A robot is a type of automated machine that can execute specific tasks with little or no human intervention and with speed and precision

Robotics is the Science of designing and build robots suitable for real-life applications in automated manufacturing and other non-manufacturing environments.

Three basic laws which the roboticists still obey with respect.

1. First Law: A robot must not harm a human being or, through inaction, allow one to come to harm.
2. Second Law: A robot must always obey human beings unless it is in conflict with the first law.
3. Third Law: A robot must protect itself from harm unless that is in conflict with the first and/or the second laws.

A robot has many components which include:

1. A base-fixed or mobile.
2. A manipulator arm with several degrees of freedom (DOF).
3. An end-effector or gripper holding a part or a tool.
4. Drives or actuators causing the manipulator arm or end-effector to move in a space.
5. Controller with hardware and software support for giving commands to the drives.
6. Sensors to feed back the information for subsequent actions of the arm or gripper as well as to interact with the environment in which the robot is working.
7. Interfaces connecting the robotic subsystems to the external world.

Basic Component Of Simple Robotics System:

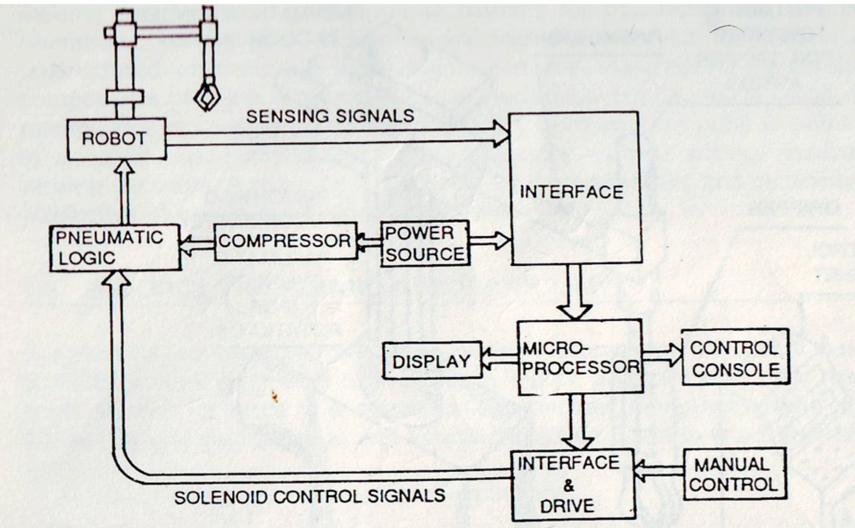


FIG. 1.2 *Basic components of a microprocessor-based robotic system*

DOF stands for "Degrees of Freedom" in robotics. It refers to the number of independent parameters or variables that define the state or configuration of a mechanical system. In the context of robotic manipulators, such as robot arms, the degrees of freedom represent the number of ways the end effector (the part of the robot that interacts with the environment) can move.

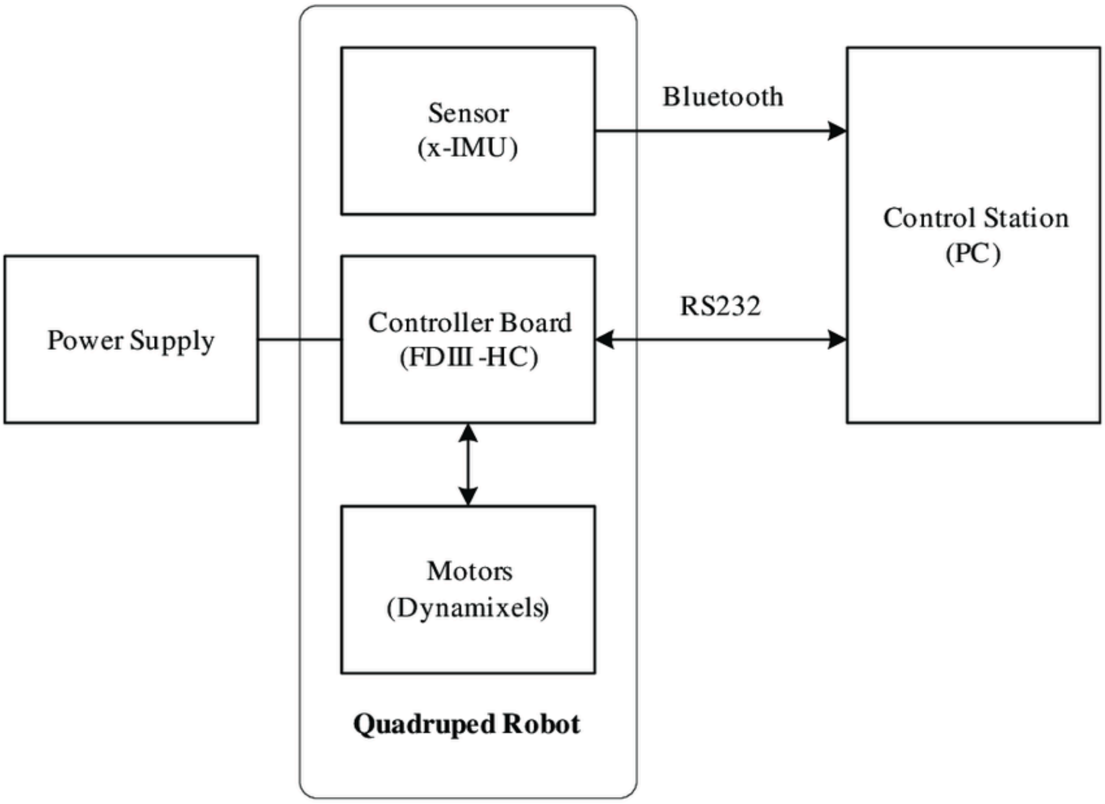
Lower pair connectors refer to types of joints that allow relative motion between two connected links. Here are the names of lower pair connectors for 1, 2, and 3 degrees of freedom (DOF):

