

Automation and Robotics



Learning Objectives

- Students to know about, how the automatic machine is working without man, working principle and their automatic technology.
- Students to know about how the Robotic machine is working as man are man's activities.



Ennenba enai ezhuththenba ivvirandum
Kannenba vaazhum uyirkku. –Kural 392

Letters and members are the two eyes of human being.

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10.1 Introduction of Automation

Automation is the technology by which a process or procedure is performed without human assistance.



Automation covers applications ranging from a household thermostat controlling a heater, to a large industrial control system.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques.

The word “Automation” is derived from ancient Greek words of Auto (means “Self”) Matos (means “moving”). Thus, a mechanism move by itself or self dictated is called automation.

10.2 Types of Automation

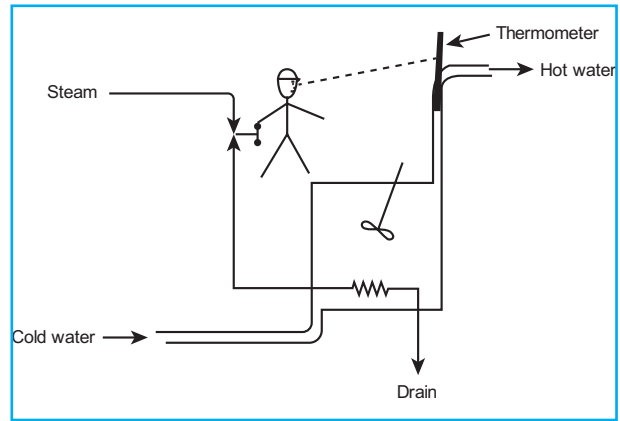
1. Based on control

a. Partial Automation

It means replacement of human activities or involvement by automatic means only partially.

b. Fully automation

The human involvement is totally eliminated and the process is entirely carried out and controlled through automatic means along with a proper feedback system.



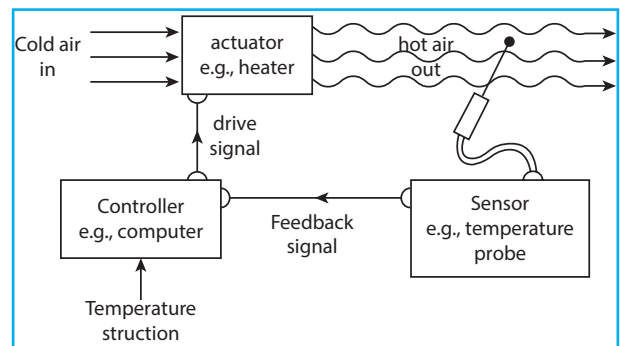
Partial Automation

2. Based on Application

a. Building Automation System (BAS)

It is the automatic centralized control of building's heating ventilation, air conditioning and lighting and other systems through a building automation system (BAS). The classifications are

