Hrishikesh Birje
21110044

Assignment 1

T2)

- Autonomous Mobile Robots
  - An autonomous mobile robot is a type of robot that has the ability to comprehend and navigate its surroundings on its own. AMRs are distinct from autonomous guided vehicles (AGVs), which depend on tracks or predetermined trajectories and frequently need operator supervision.
  - Warehouse robots
    - can autonomously transport goods between locations, improving logistics and lowering manual labor
    - Autonomous Mobile Robots (AMRs) in Action

- Autonomous underwater vehicles (AUV's)
  - Autonomous Underwater Vehicles (AUVs) are robots designed to operate underwater without direct human control.
  - SPICE by Kawasaki
    - For inspection of subsea oil and natural gas pipeline
    - Kawasaki: Autonomous Underwater Vehicle "SPICE"

- Manipulator Robots
  - Autonomous Underwater Vehicles (AUVs) are robots designed to operate underwater without direct human control.
  - SCARA
    - Epson LS-Series
      - EPSON LS-Series SCARA Robots
    - FANUC SR Series
      - High Speed SCARA Robot for Pick & Place – FANUC's New…

- Drones or Aerial Robots
  - Drones are aircraft that are flown without a human pilot aboard. They are sometimes referred to as unmanned aerial vehicles (UAVs) or aerial robots. They can be remotely operated by a person, or they can run independently using pre-programmed commands or real-time sensor data.
  - Skydio X2:
    - used in search and rescue missions and situational awareness

        - Introducing Skydio X2™

- Humaniod Robots
    - Robots that mimic the human body in both appearance and functionality are called humanoid robots.
    - Honda Asimo:
        - Can dance, run, climb stairs, stroll, and in some situations, even work as a receptionist or tour guide.
        - https://www.youtube.com/watch?v=QdQL11uWWcI

- Mobile Robots or Quadropeds
    - A multipurpose quadruped robot called ANYmal is intended for use in hazardous settings, remote monitoring, and industrial inspections. It is capable of carrying out operations like visual and thermal inspections while autonomously navigating difficult terrain.
    - ANYmal
        - ANYbotics Introduces End-to-End Robotic Inspection Solution

- Autonomous vehicles
    - Waymo's vehicles use a combination of lidar, radar, cameras, and advanced software to navigate.
    - Waymo
        - Sense, Solve, and Go: The Magic of the Waymo Driver

T3)

Electric motors:

- AC
    - Asynchronous - Induction motor
        - It is an electric motor in which the rotor revolves at a different rate than the magnetic field.
    - Synchronous

        - Rotor revolves at the same rate as the stator's magnetic field.
- DC
    - Brushed
        - Has brushes made of copper/carbon
        - Has 2 magnets surrounding the rotor. The magnetic field torque is produced when opposing polarities are linked to a current source.
    - Brushless
        - (BLDC)
            - No brushes
            - To cause the shaft to rotate, an electronic control circuit must switch current to the correct windings in the correct sequence.
            - Better than brushed
        - Stepper
            - Similar to BLDC.
            - The rotations take place in equal steps.
            - Controlled by a driver.
- Servo
    - A control circuit included into servo motors offers feedback on the location of the motor shaft at any given time.
    - Hence the servo motors can rotate with extreme precision.

6) Let $R = \begin{bmatrix} x_{11} & x_{12} \\ x_{21} & x_{22} \end{bmatrix}$

$$R^T = \begin{bmatrix} x_{11} & x_{21} \\ x_{12} & x_{22} \end{bmatrix}$$

$$RR^T = I$$

$$\begin{bmatrix} x_{11}^2 + x_{12}^2 & x_{11}x_{21} + x_{12} \cdot x_{22} \\ x_{21}x_{11} + x_{22}x_{12} & x_{21}^2 + x_{22}^2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

↳ $x_{11}x_{21} + x_{12}x_{22} = 0$

∴ Dot product of colums is 0

∴ Colums are orthogonal

7) $RR^T = I$

$\det(RR^T) = 1$

$\det(R)\det(R^T) = 1$

$[\det(R)]^2 = 1$

$\det(R) = 1$