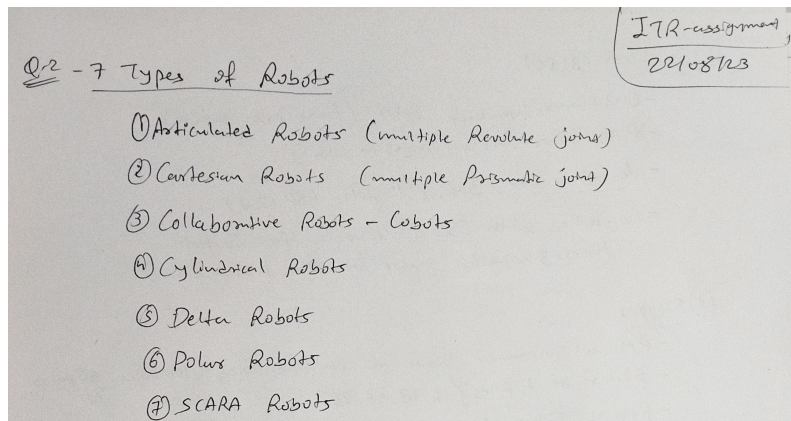


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ITR Assignment-1 Tasks:

1. Read Chapter 1 of the textbook.
- 2. Identify one or two examples of robots for each of the seven categories of robots mentioned in class. Submit your selected examples as a list of YouTube links with 2-3 line explanations for each.**

=> 7 categories of Robot



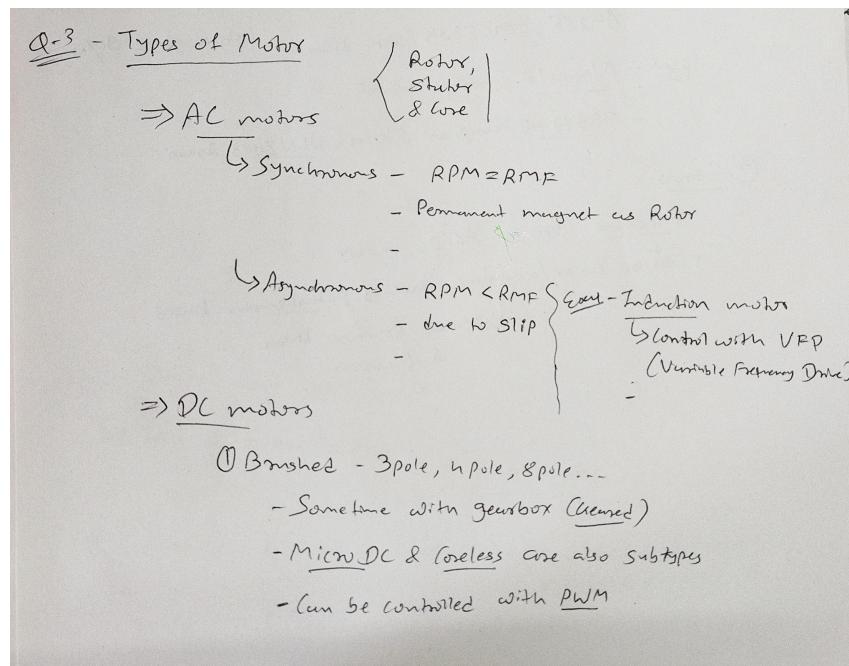
1. Articulated Robot
 - RRR/RRRR/...type configuration
 - Multiple revolute joint in chain (SCM)
 - Mimics human arm
 - [Fanuc LR Mate 200iD/4S](#)
 - [Puma260](#)
2. Cartesian Robot
 - PPP type configuration
 - 3 principal axes of control are linear
 - [Kuka KR80L](#)
 - [ONEreach Cartesian robot](#)
3. Collaborative Robot (cobot)
 - Low force, human interaction, safe
 - [Different from Traditional Robot](#)
 - [Universal ur5e](#)
 - [Kuka HRC](#)
4. Cylindrical Robot

- RPP type configuration
 - [ANALEXrobot R19](#)
5. Delta Robot
- Mostly used in pick & place
 - [Kuka KR Delta](#)
6. Polar Robot
- Robot configuration with a combined linear joint & 2 rotary joint
 - Also known as special robot
 - [Stanford type robot](#)
7. SCARA Robot
- PRR type configuration
 - Selective Compliance(flexibility in one direction) Assembly Robot Arm
 - Mostly used in P&P & assembly operations
 - [Kuka KR SCARA](#)

=> Ref:

- <https://robodk.com/download>
- <https://robodk.com/industrial-robots-reach/>
- <https://robodk.com/doc/en/Getting-Started.html>
- <https://robodk.com/blog/industrial-robot-reach-charts/>

3. Review the most common types of motors and summarize them with a 2-3 sentence description of each of them. The description offered in [this video](#) may be a good starting point.



② Brushless (BLDC)

- Outrunner/Inrunner rotor (front/back support)
- P.M. rotor (no windings in rotor)
- description like: 3phase 12 pole (3P 12N)
- Controlled with ESC (Electronic Speed Control)
(uses 3 hall-effect sensor for rotor position state)

③ Stepper

- P.M. at inrunner rotor of multiple poles ($2N$ poles, N pairs)
 - Stator of 4 poles (1A, 1B, 2A, 2B)
 - Require Stepper drivers like...
A4988, TMC2209 (silent driver)
 - Equ - Nema17 (most common)
 - 28BYJ-48 unipolar Steppers (ULN2003 driver)
- step/rotation = $4N$
step angle = $90/N$

④ Servo

- Feedback driven AC/DC motor
- Can be linear/rotary, mostly potentiometer based
↳ geared for more torque & precision

4. Review the basic kinematic principles summarized in [this video](#).

5. Review the key ideas related to connecting motor drivers, microcontrollers, and power supply to a motor described in the [link here](#). This information maybe useful for future implementation.

6. Show that columns of the rotation matrix $R(0, 1)$ are orthogonal.

ITR-assignment1
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Q.6 - show that columns of rotation matrix R_0^1 are orthogonal

$\Rightarrow R^T = R^{-1} \Leftrightarrow R^T R = I$, because orthogonal

Let $R = \text{Rot}(x, \theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$

$R^T R = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos^2\theta + \sin^2\theta & 0 \\ 0 & 0 & \cos^2\theta + \sin^2\theta \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$

[Ref](#)

7. Show that $\det(R(0, 1)) = 1$.

Q.7 - Show that $\det(R_0^1) = 1$

\Rightarrow Let $R_0^1 = \text{Rot}(x, \theta) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta \\ 0 & \sin\theta & \cos\theta \end{bmatrix}$

$\det(R_0^1) = 1(\cos\theta \cdot \cos\theta - (-\sin\theta) \cdot \sin\theta) + 0(\cos\theta \cdot 0 - (-\sin\theta) \cdot 0) + 0(\sin\theta \cdot 0 - \cos\theta \cdot 0)$

$= 1(\cos^2\theta + \sin^2\theta) + 0(0) + 0(0)$

$\boxed{\det(R_0^1) = 1}$

8. Read about the order of rotations and sample examples in the textbook.

9. Review the textbook explanation and example related to a rotation matrix for rotation about an arbitrary axis k .

Submit the assignment in the form of a PDF with active links for Task 2 and appropriate explanations for Task 3, 6, and 7. Nothing is to be submitted for tasks 1, 4, 5, 8 and 9.