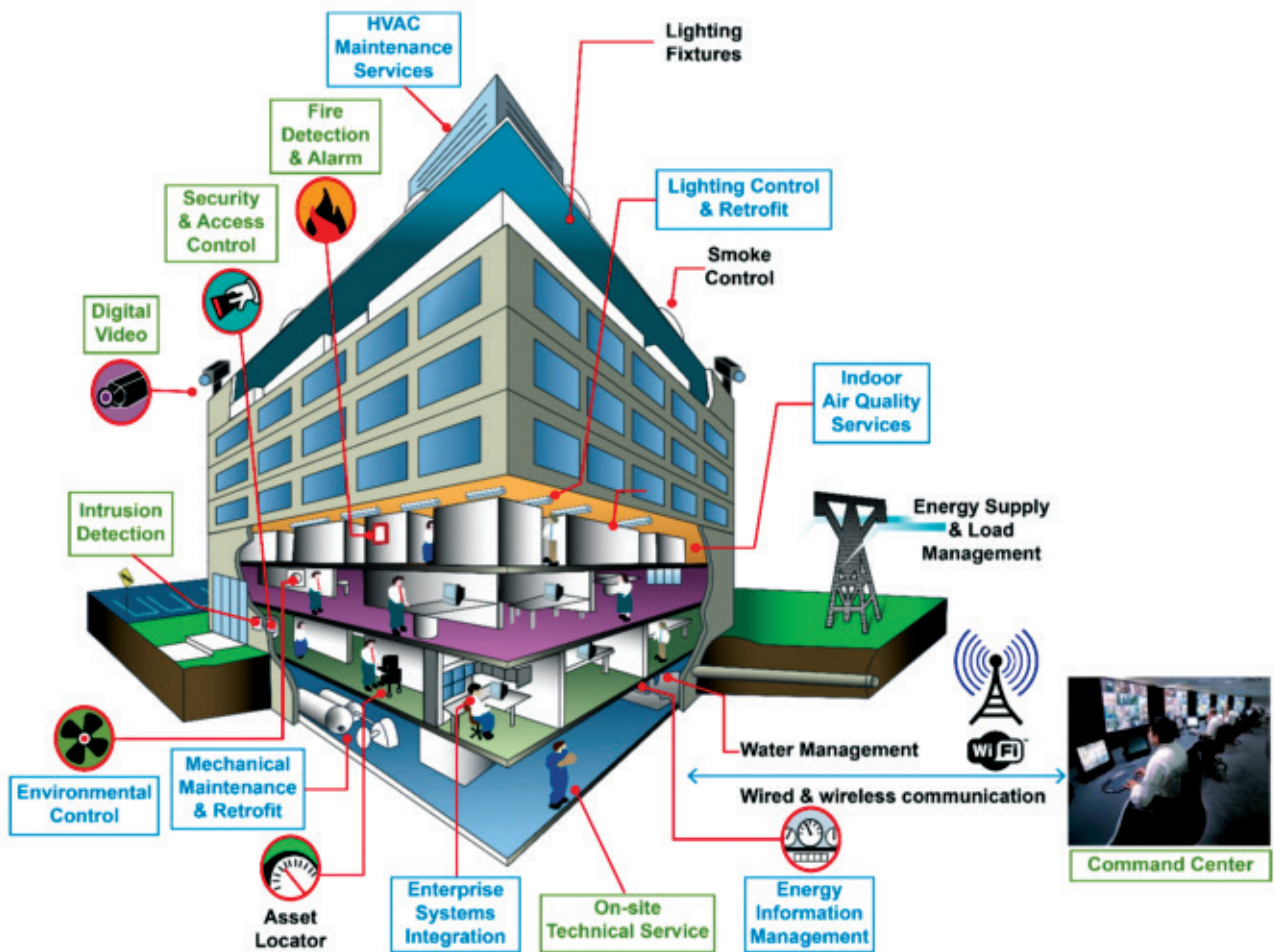
- i. Home Automation
- ii. Office Automation



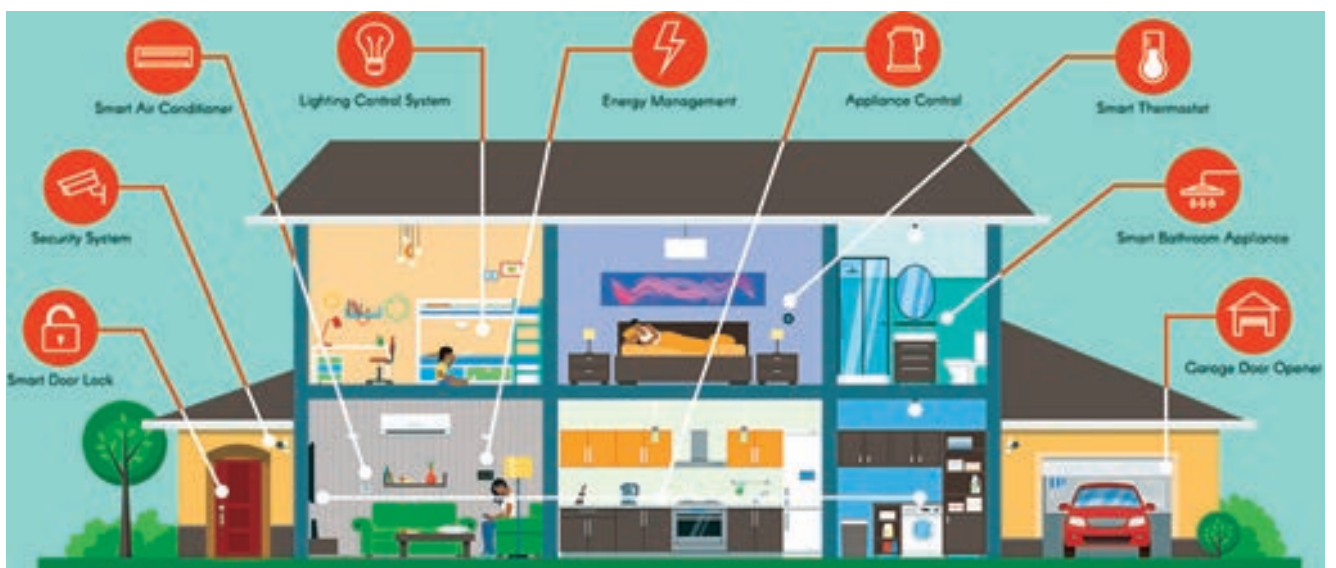
Whole Automation

b. Industrial Automation

It is use of computers and robots to control industrial processes like manufacturing without significant human assistance. The classifications are



