## UNIT-5 AUTONOMOUS SYSTEMS

### SYLLABUS:

Autonomous Systems: IoT, Robotics, Drones, Artificial Intelligence – Learning, Game Development, image and video processing

## <mark>loT</mark>

Connecting everyday things embedded with electronics, software, and sensors to the internet enables us to collect and exchange data without human interaction called the Internet of Things (IoT).

The term "Things" in the Internet of Things refers to anything and everything in day to day life which is accessed or connected through the internet. IoT is an advanced automation and analytics system which deals with artificial intelligence, sensor, networking, electronic, cloud messaging etc. to deliver complete systems for the product or services. The system created by IoT has greater transparency, control, and performance.



## How IoT works?

The entire IoT process starts with the devices themselves like smartphones, smartwatches, electronic appliances like TV, Washing Machine which helps you to communicate with the IoT platform.



**1) Sensors/Devices:** Sensors or devices are a key component that helps you to collect live data from the surrounding environment. All this data may have various levels of complexities. It could be a simple temperature monitoring sensor, or it may be in the form of the video feed.

A device may have various types of sensors which perform multiple tasks **apart** from sensing. Example, A mobile phone is a device which has multiple sensors like GPS, camera but your smartphone is not able to sense these things.

**2) Connectivity:** All the collected data is sent to a cloud infrastructure. The sensors should be connected to the cloud using various mediums of communications. These communication mediums include mobile or satellite networks, Bluetooth, WI-FI, WAN, etc.

**3) Data Processing:** Once that data is collected, and it gets to the cloud, the software performs processing on the gathered data. This process can be just checking the temperature, reading on devices like AC or heaters. However, it can sometimes also be very complex like identifying objects, using computer vision on video.

**4)User Interface:** The information needs to be available to the end-user in some way which can be achieved by triggering alarms on their phones or sending them notification through email or text message. The user sometimes might need an interface which actively checks their IoT system. For example, the user has a camera installed in his home. He wants to access video recording and all the feeds with the help of a web server.

However, it's not always one-way communication. Depending on the IoT application and complexity of the system, the user may also be able to perform an action which may create cascading effects.

For example, if a user detects any changes in the temperature of the refrigerator, with the help of IoT technology the user should be able to adjust the temperature with the help of their mobile phone.



INDUSTRY	USE CASE
Smart City	The concept of "Smart City" addresses planning and public administration through the automation of services in a creative

	and sustainable way.Smart cities improve and modernize many sectors, including government services, transport and traffic management, energy, healthcare, water, innovative urban agriculture, and waste management.
Smart Home	Have access to control and monitor home processes through their smartphones, tablets, and laptops. Imagine you forgot to turn off your oven — you might be able to simply turn it off through your phone.
Smart Cars	Central computers installed in the car receive data from sensors installed throughout the car to determine engine oil level, radiator water temperature, etc You can even monitor the state of the car, including its location, oil levels, gas, and more through a phone app.
Agriculture	Farmers can use intelligent IoT farming applications to optimize many time-consuming farm operations, presenting opportunities to revolutionize the farming industry. IoT can help you determine the best time to harvest crops, generate soil chemistry-based fertilizer profiles, and detect soil nutrients and moisture concentrations.
Fitness Trackers	IoT-connected devices help you optimize your fitness goals and track progress. Fitness trackers track your daily activities like sleeping patterns, heart rate, patterns of activity, statistics of workouts, calories burned, and more.
IoT Hospitality and Tourism	The IoT has great potential to optimize hospitality and tourism operations. Staffing is a large expense for hotels and motels in the hospitality industry, but IoT can automate certain interactions to reduce staffing burdens. For example, mobile electronic keys allow hotel guests to access and check into their rooms without having to interact with a staff member.

	From the guest's smartphone, they can request room service, share any room issues like a lack of towels, helping hotels gain useful information more quickly.
Health Monitoring	The IoT provides a path through attaching sensors to patients at home. Through these sensors, doctors can monitor and track a patient's progress, and alerts can inform doctors of any emergencies, like a heart attack
Smart Grid	The smart grid is the IoT that attends to energy systems. Utility companies use smart grid technologies to find energy efficiencies through various means, including monitoring energy consumption, predicting energy shortages and power outages, and gathering data on how different individuals and companies use energy.
Factories	Machine equipment and factory items are connected to sensors to improve analytics. Such technology can help factories reduce energy consumption, improve asset tracking, and find equipment issues early to protect profits and improve supply chain productivity.

# **Robotics**

Robotics is a branch of Artificial Intelligence (AI), it is mainly composed of electrical engineering, mechanical engineering and computer science engineering for construction, designing and application of robots. The objective of the robotics field is to create intelligent machines that can assist humans in a variety of ways.

