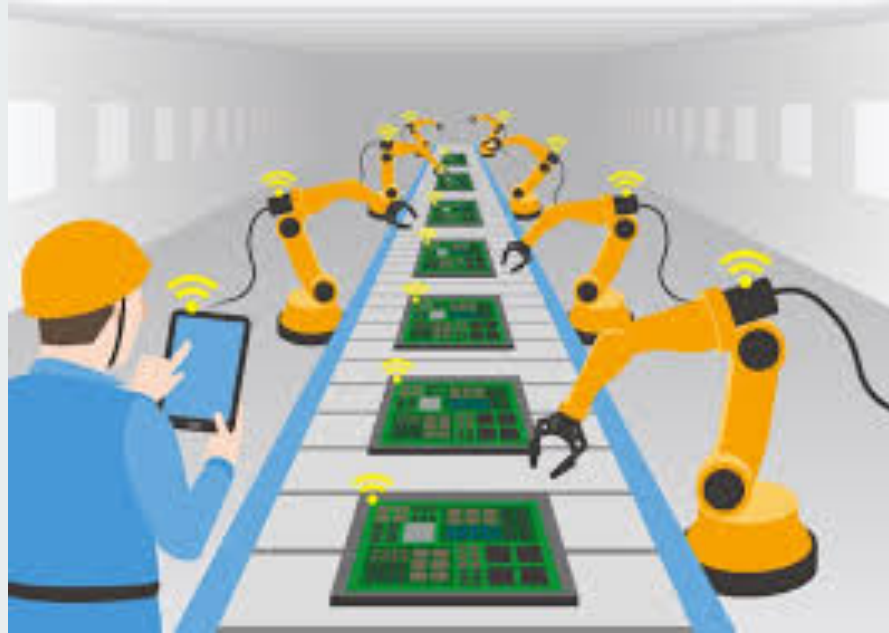




# Industry 4.0

## Robotics and Automation



Prepared by: Dr. T. Kar

# Introducton to Robotics and Automation

- Robotics:** The science of designing and building Robots that are suitable for real life application both in automated manufacturing and other non-manufacturing environments.



- Auto**  
 in aother areas, primarily by using robots



using technology to complete tasks in industries or


# What Is a Robot in Robotic Automation?



## Robot:

1. Robots are mechanical devices that can automatically perform specific operation
2. This can be controlled by an external control devices or a built-in control device
3. The shape of robots is given depending upon its characterstics and purposes of the work
4. It can be used for monotonous, repetitive, tedious, and dangerous jobs that exist in industrial sites
5. It is extensively used at places where human being cannot reach.

# Basic Objectives for Designing Robots

- 
- A short horizontal bar with a teal segment on the left and an orange segment on the right is positioned above the first bullet point.
- To increase productivity
  - Reduce production life
  - Minimize labour requirement
  - Enhanced quality of the products
  - Minimize loss of man hours, on account of accidents.
  - Make reliable and high speed production.

# Field of Application of Robots

## Industrial

Material Handling

Mechanical Operations

Inspection Operations

Assembly Operations

Processing Operataion

## Non-Industrial

Madical fields

Article writing

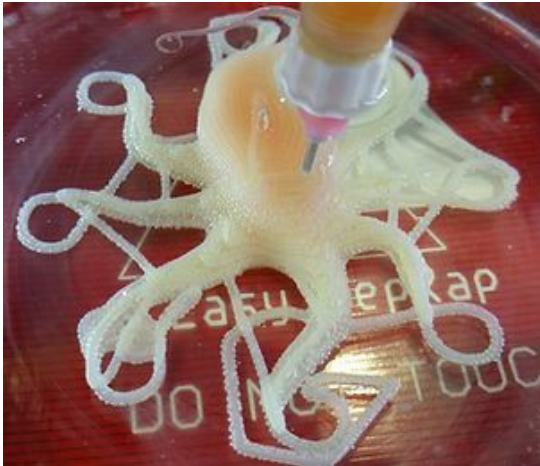
Customer Service

Distribution Field

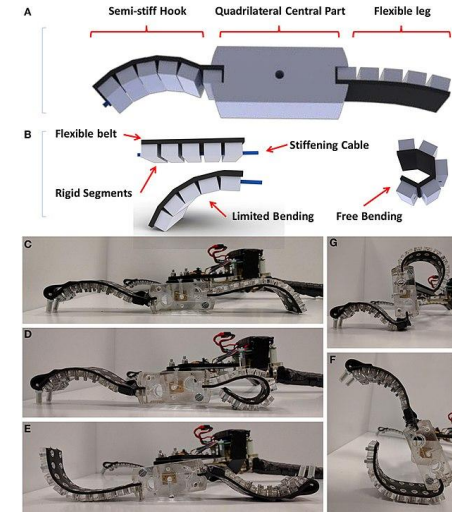
Process human resource information

# Soft Robotics

- Soft robotics is a subfield of robotics that concerns the design, control, and fabrication of robots composed of compliant materials, instead of rigid links.