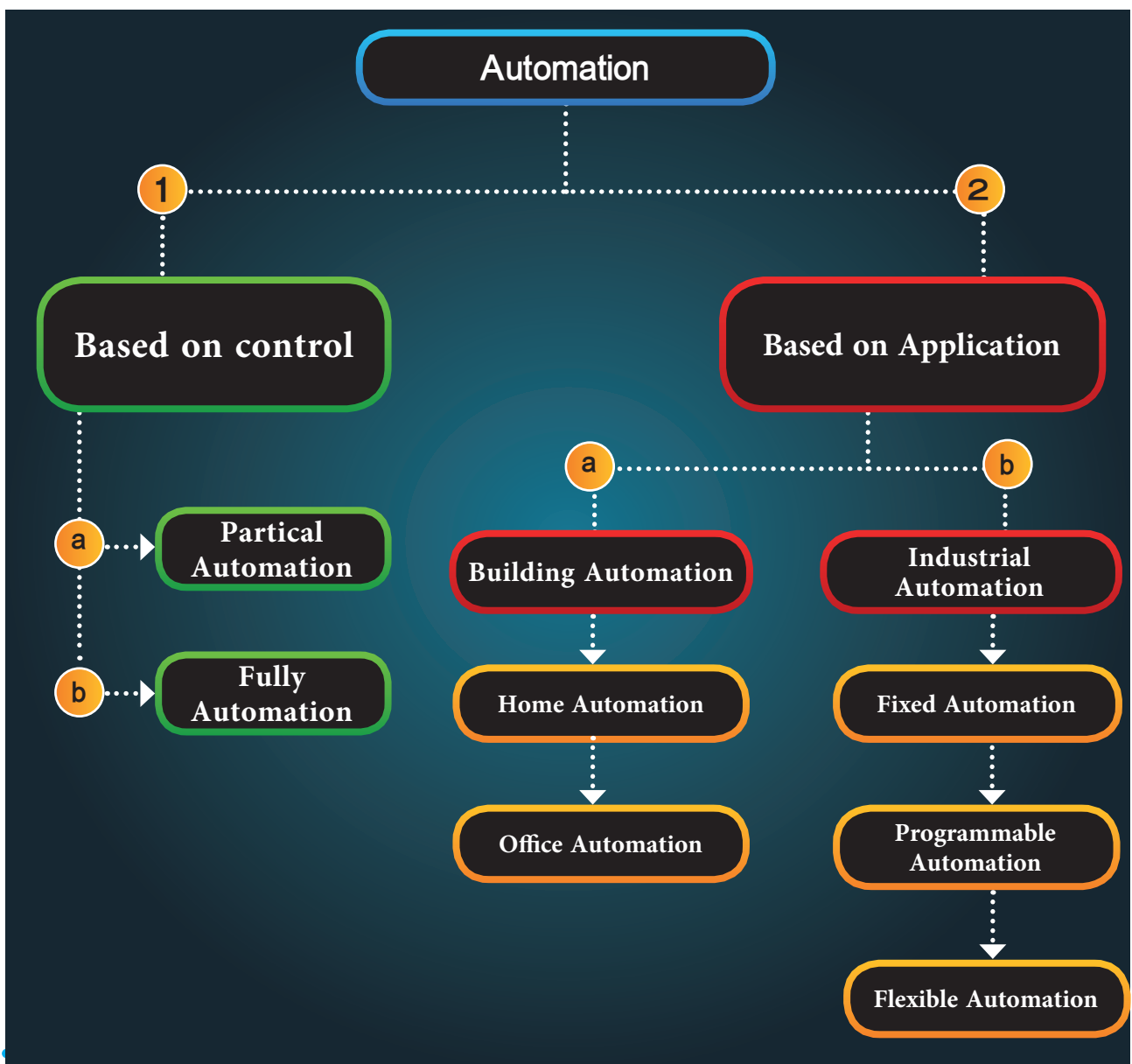
Building Automation System (BAS)

