \cdot j_0 & j_1 \cdot j_0 & k_1 \cdot j_0 \\ i_1 \cdot k_0 & j_1 \cdot k_0 & k_1 \cdot k_0 \end{bmatrix}$$



We have to prove $C_1(C_1)^T = I$

$C_1(C_1)^T = I$

taking transpose both sides.

$(C_1)^T C_1 = I$

$$(C_1)^T C_1 = \begin{bmatrix} i_1 \cdot i_0 & i_1 \cdot j_0 & i_1 \cdot k_0 \end{bmatrix} \times \begin{bmatrix} i_1 \cdot i_0 \\ i_1 \cdot j_0 \\ i_1 \cdot k_0 \end{bmatrix}$$

1×3 $\quad$ 3×1

$$= \begin{bmatrix} \sin\beta\sin\alpha & \cos\beta & \sin\beta\cos\alpha \end{bmatrix} \times \begin{bmatrix} \sin\beta\sin\alpha \\ \cos\beta \\ \sin\beta\cos\alpha \end{bmatrix}$$

$$= \sin^2\beta\sin^2\alpha + \cos^2\beta + \sin^2\beta\cos^2\alpha$$

$$= \sin^2\beta(\sin^2\alpha + \cos^2\alpha) + \cos^2\beta$$

$$= \sin^2\beta + \cos^2\beta$$

$(C_1)^T C_1 = 1 \rightarrow I \rightarrow 1 \times 1$

Similarly we can prove for C_2 & C_3.

Ans 7.

(7) $\det(R_0') = \pm 1$

Since R_0' is an Orthogonal matrix, so its transpose is the inverse of it which means that

$$R_0' (R_0')^T = I$$

$$\det(R_0')(R_0')^T) = \det(I)$$

$$\det(R_0') \det(R_0')^T = 1$$

$$\det(R_0') \det(R_0') = 1$$

$$(\det(R_0'))^2 = 1$$

$$\boxed{\det R_0' = \pm 1}$$

if we restrict ourselves to the right-handed Coordinate System then $\boxed{\det R_0' = +1}$.