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Issac Asimov also proposed his three "Laws of Robotics", and he later added a "zeroth law"

- Zeroth Law A robot is not allowed to injure humanity, or, through inaction it allows humanity to come to harm.
- **First Law** A robot can not injure a human being, or, through inaction it allows a human being to come to harm, unless it would violate the higher order law.

- **Second Law** A robot should follow the orders given by human beings, except when such orders given by humans would conflict with a higher order law.
- **Third Law** A robot is allowed to protect its own existence as long as such protection would not conflict with a higher order law.

## **Types of Robots:**

### 1)Mobile Robots

Mobile robots are able to move from one location to another location using locomotion. It is an automatic machine that is capable of navigating an uncontrolled environment without any requirement of physical and electromechanical guidance devices. Mobile Robots are of two types:

(a) Rolling robots - Rolling robots require wheels to move around. They can easily and quickly search. But they are only useful in flat areas.

**(b)** Walking robots - Robots with legs are usually used in conditions where the terrain is rocky. Most walking robots have at least 4 legs.

### 2) Industrial Robots

Industrial robots perform the same tasks repeatedly without ever moving. These robots are working in industries in which there is a requirement of performing dull and repeated tasks suitable for robots.

An industrial robot is never tired, it will perform their work day and night without ever complaining.

### 3) Autonomous Robots

Autonomous robots are self-supported. They use a program that provides them the opportunity to decide the action to perform depending on their surroundings.

Using artificial intelligence these robots often learn new behavior. They start with a short routine and adapt this routine to be more successful in a task they perform. Hence, the most successful routine will be repeated.

### 4) Remote Controlled Robots

Remote controlled robot used for performing complicated and undetermined tasks that autonomous robots cannot perform due to uncertainty of operation.

Complicated tasks are best performed by human beings with real brainpower. Therefore a person can guide a robot by using a remote. Using remote controlled operation humans can perform dangerous tasks without being at the spot where the tasks are performed.

## **APPLICATIONS OF ROBOTS:**

**1. Industrial robots** – These robots bring into play in an industrialized manufacturing atmosphere. Typically these are articulated arms particularly created for applications like- material handling, painting, welding, and others.

**2. Domestic or household robots** – Robots that are used at home. This sort of robot consists of numerous different gears for example- robotic pool cleaners, robotic sweepers, robotic vacuum cleaners, robotic sewer cleaners, and other robots that can perform different household tasks.

**3. Medical robots** – Robots employed in medicine and medicinal institutes. First & foremost surgical treatment robots. Also, several robotic directed automobiles and perhaps lifting supporters.

**4. Service robots** – Robots that cannot be classed into any other type by practice. These could be various data collecting robots, robots prepared to exhibit technologies, robots employed for research, etc.

**5. Military robots** – Robots brought into play in military & armed forces. This sort of robot consists of bomb discarding robots, various shipping robots, exploration drones.

**6. Entertainment robots** – These types of robots are employed for entertainment. This is an extremely wide-ranging category. It begins with model robots such as Robosapien or the running photo frames and concludes with real heavyweights like articulated robot arms employed as movement simulators.

**7. Space robots** – I would like to distinct out robots employed in space as a split apart type. This type of robot would consist of the robots employed on Canadarm that was brought into play in space Shuttles, the International Space Station, together with Mars explorers and other robots employed in space exploration & other activities.

# <mark>Drones</mark>

Drones, sometimes referred to as unmanned aerial vehicles (UAVs) that receive remote commands from a pilot or rely on software for autonomous flight. Many drones display features like cameras for collecting visual data and propellers for stabilizing their flight patterns. Sectors like videography, search and rescue, agriculture and transportation have adopted drone technology.

### **Different Types of Drone**

#### **Bicopters**

A bicopter is a type of drone that has two rotors.Bicopters typically have two fixed-pitch propellers, one clockwise (CW) and the other counterclockwise (CCW).



R = Right Throttle, Right Tilt

BICOPTER



### Quadcopter

The quadcopter is indeed the most popular multi-copter. A quadcopter is a multi-rotor drone with 4 motors attached and is a popular choice for consumer and commercial drones.. This Drone stabilizes its flight using an electronic sensor and control system. There are three types of quadcopters - Plus shape quadcopter, Cross shape quadcopter, and H shape quadcopter.



Hexacopter

The hexacopter has six propellers that are placed in a circle around the hexacopter's main body. A hexacopter has six rotors and is used for more heavy-duty applications, such as aerial photography and videography.