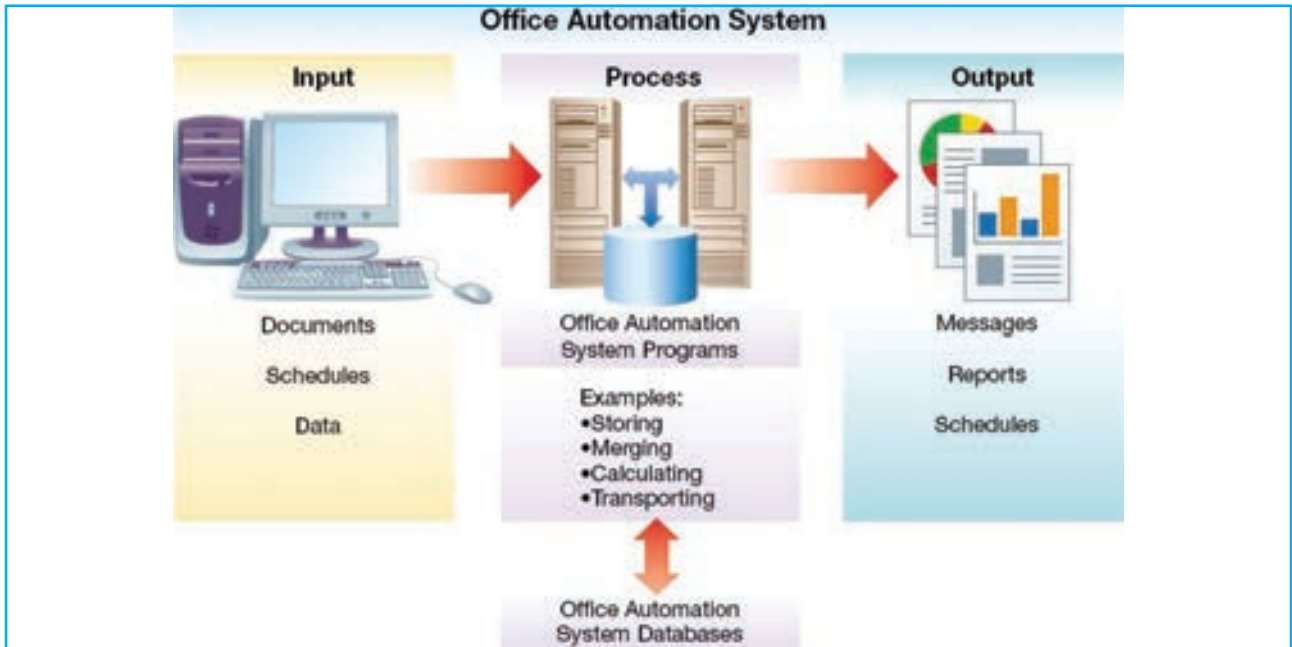


Home Automation



Industrial Automation System

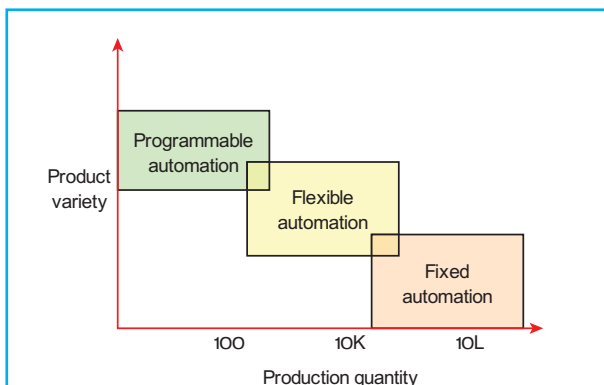




Office Automation

A. Fixed Automation (Hard Automation)

Fixed automation is a system in which the sequence of processing (or assembly) operations is **fixed** by the equipment configuration.



Advantages

1. The movement of parts is very fast and efficient
2. Very high efficiency
3. Unit cost is low

Disadvantages

1. High initial investment
2. Inflexibility

B. Programmable Automation

The word “Programmable” means that one set of task can be easily switched over to another set by changing the computerized instructions.

