SKILRY

# ROBOTICS

Robotics is a domain in artificial intelligence that deals with the study of creating intelligent and efficient robots.

# WHAT ARE ROBOTS?

Robots are the artificial agents acting in real world environment.

## Objective

Robots are aimed at manipulating the objects by perceiving, picking, moving, modifying the physical properties of object, destroying it, or to have an effect thereby freeing manpower from doing repetitive functions without getting bored, distracted, or exhausted.

## What is Robotics?

Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots.

# Aspects of Robotics

- The robots have mechanical construction, form, or shape designed to accomplish a particular task.
- They have electrical components which power and control the machinery.
- They contain some level of computer program that determines what, when and how a robot does something.

# Difference in Robot System and Other AI Program

Here is the difference between the two:

| AI Programs | Robots |
|---|---|
| They usually operate in computer-stimulated worlds. | They operate in real physical world |
| The input to an AI program is in symbols and rules. | Inputs to robots is analog signal in the form of speech waveform or images |
| They need general purpose computers to operate on. | They need special hardware with sensors and effectors. |

# ROBOT LOCOMOTION

Locomotion is the mechanism that makes a robot capable of moving in its environment. There are various types of locomotions:

- Legged
- Wheeled
- Combination of Legged and Wheeled Locomotion
- Tracked slip/skid

# LEGGED LOCOMOTION

- This type of locomotion consumes more power while demonstrating walk, jump, trot, hop, climb up or down, etc.
- It requires more number of motors to accomplish a movement. It is suited for rough as well as smooth terrain where irregular or too smooth surface makes it consume more power for a wheeled locomotion. It is little difficult to implement because of stability issues.

- It comes with the variety of one, two, four, and six legs. If a robot has multiple legs then leg coordination is necessary for locomotion.

The total number of possible gaits (a periodic sequence of lift and release events for each of the total legs) a robot can travel depends upon the number of its legs.

If a robot has k legs, then the number of possible events N = (2k-1)!.

In case of a two-legged robot (k=2), the number of possible events is N = (2k-1)! = (2*2-1)! = 3! = 6.

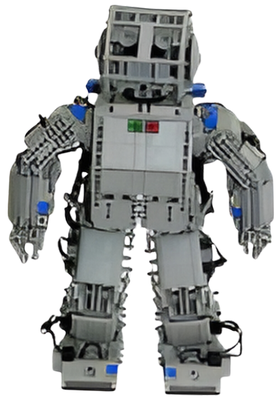
Hence there are six possible different events:

Lifting the Left leg
Releasing the Left leg
Lifting the Right leg

# Hence there are six possible different events:

Lifting the Left leg
Releasing the Left leg
Lifting the Right leg
Releasing the Right leg
Lifting both the legs together
Releasing both the legs together.

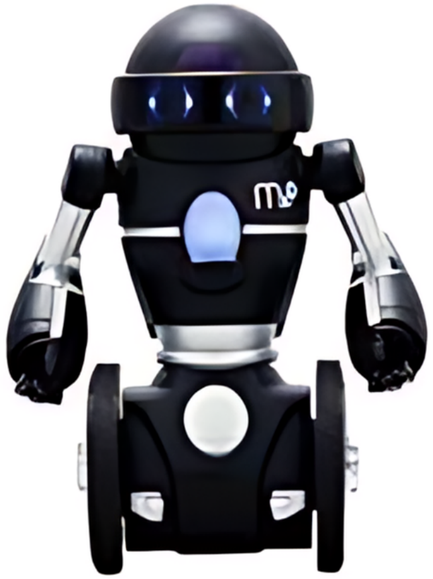
In case of k=6 legs, there are 39916800 possible events. Hence the complexity of robots is directly proportional to the number of legs.



# Wheeled Locomotion

It requires fewer number of motors to accomplish a movement. It is little easy to implement as there are less stability issues in case of more number of wheels. It is power efficient as compared to legged locomotion.

- Standard wheel: Rotates around the wheel axle and around the contact
- Castor wheel: Rotates around the wheel axle and the offset steering joint
- Swedish 45° and Swedish 90° wheels: Omni-wheel, rotates around the contact point, around the wheel axle, and around the rollers.
- Ball or spherical wheel: Omnidirectional wheel, technically difficult to implement.



# Slip/Skid Locomotion

In this type, the vehicles use tracks as in a tank. The robot is steered by moving the tracks with different speeds in the same or opposite direction. It offers stability because of large contact area of track and ground.

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# Components of a Robot

Robots are constructed with the following:

**Power Supply:** The robots are powered by batteries, solar power, hydraulic, or pneumatic power sources.

**Actuators:** They convert energy into movement.

**Electric motors (AC/DC):** They are required for rotational movement.

**Pneumatic Air Muscles:** They contract almost 40% when air is sucked in them.

**Muscle Wires:** They contract by 5% when electric current is passed through them.

**Piezo Motors and Ultrasonic Motors:** Best for industrial robots.

**Sensors:** They provide knowledge of real time information on the task environment. Robots are equipped with vision sensors to be to compute the depth in the environment. A tactile sensor imitates the mechanical properties of touch receptors of human fingertips.

# Computer Vision

This is a technology of AI with which the robots can see. The computer vision plays vital role in the domains of safety, security, health, access, and entertainment.

Computer vision automatically extracts, analyzes, and comprehends useful information from a single image or an array of images. This process involves development of algorithms to accomplish automatic visual comprehension.

### Hardware of Computer Vision System

### This involves:

- Power supply
- Image acquisition device such as camera
- a processor
- a software
- A display device for monitoring the system
- Accessories such as camera stands, cables, and connectors

## Tasks of Computer Vision

**OCR:** In the domain of computers, Optical Character Reader, a software to convert scanned documents into editable text, which accompanies a scanner.

**Face Detection:** Many state-of-the-art cameras come with this feature, which enables to read the face and take the picture of that perfect expression. It is used to let a user access the software on correct match.

**Object Recognition:** They are installed in supermarkets, cameras, high-end cars such as BMW, GM, and Volvo.

**Estimating Position:** It is estimating position of an object with respect to camera as in position of tumor in human's body.

## ApplicationDomainsof Computer Vision

- agriculture
- autonomous vehicles
- biometrics
- character recognition
- forensics, security, and surveillance
- industrial quality inspection
- face recognition
- gesture analysis
- geoscience
- medical imagery
- pollution monitoring
- process contro
- remote sensing
- robotics
- transport

## Applications of Robotics

The robotics has been instrumental in the various domains such as:

**Industries:** Robots are used for handling material, cutting, welding, color coating, drilling, polishing, etc.

**Military:** Autonomous robots can reach inaccessible and hazardous zones during war. A robot named Daksh, developed by Defense Research and Development Organization (DRDO), is in function to destroy life-threatening objects safely.

**Medicine:** The robots are capable of carrying out hundreds of clinical tests simultaneously, rehabilitating permanently disabled people, and performing complex surgeries such as brain tumors.

**Exploration:** The robot rock climbers used for space exploration, underwater drones used for ocean exploration are to name a few.

**Entertainment:** Disney's engineers have created hundreds of robots for movie making.