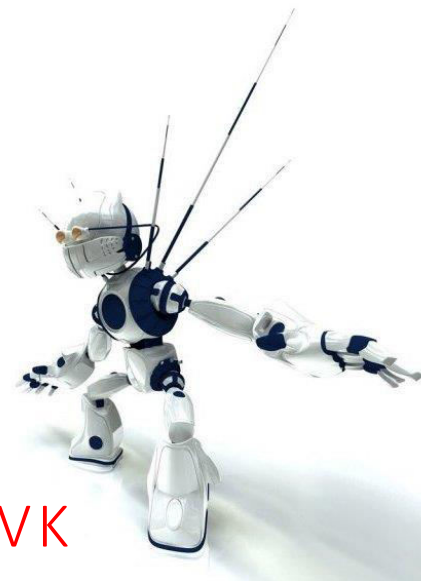


# ROBOTS AND ROBOTIC ARM

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-BY LALITHEJ VVK

# ROBOT????

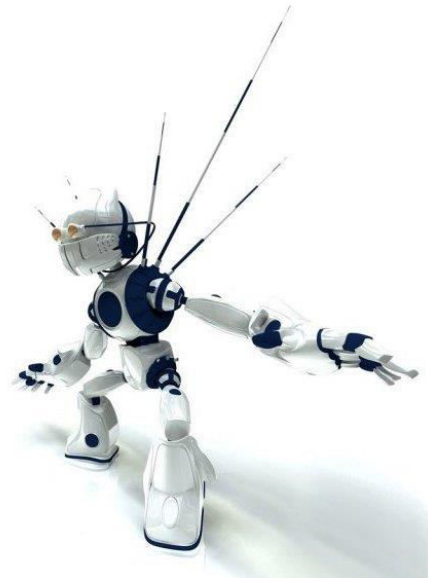
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## What is a Robot???

- A system that works or operates under human's command.
- It is a system that contains sensors, control systems, manipulators, power supplies and software all working together to perform a specific task depicted by the user.

## Why do we call it a Robot???

- The word '**Robot**' was rooted from Czech word '**Robota**' which means '**forced labourer**' or simply a '**Worker**'.



# Classification of Robots

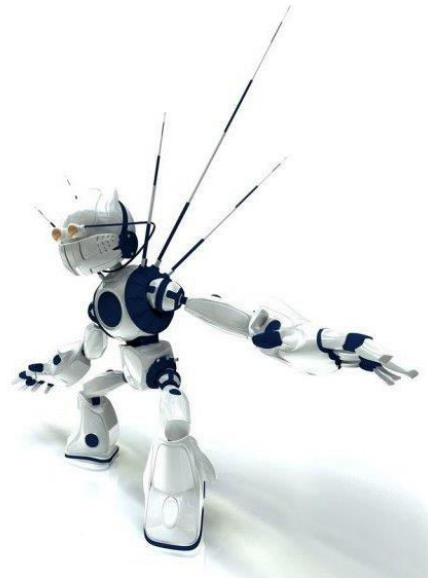
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## **Based on their task :**

*Playback Robot* : A robot which performs operations by reading off the memorized information for an operating sequence.

*Manipulator* : A robot which can move objects spatially.

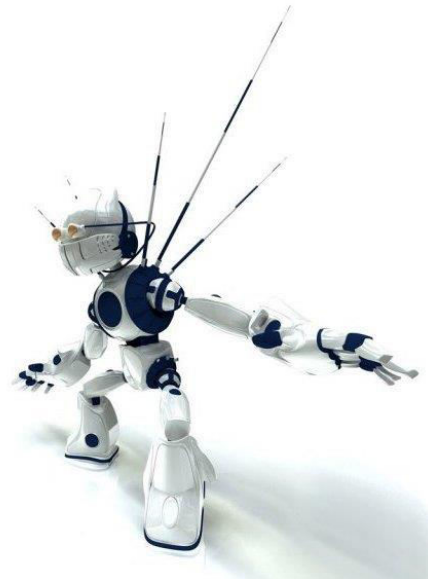
*Intelligent Robot* : A robot that can determine its own behavior within its limits and perform operations without interference of user.



