# Robot Manipulator

Robotic Hardware Systems

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# Definition

- A robot manipulator is an electronically controlled mechanism, consisting of multiple segments, that performs tasks by interacting with its environment.

- They are also commonly referred to as robotic arms.

- Robot manipulators are extensively used in the industrial manufacturing sector

# Physical Design for various applications



- The Canadarm or Canadarm or Canadian Space Arm1 (formerly the Shuttle Remote Manipulator System, SRMS) is a mechanical manipulator arm designed by Canada and attached to the US Space Shuttle.

- It is mainly used to manipulate payloads to extract them from the storage bay of the shuttle and deploy them, or vice versa. It can also serve as a support for astronauts when they perform spacewalks or allow the inspection of certain parts of the shuttle which are inaccessible to the crew.

- The Canadarm is 15.32 m long and is divided into three segments modeled on the human arm:
  - Upper arm segment, 6.38 m long.
  - Lower arm segment, 7.06 m long.
  - The wrist and the effector which is the hand of the Canadarm, 1.88 m long.

# Physical Design for various applications

- The Terabot-S is a platform-agnostic robot manipulator designed by Oceaneering Space Systems in Clear Lake, Texas USA for mobile robotics applications such as first response, military EOD, surveillance, mining, research, and CBRN sampling.

-  Since the Terabot-S is platform agnostic, it can be fitted to virtually any unmanned ground vehicle (UGV) or mobile robotic platform.

- The manipulator joints have integrated clutches for protection against overloads and are fully sealed against water and dust.

- The manipulator has a manual, tool-free, quick-release end-effector attachment mount to allow the user to rapidly change end-effectors as needed in the field.
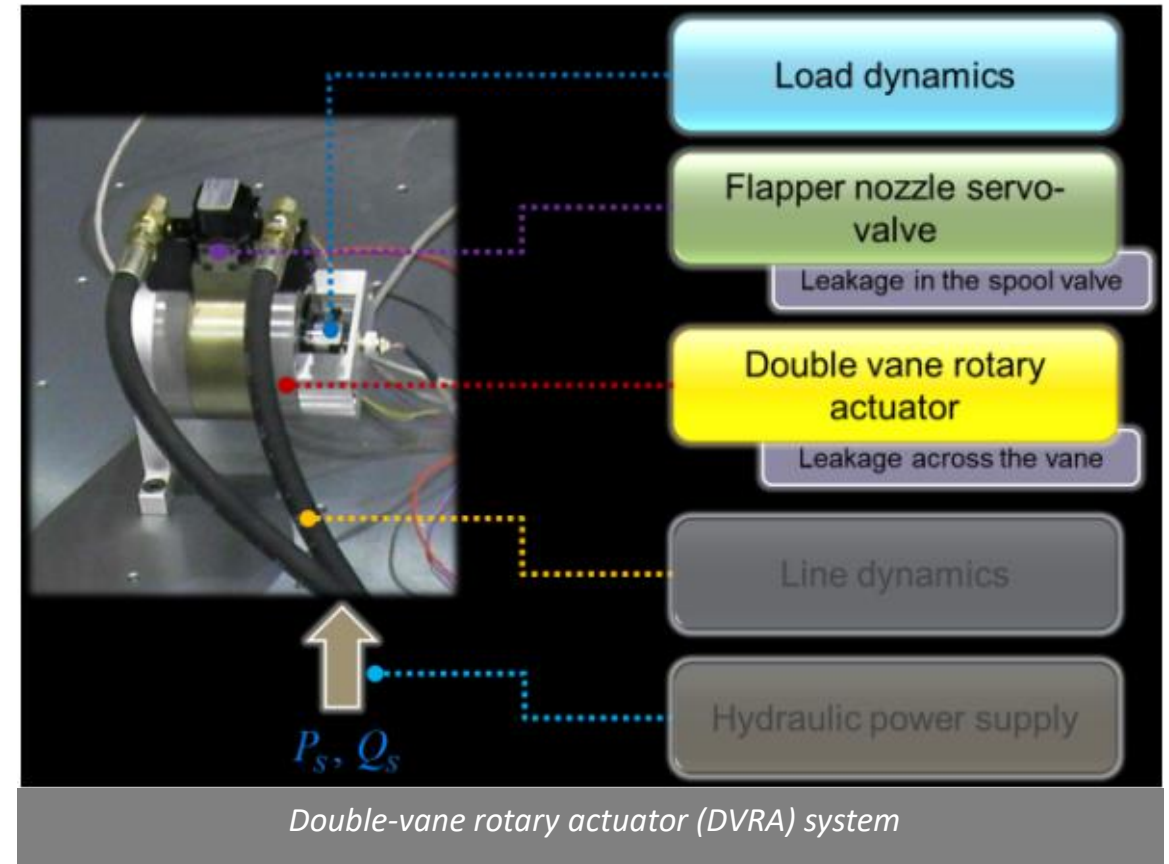
# Physical Design for various applications