### **APPLICATIONS OF DRONE:**

Drones have a wide range of applications across various industries and sectors. Some common applications of drones include:

- 1. Agriculture: Drones are used for crop spraying, monitoring crop growth, and identifying areas in need of irrigation or fertilization.
- 2. Delivery: Drones are used for delivering packages, medical supplies, and other goods to remote or hard-to-reach locations.
- 3. Environmental monitoring: Drones are used for monitoring wildlife, tracking environmental changes, and monitoring pollutants and other environmental hazards.
- 4. Emergency response: Drones are used for search and rescue missions, disaster relief, and firefighting.
- 5. Energy: Drones are used for inspecting oil rigs, wind turbines, and other energy infrastructure.
- 6. Film and television: Drones are used for aerial photography and videography, providing unique perspectives and capturing aerial shots.
- 7. Inspection: Drones are used for inspecting bridges, pipelines, power lines, and other critical infrastructure.
- 8. Law enforcement: Drones are used by law enforcement agencies for surveillance, reconnaissance, and crowd control.

- 9. Military: Drones are used for military purposes, such as surveillance, reconnaissance, and attacking targets.
- 10.Real estate: Drones are used for capturing aerial images and videos of real estate properties, providing unique perspectives and showcasing property features.
- 11.Sports: Drones are used for capturing aerial footage of sporting events and competitions.
- 12.Surveying and mapping: Drones are used for surveying large areas of land, creating 3D models of landscapes, and collecting topographic data.

These are just some of the many applications of drones, and new uses for drones are being developed all the time.

# Artificial Intelligence

In today's world, technology is growing very fast, and we are getting in touch with different new technologies day by day.

Here, one of the booming technologies of computer science is Artificial Intelligence which is ready to create a new revolution in the world by making intelligent machines. The Artificial Intelligence is now all around us. It is currently working with a variety of subfields, ranging from general to specific, such as self-driving cars, playing chess, proving theorems, playing music, Painting, etc. AI is one of the fascinating and universal fields of Computer science which has a great scope in future. AI holds a tendency to cause a machine to work as a human.

we can define AI as:

"It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and be able to make decisions."

## Advantages of Artificial Intelligence

Following are some main advantages of Artificial Intelligence:

- High Accuracy with less errors: AI machines or systems are prone to less errors and high accuracy as it takes decisions as per pre-experience or information.
- **High-Speed:** Al systems can be of very high-speed and fast-decision making, because of that Al systems can beat a chess champion in the Chess game.

- **High reliability:** AI machines are highly reliable and can perform the same action multiple times with high accuracy.
- Useful for risky areas: AI machines can be helpful in situations such as defusing a bomb, exploring the ocean floor, where employing a human can be risky.
- **Digital Assistant:** Al can be very useful to provide digital assistance to the users such as AI technology is currently used by various E-commerce websites to show the products as per customer requirement.
- Useful as a public utility: AI can be very useful for public utilities such as a self-driving car which can make our journey safer and hassle-free, facial recognition for security purposes, Natural language processing to communicate with the human in human-language, etc.

### Game Development:

Artificial intelligence (AI) has had a significant impact on the gaming industry in recent years, with many games now incorporating AI to enhance gameplay and make it more immersive for players.



One common use of AI in gaming is in the control of non-player characters (NPCs). These characters can interact with players in a more realistic and dynamic way, adding to the immersion of the game.

For example, NPC characters might have their own goals and motivations that they pursue, or they might react differently to different player actions. This can make the game feel more alive and believable, as players feel like they are interacting with real characters rather than just programmed entities.

Al is also being used in game design to create more dynamic and interesting levels and content. This can help developers create more diverse and engaging games with less effort. For example, AI might be used to design game levels that are procedurally generated, meaning that they are created on the fly as the player progresses through the game. This can help keep the game fresh and interesting for players, as they are not simply playing through the same levels over and over again.

## Image and video processing:

Image and video processing refer to the techniques and technologies used to extract information from images and videos. Image and video processing can be used for a wide range of applications, including:

- 1. Image and video recognition: This involves identifying objects, people, and other features in images and videos.
- Image and video analysis: This involves analyzing images and videos to extract information, such as color, texture, and shape.
- 3. Image and video compression: This involves reducing the size of images and videos to make them easier to store and transmit.
- 4. Image and video enhancement: This involves improving the quality of images and videos, such as removing noise and improving resolution.
- Image and video restoration: This involves restoring images and videos that have been degraded or damaged, such as removing scratches or restoring missing pixels.
- 6. Image and video segmentation: This involves dividing images and videos into different regions or segments, such as separating the foreground and background in an image.
- Image and video tracking: This involves tracking objects or features in images and videos over time, such as tracking a person moving through a video.

These are just some of the many applications of image and video processing. The field of image and video processing is constantly evolving, with new techniques and technologies being developed all the time. Image and video processing is a critical component of many fields, including computer vision, robotics, and multimedia, and it is used in a wide range of applications, from security and surveillance to entertainment and art.