# ROBOTIC ARM

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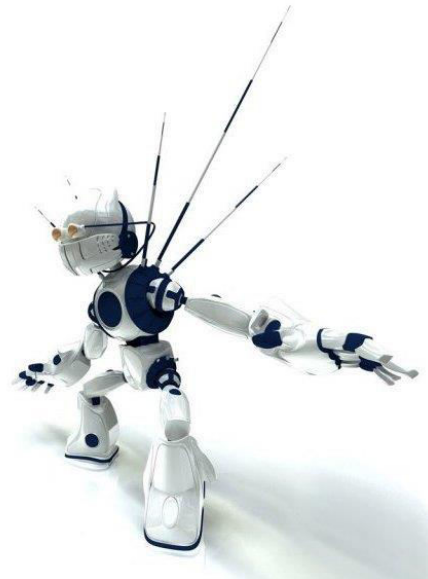
- A robotic arm is a mechanical arm having functions similar to that of human arm programmed and designed for specific tasks.
- Robotic arm is a basic form of a manipulator designed to move objects or to perform specific functions like drilling or welding in industries



# Parts of a Robotic Arm

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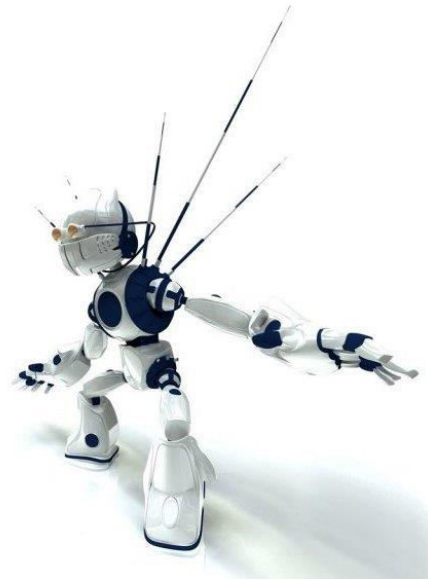
- Kinematic Chain
- End Effector



# Kinematic Chain

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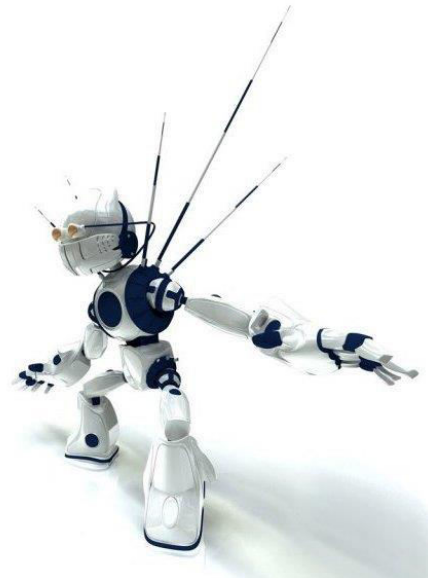
- A Kinematic Chain constitutes number of rigid bodies connected in chain such that their motion is constrained.
- Motion of each independent body or link would alter the motion of the chain.
- Thus number of degrees of freedom of each link would constitute the degrees of freedom of the kinematic chain.
- End effector is not a part of kinematic chain as it is not responsible for the motion of the manipulator.



# Joints used in a robotic arm

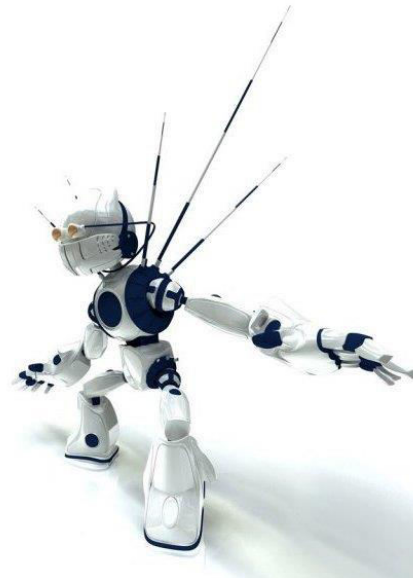
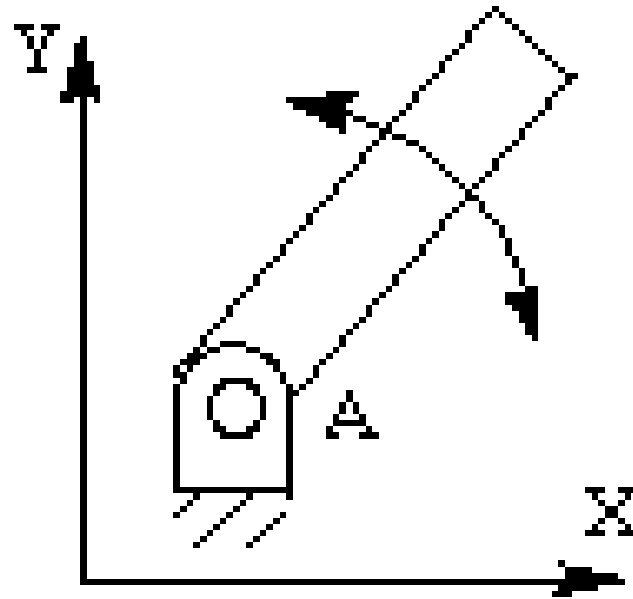
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- As the arm is a replica of an actual human arm which has either a linear joint or a rotary joint but not both.
- Thus the types of joints are restricted to only two.
- They are :
  - Revolute Joint (R)
  - Prismatic Joint (P)