- SCARA stands for Selective Compliant Assembly Robot Arm

- The SCARA is a category of robot on its own. There are two subcategories of SCARA, 3-axis robots and 4-axis robots. The arm of the SCARA bends in the XY plane (horizontal plane) thanks to two pivot links having for axis of rotation the Z axis (vertical axis) but remains rigid in the vertical plane (Z axis). The SCARA also has a vertically sliding axis through a prismatic connection.

- Its workspace is cylindrical. It is generally chosen for its high precision, speed of action, small size and price.

- SCARA is generally used for palletizing, loading or positioning. It is very often used in the food industry and the pharmaceutical industry.

# Locomotion System & Actuators

- Manipulator robots are electrically, hydraulically, or pneumatically actuated

- Pneumatic actuation provides a higher speed in operations than hydraulic

- Servos are mostly used in electrical actuation due to the high accuracy and precision provided

- Belts are sometimes used for torque transfer

- One robot can be used for different types pf applications. Only the end effector will be changed (mill cutter, camera, gripper, polisher etc.)
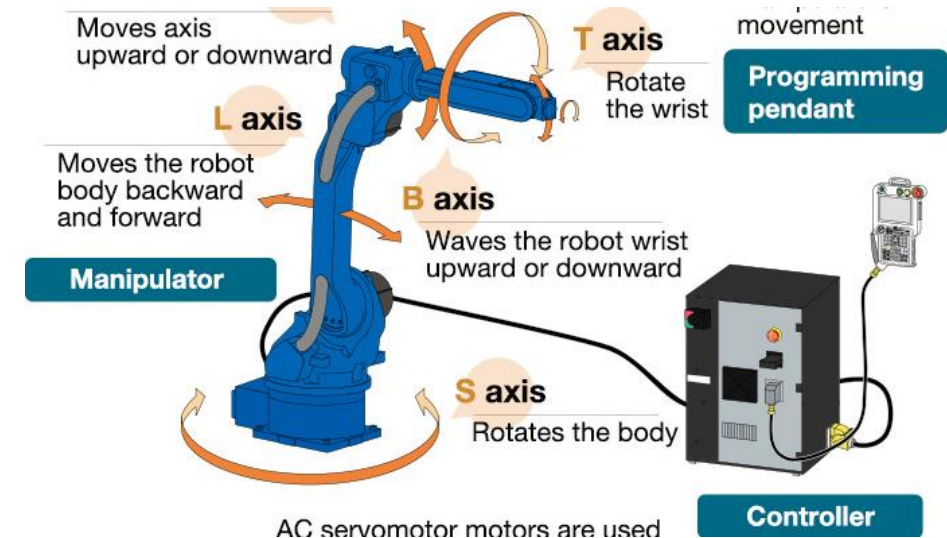


Double-vane rotary actuator (DVRA) system

# Navigation System (Sensors) & Control



*PIC16F877A microcontroller*

- Using inverse kinematics, the angles of the joints will be calculated and applied based on the desired position inserted.