- i. Computer Aided Design (CAD)
- ii. Computer aided Manufacturing (CAM)
- iii. Computer Integrated Manufacturing (CIM)

Advantages

- For large batches the unit cost is low
- The change in product can be dealt with flexibility

Disadvantages

- Unit cost, as compared to fixed automation is high
- Long setup time is required for new product

C Flexible Automation (Soft Automation)

It has the capability of producing a variety of parts with minimal change over time from one part to the next.

Advantages

- Customized products
- Design variations can be dealt with flexibility
- Parts with complex shapes can be produced.

Disadvantages

- High initial investment
- Unit cost is relatively high

10.3 Needs for Industrial Automation

- To increase the labour productivity
- To improve the product quality
- To reduce the labour or production cost
- To reduce routine manual tasks
- To improve safety
- To assist remote monitoring

10.4 The advantages of automation

- Increased throughout productivity.
- Improved quality or increased predictability of quality
- Reduce overall production cost
- Less floor area required
- Human fatigue is greatly minimized
- Replaces humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)

- Reduces operation time and work handling time significantly.
- Reduce maintenance requirements
- Uniform components are produced

The disadvantages of automation

- Possible security threats/vulnerability due to increased relative susceptibility for committing errors.
- Unpredictable or excessive development costs.
- High initial cost.
- Displaces workers due to job replacement.
- Leads to further environmental damage and could compound climate change.

10.5 Applications

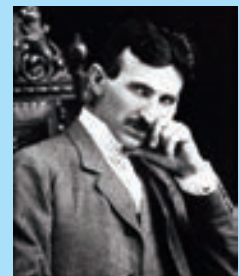
- Numerical Control Machines
- Automated production lines
- Automated assemble lines
- Robots in manufacturing
- Flexible manufacturing system
- Automation in Daily life



Father of automation

Nikola Tesla (1856 – 1943)

“Nikola Tesla” is called the father of automation. Year: 1856 – 1943. He was a Serbian – American inventor, Electrical engineer, Mechanical Engineer.



Nikola Tesla
(1856 – 1943)

10.6 Elements of automation

1. Source of power
2. Feedback control
3. Machine programming

ROBOTICS

10.7 Introduction

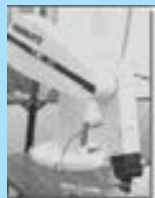
Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electronics engineering, computer science, and others. Many definitions have been suggested for what we call a robot. (The word may conjure up various level of technological specification, ranging from a simple material handling device to a humanoid). It is widely accepted that today's robots used in industries originated in the invention of programmed material handling device by George. C. Devol in 1954.



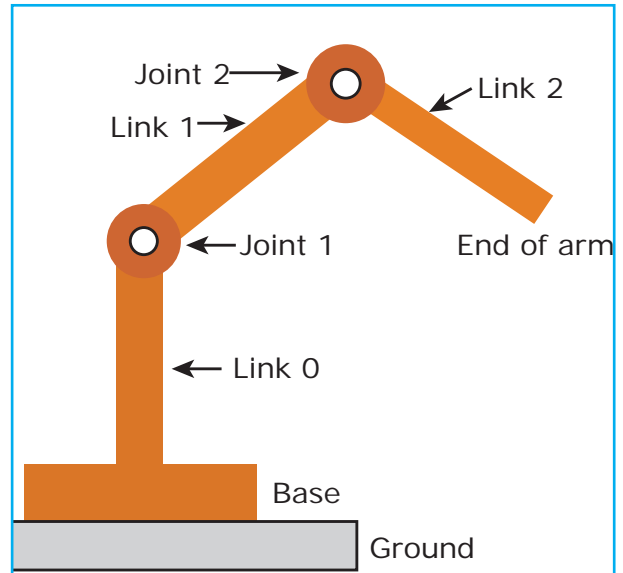
FIRST ROBOT IN THE WORLD

Father of Robotics Mr. George Devol

In 1954 George Devol invented the first digitally operated and a programmable robot called the Unimate. In 1956, Devol and his partner Joseph Engelberger formed the world's first robot company. In 1961, the first industrial robot, Unimate, went online in a General Motors automobile factory in New Jersey. Oct 16, 2017.



10.8 Definition-Robotics



The latest technologies are used to develop machines that can substitute for humans and replicate human actions are called robot.

The robots are mainly used in dangerous environments, manufacturing process or where human cannot survive.

Autonomy

Interaction between the human control and machine motions.