# Revolute Joint

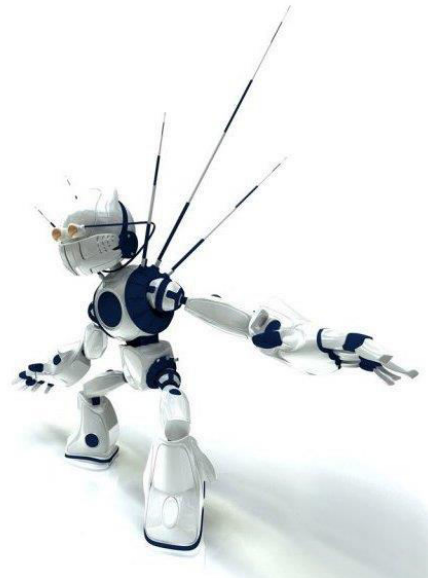
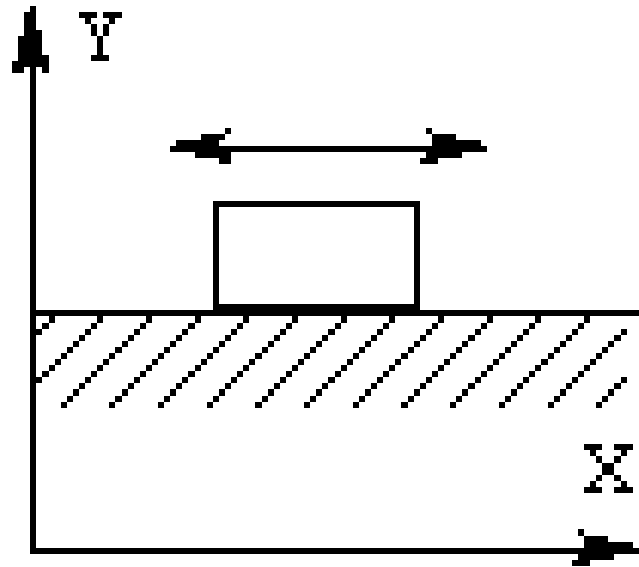
- If the link in a link-joint pair rotates along the axis of the joint then it is a revolute joint





# Prismatic Joint

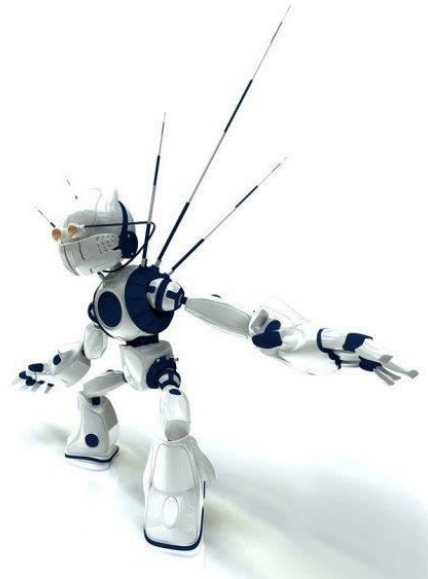
- If the link traverses back and forth from the joint then it is said to be a Prismatic Joint.