1. 1 Degree of Freedom (1 DOF):
   - Revolute Joint: This type of joint allows rotational motion about a fixed axis. It is commonly represented as a hinge or rotary joint and provides one degree of freedom.
2. 2 Degrees of Freedom (2 DOF):
   - Revolute Joint: Same as in 1 DOF, providing rotational motion about a fixed axis.

- Prismatic Joint: This joint allows linear motion along a fixed axis. It is represented as a sliding or translational joint and provides one degree of freedom.

3. 3 Degrees of Freedom (3 DOF):
    - Revolute Joint: Provides rotational motion about a fixed axis.
    - Prismatic Joint: Provides linear motion along a fixed axis.
    - Spherical Joint (also known as Ball Joint): This joint allows rotational motion about multiple axes intersecting at a common point. It provides two degrees of freedom, typically represented as pitch and yaw rotations.

Block Diagram of Robotics System:



Contact and non-contact sensors are both types of sensors used to detect and measure various physical phenomena, but they operate in fundamentally different ways:

1. Contact Sensors:
    - Contact sensors require physical contact with the object or substance they are sensing.
    - They typically use mechanical components such as switches, levers, or probes to make direct contact with the object.
    - Examples of contact sensors include limit switches, tactile sensors, and certain types of temperature sensors.
    - Contact sensors can provide accurate measurements but may wear out over time due to the mechanical contact.
2. Non-Contact Sensors:
    - Non-contact sensors do not require physical contact with the object or substance they are sensing.
    - They operate by detecting changes in various physical properties, such as light, sound, electromagnetic fields, or radiation, without making direct contact.
    - Examples of non-contact sensors include proximity sensors, infrared sensors, ultrasonic sensors, and cameras.

- Non-contact sensors are often preferred in applications where physical contact may be impractical, where the object is moving, or where contamination or damage to the sensor or the object being measured must be avoided.
- While non-contact sensors offer advantages such as non-intrusiveness and longevity, they may be less accurate or sensitive compared to contact sensors in certain applications.

Tactile Sensor:
A tactile array sensor is a device designed to detect and measure pressure distribution across a surface. It typically consists of an array of individual sensing elements, each capable of detecting pressure or force independently. Here's how it generally works:

1. Sensing Elements:
    - Tactile array sensors are composed of multiple sensing elements arranged in a grid or array format.
    - Each sensing element is usually a small sensor, such as a piezoresistive sensor, capacitive sensor, or force-sensitive resistor (FSR).
    - These sensing elements are distributed across the surface of the sensor, covering the area to be monitored.
2. Pressure Detection:
    - When an external force is applied to the surface of the tactile array sensor, it causes deformation or compression in the sensor material.
    - This deformation or compression leads to changes in the electrical properties of the individual sensing elements.
    - For example, in a piezoresistive sensor, pressure causes a change in resistance, while in a capacitive sensor, it alters the capacitance.
3. Data Acquisition:
    - Each sensing element in the array produces a signal proportional to the pressure or force applied to its location.
    - These signals are then collected and processed by the sensor's electronics.
    - The sensor's electronics typically include analog-to-digital converters (ADCs) to convert the analog signals from the sensing elements into digital data.
4. Analysis and Output:
    - The digital data representing the pressure distribution across the sensor surface is then analyzed by the sensor's control system or connected device.
    - Depending on the application, the sensor may provide real-time feedback, generate a visual representation of the pressure distribution, or trigger specific actions based on predefined thresholds.

Proximity sensors detect the presence or absence of objects without physical contact. They work based on various principles:

1. Inductive Sensors: Detect metallic objects by generating an electromagnetic field. Changes in the field when an object enters the detection range trigger a signal.
2. Capacitive Sensors: Detect objects based on capacitance changes. When an object enters the detection range, it alters the capacitance between sensor plates, triggering a signal.
3. Ultrasonic Sensors: Emit high-frequency sound waves and measure their reflection time. Changes in reflection time when an object enters the detection range trigger a signal.
4. Photoelectric Sensors: Use light beams to detect objects. Interruption of the light beam by an object triggers a signal.

These sensors offer efficient, contactless detection suitable for various applications.