1. Tele operation:
A human controls each movement, each machine actuator change is specified by the operator.
2. Supervisory:
A human specifies general moves or position changes and the machine decides specific movements of its actuators.
3. Task – Level – autonomy
The operator specifies only the task and the robot manage itself to compose it.
4. Fully autonomy
The machine will create and complete all its task without human interaction

10.9 Objectives of Industrial Robotics

1. To reduce production time
2. To minimize labour requirement
3. To raise the quality level of products
4. To increase the productivity
5. To improve existing manufacturing processes.

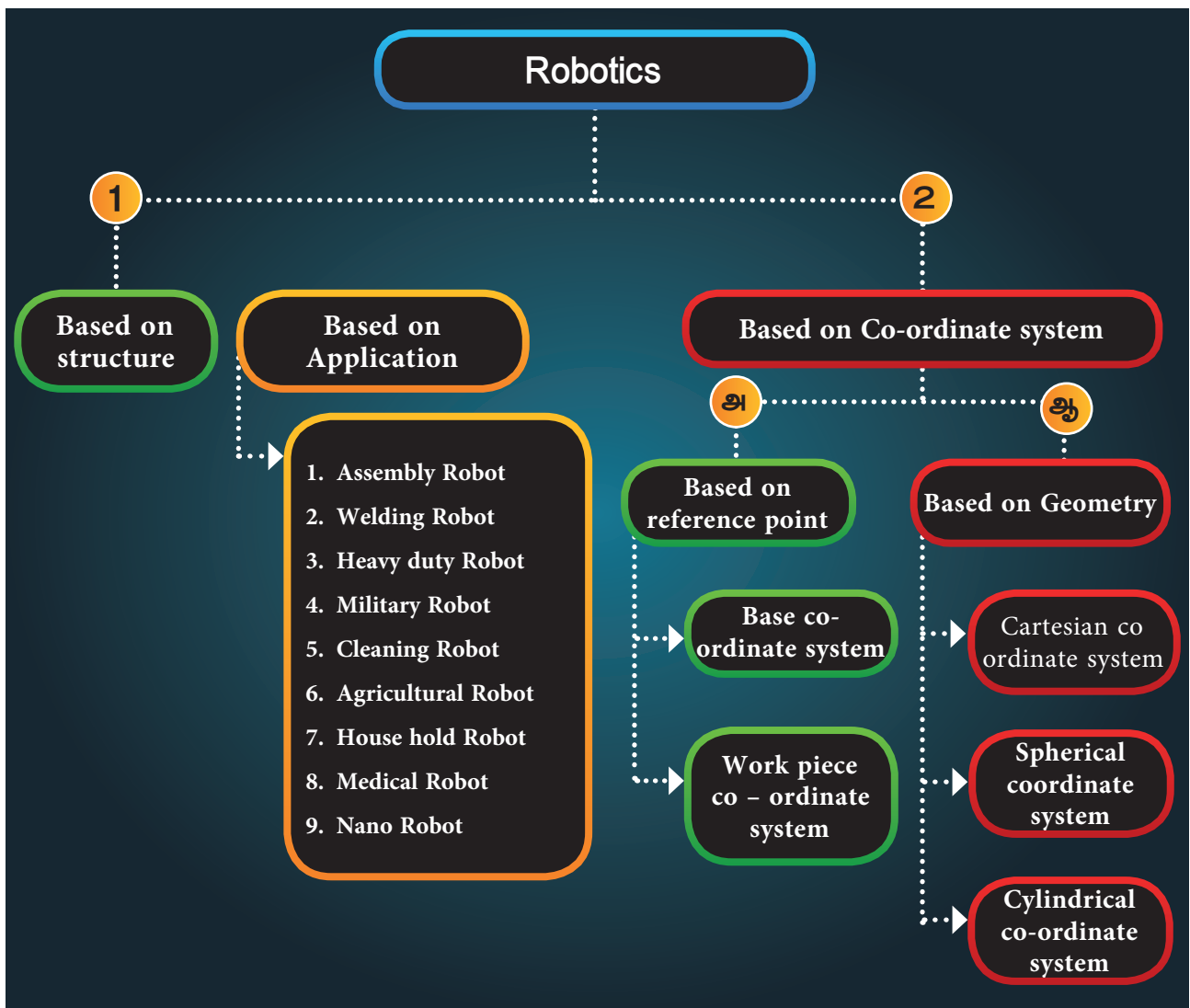
10.10 Advantages

1. Lifting and moving heavy objects
2. Working in holistic environment
3. Providing repeatability and consistency

4. Working during unfavourable hours
5. Performing dull or momotonous jobs
6. Increasing productivity and safety
7. Achieving more accuracy than human beings

Disadvantages

- The robots lack capability to respond in emergencies
- The initial and installation cost of equipment high
- They replace human workers, thus causing unemployment.