# End Effector

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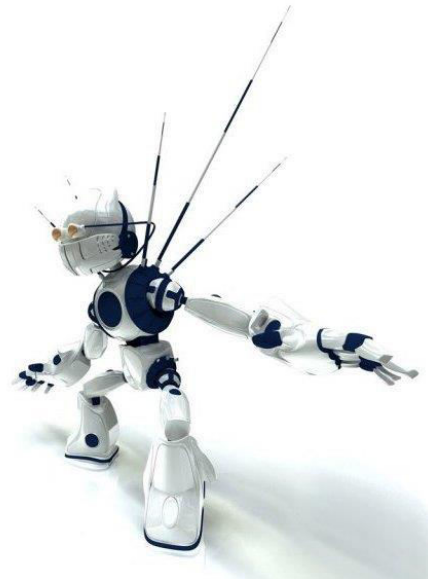
- Defines the work output of the manipulator.
- Usually connected to the wrist.
- Does not have any effect on DOF of the robot.
- Classified into *two* types
  - *Gripper* : To move objects spatially.
  - *Tools* : To perform specific tasks  
eg : for welding, a *welding torch* is used as an end effector of the manipulator



# Workspace of a Robotic Arm

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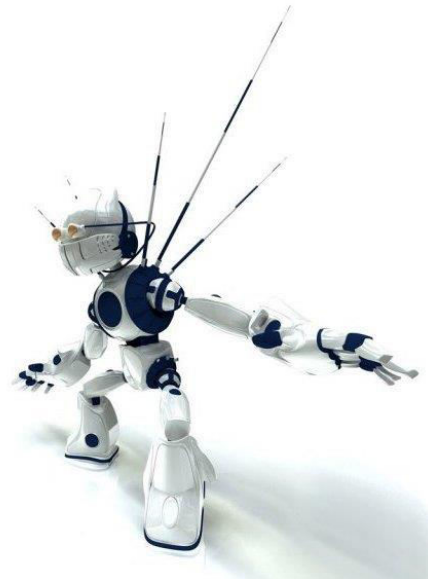
- The region where the manipulator can provide an output is called a workspace.
- An object can be moved only if it is present in the workspace of the arm
- Workspace is determined by two parameters :
  - Work Volume : volume swept by the end effector of the arm.
  - Work Envelope : the enveloped surface of the workspace.



# Configuration of Robotic Arm

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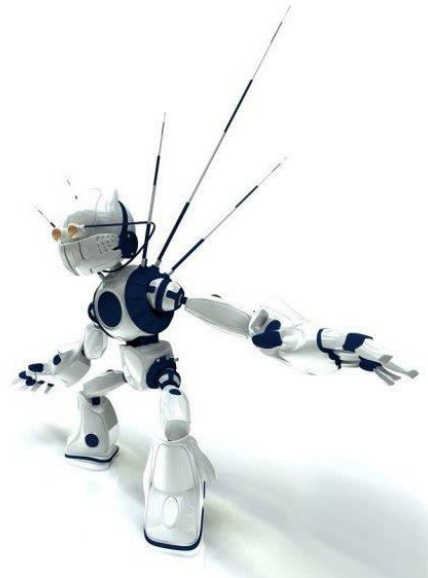
- Based on types of joints and workspace, configuration of Robotic Arm can be classified into many types.
- Most commonly used configurations are :
  - Cartesian (PPP) Configuration
  - Polar (RRP) Configuration
  - Cylindrical (RPP) Configuration



# Cartesian Configuration

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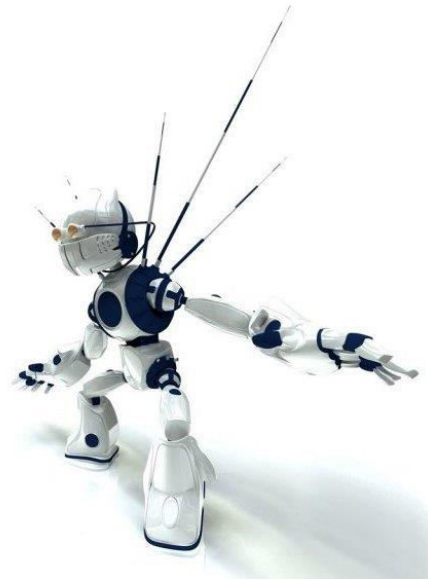
- This type of configuration is formed by three prismatic joints P,P,P.
- This promotes translation motion in all the axes.
- However this type of arm is not configured for rotational type of motion.
- The workspace of this configuration is a Cuboid.
- The work volume of cuboid is determined by the lengths of all the maximum lengths of prismatic joints.