[3D printed model resembling an octopus ]



[Soft-legged wheel-based robot with terrestrial locomotion abilities]

# Types of robots by chronology

## First generation: robot manipulators

- These can pick up and move objects but they have very restricted movements.

## Second generation: learning robots

- These gather information from the environment to make more complex movements.

## Third generation: reprogrammable robots

- These are equipped with sensors and they use programming languages to vary their functions in keeping with the needs of any given moment.

## Fourth generation: mobile robots

- The first intelligent robots capable of interpreting the environment in real time appear in the fourth generation.

## Fifth generation: robots with artificial intelligence

- This is the stage that's currently under development. They're intended to mimic human beings and they're autonomous.

# Robot of Different Generation

- First Generation Robot



- (a) Simple Mechanical Arm
- (b) Have the ability to make precise motion

- Second Generation Robot

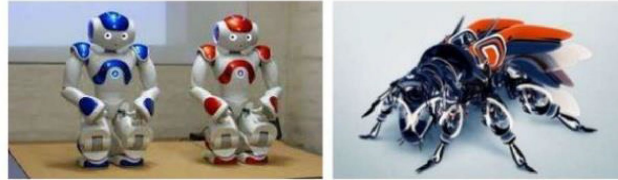


- (a) Has rudimentary machine elements
- (b) Equipped with sensor that tells things about outside world
- (c) Includes pressure sensor, radar, sonar and vision system
- (d) Has controller that process data from the sensors



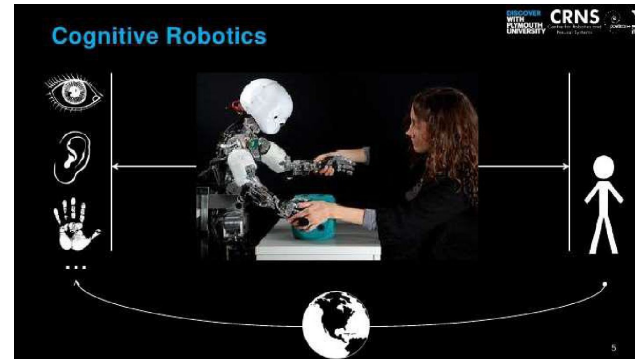
# Robot of Different Generation

- Third generation robot



- (a) Autonomous Robot
- (b)
- (c)

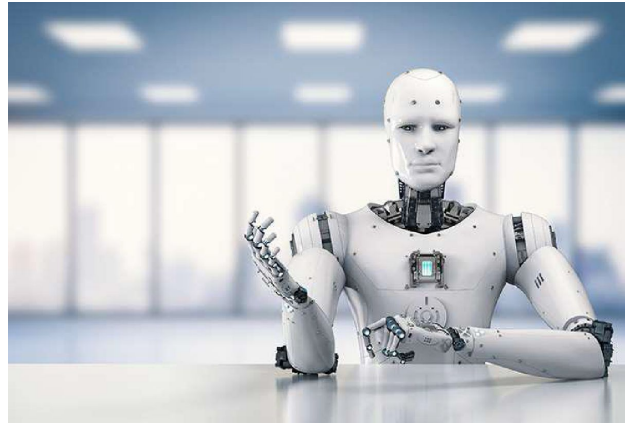
- Fouth generation robot



- (a) Cognitive Robot
- (b)
- (c)