10.11 Three Main components of robots

1. Mechanical Components
2. Electrical components
3. Computer programming code

BASIC PRINCIPLE OF ROBOTICS

10.12 Asimov Laws of robotics

1. A robot must not injure a human being or, through inaction, allow a human being to come harm.
2. A robot must obey the orders given it by human being except where such orders would conflict with first law.
3. A robot must protect its own existence as long as such protection does not conflict with the first law or second law.

Mr. Isaac Asimov (1920 - 1992)

Isaac Asimov was an American writer and professor of biochemistry at Boston University. He was known for his works of science fiction and popular science. He was a prolific writer who wrote (or) edited more than 500 books and an estimated 90,000 letters and postcards.



10.13 Need of Robotics

- To improve the quality of products
- To reduce the preparation time
- To reduce the rejection rate and waste
- Higher flexibility of product type and variation

- Skilled labour shortage
- Rising cost
- Pressure to increase production rates to complete market.

Functions of Robotics

It can be classified into three areas

1. “Sensing” the environment by external sensors.
Example: Vision, Voice, Touch, Proximity, and so on
2. “Decision making” based on the information received from the sensor
3. “Performing” the task decided.

10.14 Types of Robots

1. Based on structure
2. Based on application
 - a. Assembly robot
 - b. Welding robot
 - c. Heavy duty robot
 - d. Military robot
 - e. Hospital robot
 - f. Cleaning robot
 - g. Agricultural robot
 - h. Medical robot
 - i. House hold robot
 - j. Nano robot
3. Based on coordinate system,
 - a. Base on the reference point
 - i. Base coordinate system
It is located at the base of the robot
 - ii. The work piece coordinate system
It is related to the work piece and is often the best one for programming the robot.

- b. Based on geometry
 - i. Cartesian coordinate system
 - ii. Cylindrical coordinate system
 - iii. Spherical coordinate system

10.15 Applications of Robotics

1. Most robots today used to do repetitive actions or jobs considered too dangerous for human
2. It is ideal for going into a building that has a possible bomb

3. It is also used in factories to build things like cars, candy bars and electronics

10.16 Parts of robots

1. The control system is – also known as the “brain” of Robot which is run by a computer program.
2. Mechanical parts – motors, pistons, grippers, wheels, and gears that