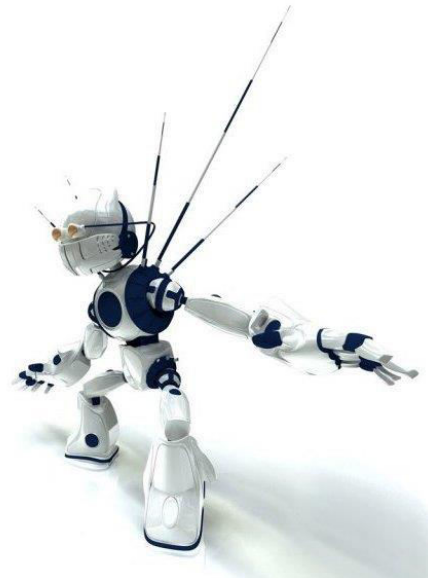
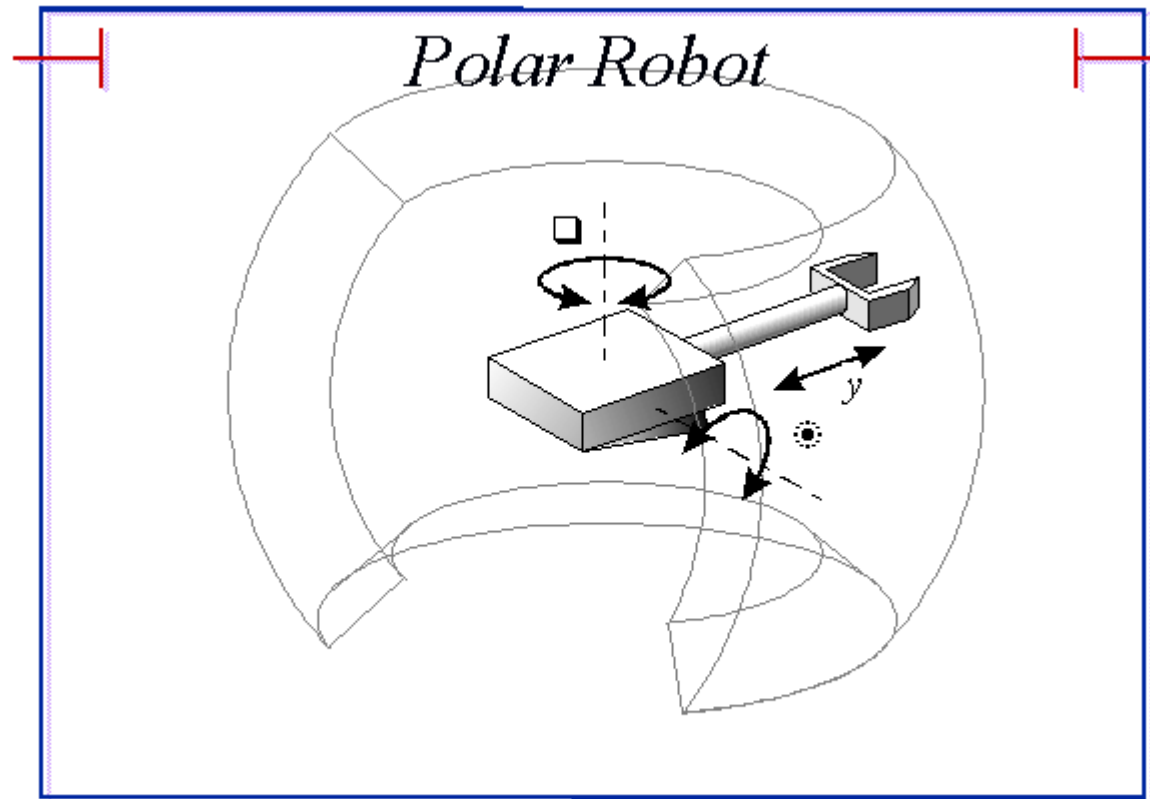
# Polar or Spherical Configuration

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- This type of configuration consists of two revolute joints and a prismatic joint.
- The order of placements of these joints is R,R,P.
- This type of configuration has a hollow sphere as its workspace.
- Radius of this sphere is equal to the maximum length of prismatic joint.