- The inputs are inserted in the User interface and all the calculations are made in the controller software.

- Using the driver, joints are moved according to the calculations made.

- It is rare to have a sensing system or cameras in robot manipulators as the need of them is neglectable. However, it is recommended to use them in order to reach an accurate desired output.

- In the case of mobile manipulators cameras can be used for mapping, location, and discovery.



Moves axis upward or downward

**T axis** Rotate the wrist

movement

**Programming pendant**

**L axis** Moves the robot body backward and forward

**B axis** Waves the robot wrist upward or downward

**Manipulator**

**S axis** Rotates the body

AC servomotor motors are used

**Controller**

# Data Collection and Transmission

- The type of data collected and transmitted is usually the position of the end effector i.e. where is the end effector positioned now? How many times the end effector has reached the position (X1,Y1,Z1)? What is the history of the robot movements?

- This type of data is transmitted and collected through the software based on the programming code.

- Other types of data can be related to the localization of the robot and its environment.

- In this case, for a mobile robot or a space robot, data can be communicated through a transmitter placed on the robot and a receiver connected to the user interface. GPS or WiFi can also be used

- In the case of terabit-s robot, serial communication is used, where data is sent one bit at a time, sequentially, over a communication channel or computer bus

- Ethernet communication is used for industrial robots
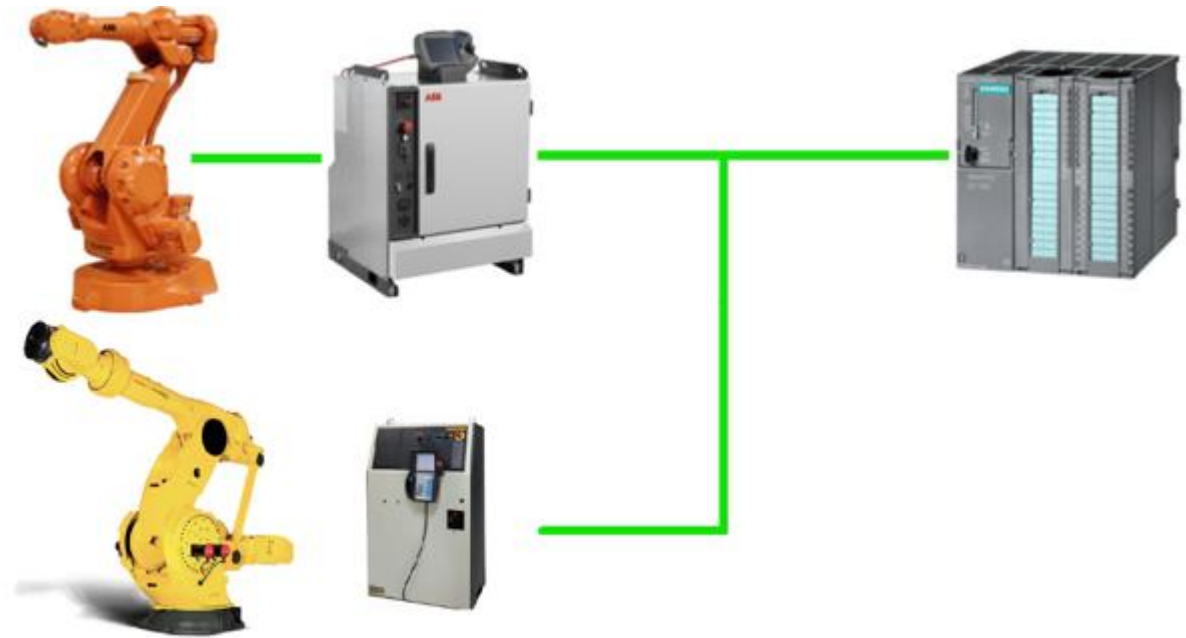
# Power Management

- The types of batteries are chosen based on the applications and equipment
- Power required depends on the total current needed by all the robot motors

*EPSON G6 SCARA ROBOT BATTERY 3.6V
LITHIUM PLC*