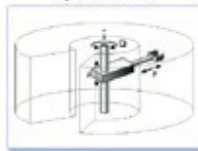
All Types of Robots

STATIONARY ROBOTS

Cartesian Robots



Cylindrical



Spherical



SCARA



Articulated



Parallel

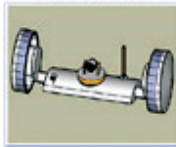


WHEELED ROBOTS

Single Wheel



2 Wheeled



3 Wheeled



4 Wheeled



6 Wheeled



Tracked Robots



LEGGED ROBOTS

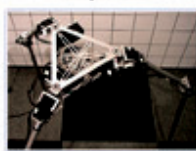
One Leg



Bipedal



Tripedal



Quadrupedal



Hexapod



Many Legs



SWIMMING ROBOTS



FLYING ROBOTS



Robotic Balls



SWARM ROBOTS



MODULAR ROBOTS



MICRO Robots



NANO Robots



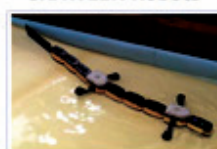
SOFT ROBOTS



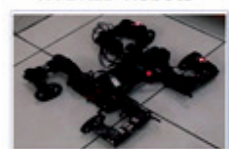
SNAKE Robots

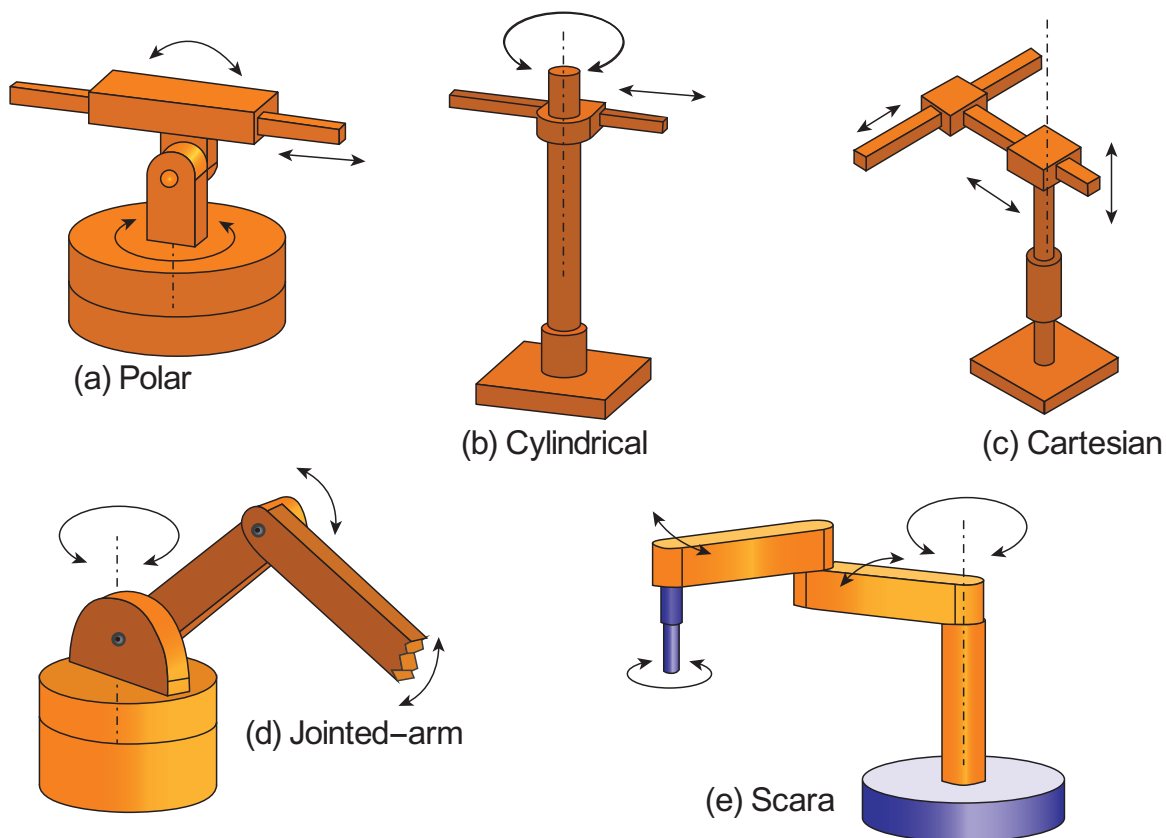


CRAWLER Robots



HYBRID Robots





Robot Coordinate System

make the robot move, grab, turn, and lift....

3. Sensors – to tell the robot about its surroundings

10.17 Materials used for robots

Following are some of the plastics most frequently used as rigid structural materials.

1. Polystyrene
2. Plexiglass
3. Rigid PVC
4. ABS plastic
5. Polycarbonate
6. Polyethylene and polypropylene
7. Nylon

ACTIVITIES

1. Buying the Robotoys and give practice for dismantling and assembling the parts.
2. Students to know about the functioning of parts of robot.
3. How to operate the electric equipments in home and offices through the cellphone.

Questions

Part I.

Choose the correct option 1 Mark

1. “Centralized control automation” belongs to
 - a. Building automation system
 - a. Industrial automation system
 - a. Standard automation system
 - a. Partial automation system
2. The basic principles of Robot is formed by
 - a. Asimov
 - a. Hectare
 - a. George devil
 - a. Joseph rengal Berger
3. The brain of the Robot is called _____
 - a. Sensor
 - a. Control system
 - a. Piston
 - a. Gears
4. The part which receives the commands and send to the control system in Robot is
 - a. Control system
 - a. Gears
 - a. Sensor
 - a. Piston



Part II.

Answer the following questions in one or two sentences 3 Marks

5. What is meant by “Automation”?
6. What are the different types of automation?
7. What are various types of “Based on control”? of automation
8. Mention the types of “Based on Application” of automation
9. What is the purpose of Robots?

Part III.

Answer the following questions in about a page 5 Marks

10. What are the reasons for automation needed in industrial field?
11. What are the applications of automation?
12. What are the needs of robot?

Part IV.

Answer the following Questions in detail. 10 Marks

13. Mention the merits and demerits of automation.
14. Explain the parts of robots. What are the materials required to make robots?