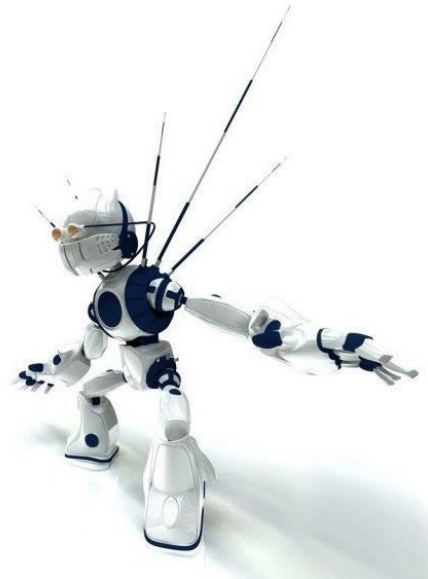
# Polar or Spherical Configuration



# Cylindrical Configuration

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- This type of configuration consists of two prismatic joints and a revolute joint.
- Order of placements of these joints is R,P,P.
- This type of configuration has hollow cylinder as its workspace.
- Inner and Outer radii of this workspace are maximum and minimum lengths of prismatic joints.

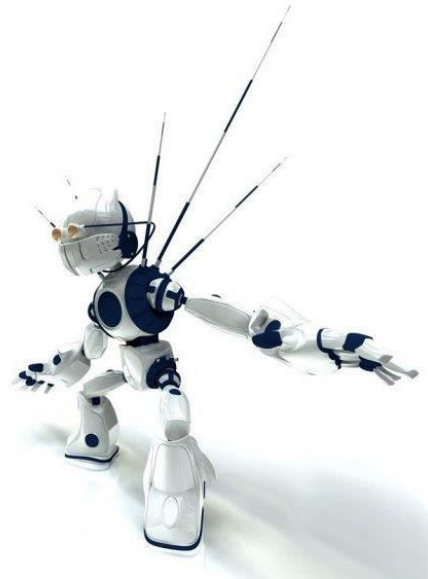




# Manipulation and Control

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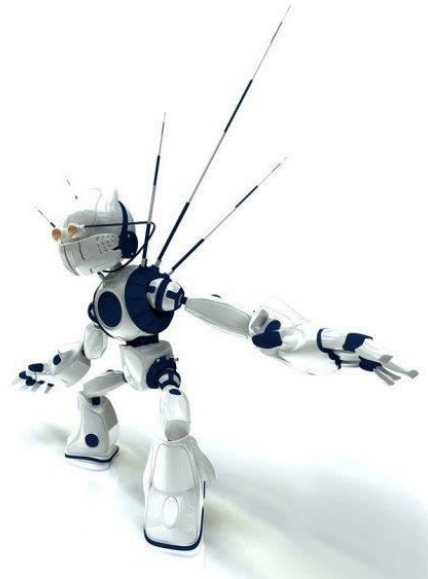
- Control and manipulation of a robotic arm can be done by programming the arm or by 'teaching' to perform tasks.
- This can be done for an arm that is controlled by the user.
- However the arm can be programmed such a way that it responds to the changes in environment.
- This can be done using various kinds of sensors.



# Robot Sensing and Vision

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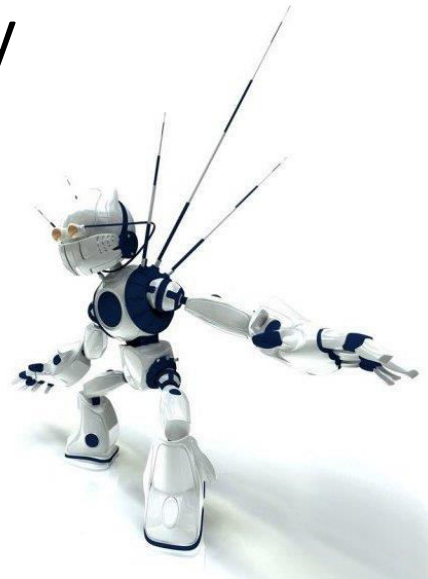
- A Robot can interact with the user or perform the task with ease without user's interference by sensing various kinds of sensors for the arm.
- Also, the robot can visualize the environment and perform tasks if it is provided with vision.
- This can be done using image processing



# Is programming necessary.....??

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- Programming is heart of a ROBOT, though there are robots completely based on mechanical but a perfect robot needs both.
- However, a robotic arm need not be necessarily controlled by programming.
- It can be manually controlled using force as a parameter
- This force can be completely mechanical.



# Mechanical Robotic Arm

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- Control of Robotic arm alone can be done using force i.e fluid pressure as a parameter.
- Based on type of fluid a robotic arm is classified into two types :
  - a) Pneumatic Robotic Arm : Fluid : Air or Gas
  - b) Hydraulic Robotic Arm : Fluid : Liquid
- Different types of fluid are used in different applications.