# Robot of Different Generation

- Fifth generation Robot



Robot with artificial intelligence

- **Industrial robots:** These types of robots have a clear focus on the production line and they carry out ~~routine~~ and repetitive activities. For example, they may be tasked with categorising products at a warehouse or participating in an assembly line by moving products along it.
- **Domestic robots:** These help with cleaning tasks and watching over the house. This group includes vacuum-cleaning robots, lawn-mowing robots, kitchen robots that prepare a recipe from start to finish and connected security cameras.
- **Educational robots:** This group may include machines intended for cognitive development or the learning of a subject. Such as robotics kits for children.
- **Military robots:** As for military robots, they're responsible for supporting armies during certain operations, such as transporting equipment and helping to detect the presence of explosives.
- **Medical robots:** These can provide support for the health sector, e.g. in order to assist people with reduced mobility, move machinery and medicines and even participate in surgical procedures

# Types of robots depending on their mobility

---

Depending on the performance and capacity for movement and decision-making, robots can be distinguished as follows:

- **Articulated robots or robotic arms:** These have very low capacity, but they're excellent partners for moving products, handling tools, packaging, etc.
- **Automated guided vehicles (AGVs):** these move along a pre-defined track and they usually require human supervision.
- **Autonomous mobile robots:** what are known as AMRs can move and make decisions on their own, practically in real time. They incorporate sensors and on-board processing equipment to carry out their functions.
- **Humanoids:** usually a type of AMR, they have human forms and they can perform functions like people.
- **Cobots:** these are designed for the purpose of working alongside with humans, helping with dangerous and repetitive tasks.

# Present Application of Robots

- Material transfer applications
- Machine loading and unloading
- Processing operations like,
  - (a) Spot welding
  - (b) Continuous arc welding
  - (c) Spray coating
  - (d) Drilling, routing, machining operations
  - (e) Grinding, polishing debarring wire brushing
  - (g) Laser drilling and cutting etc.
- (iv) Assembly tasks, assembly cell designs, parts mating.
- (v) Inspection, automation.

# Future Application of Robots

The profile of the future robot based on the research activities will include the following,

- (a) Intelligence
- (b) Mobility and navigation (walking machines)
- (c) Universal gripper
- (d) Systems and integration and networking
- (e) FMS (Flexible Manufacturing Systems)
- (f) Underground coal mining
- (g) Fire fighting operations
- (h) Robots in space
- (i) Security guards
- (j) Garbage collection and waste disposal operations
- (k) Household robots
- (l) Medical care and hospital duties etc.

# Automation and its Types

- **Automation:** Automating the tasks or processes by using robots.
- **Fixed Automation:** Automation in which sequence of processing or assembly operations are fixed by the equipment configuration.

**Features:** High product rates, relatively inflexible in product design,

**Examples:** Automobile Industry

- **Programmable Automation:** Automation in which the equipment is designed to accommodate various product configurations in order to change the sequence of operations or assembly operations by means of control program.

**Features :** High investments, lower production rates than fixed automation, flexibility and changes in products rates, suitable for batch production,

**Examples:** Industrial robots, NC Machine tools,

# Automation and Its Types


- **Flexible Automation:** A computer integrated manufacturing system which is an extension of programmable automation is referred as flexible automation.

**Features :** High investment, Medium Production rates, Flexibility to deal with product design variation, Continuous production of variable mixtures of products.

**Examples:** Flexible Manufacturing Systems (FMS)



# Automation Application Areas Using Robots

- 
- A short horizontal bar with a teal left half and an orange right half is positioned below the title.
- Invoice Processing
  - Sales and Customer Service
  - Data Science Field
  - Compliance
  - Marketing
  - Finance
  - Manufacturing
  - Distribution
  - IT Tasks

# Automation Example Using Robotics

Let us take a real company job as an example. Suppose you have an employee at a company, and one of his jobs is to reflect the system of emails from essential customers immediately. In this case, if robot automation is applied, the following commands can be designed:

1. Login to the corporate mail system
2. Read when a specific sender's mail arrives
3. Download attached file when specific word or form comes
4. Text excerpt in the specified location of the attached file
5. Company system login
6. Enter and save the extracted text in the company system
7. Send SMS or email to the person in charge in case of unexpected error
8. Write completion record after completion of work

# Benifits of Automation

## Adavantages

- High Production rates
- Lead time decreases
- Storing capacity decreases
- Human errors are eliminated.
- Labour cost is decreases.

## Disadvantages

- A Initial cost of raw material is very high,
- Maintenance cost is high,
- Required high skilled Labour.
- Indirect cost for research development & programming increases.

# Area That are Difficult to Apply Robotics

---

- Immotional Communication with Customer
- Sales and Marketing
- Human Resource Management