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Introduction to Intelligent Systems (IIS)

Topic : Intelligent Sensing Systems

COURSE OBJECTIVES :

- **Upon successful completion of this course, students will be able to:**

- **Evolutions of intelligent systems.**

- **How to build an Intelligent Systems to solve problems by computational reasoning using captured domain knowledge and data.**

- **Intelligent Systems that will help to control the advanced robotic systems.**

- **The skills and techniques required to build Intelligent Sensing Systems that are able to make decisions based on real world data.**

- **To develop the ability to implement a particularly intelligent system of choice.**
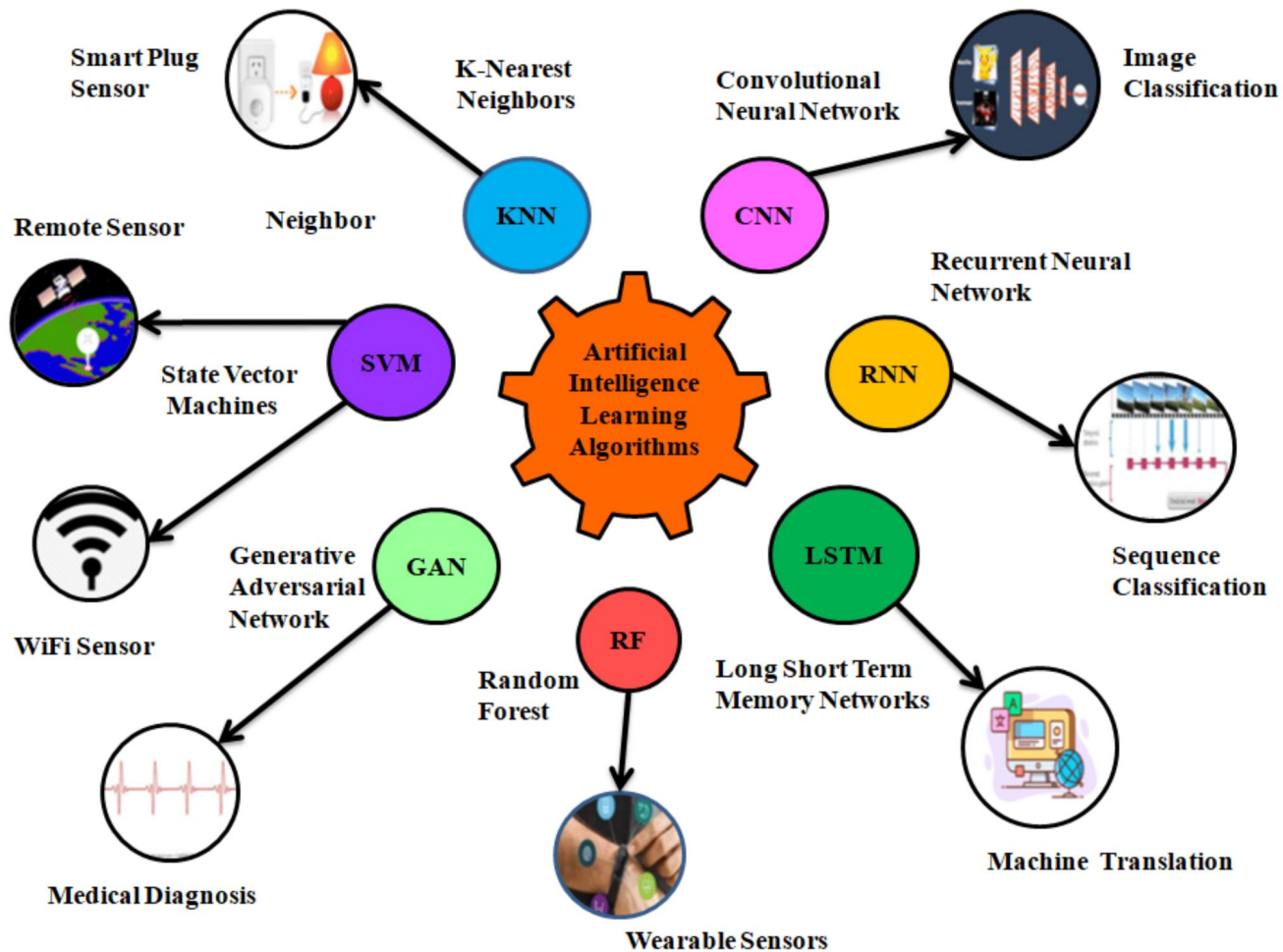
<u>Topic 2 :</u>

Intelligent Sensing Systems

- Introduction of sensors

- Types of sensors and actuators

- Intelligent sensors

- Vision Systems

- Spatial Reasoning from Sensor Data

- Real Time Audio-Visual Sensing and Sense Making

- IOT and clouds

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- **Introduction of sensors**

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Smart Plug Sensor

K-Nearest Neighbors

Convolutional Neural Network

Image Classification

KNN

CNN

Remote Sensor

Neighbor

Recurrent Neural Network

SVM

State Vector Machines

RNN

Artificial Intelligence Learning Algorithms

Sequence Classification

WiFi Sensor

Generative Adversarial Network

GAN

LSTM

Random Forest

RF

Long Short Term Memory Networks

Medical Diagnosis

Wearable Sensors

Machine Translation

Intelligent Sensing Systems:

Intelligent Sensing Systems (ISS) represent an advanced category of sensing technologies that go beyond traditional sensors by incorporating intelligence and decision-making capabilities. These systems leverage sophisticated algorithms, data processing, and sometimes machine learning to extract meaningful insights from the data collected by sensors. The goal is to enable more autonomous and adaptive responses to the environment.

Introduction of Sensors:

- **Definition:**

  Sensors are devices that detect and measure physical properties or changes in the environment and convert them into signals or data. They play a crucial role in collecting information for various applications, ranging from industrial processes to consumer electronics.

- **Functionality:**

  Sensors can measure a wide range of parameters, such as temperature, pressure, light, sound, motion, and more. They act as the first line of communication between the physical world and digital systems.

Introduction of Sensors:

Applications:

Sensors find applications in diverse fields, including healthcare, automotive, manufacturing, environmental monitoring, and smart cities. They enable data-driven decision-making and automation by providing real-time information.

Types of Sensors and Actuators:

Alcohol Sensor   Ultrasonic Sensor   IR optical Sensor   LDR Sensor   Gas Sensor   Gyroscope Sensor

Different types of Sensors

Iot4beginners

Rain Sensor   Sense Hat   Photo Diode   IR proximity Sensor   Proximity Sensor   PIR Sensor

# Types of Sensors and Actuators:

- **Temperature Sensors:** Measure temperature changes.

- **Pressure Sensors:** Detect changes in pressure.

- **Proximity Sensors:** Detect the presence or absence of objects.

- **Motion Sensors:** Detect movement or acceleration.

- **Light Sensors:** Measure light intensity.

- **Biometric Sensors:** Capture physiological or behavioral characteristics.

Types of Sensors and Actuators:

Actuators:

- Actuators are devices that convert digital signals into physical actions. Examples include motors, valves, and solenoids. They play a key role in responsive systems by carrying out actions based on sensor inputs.

Intelligent Sensors:
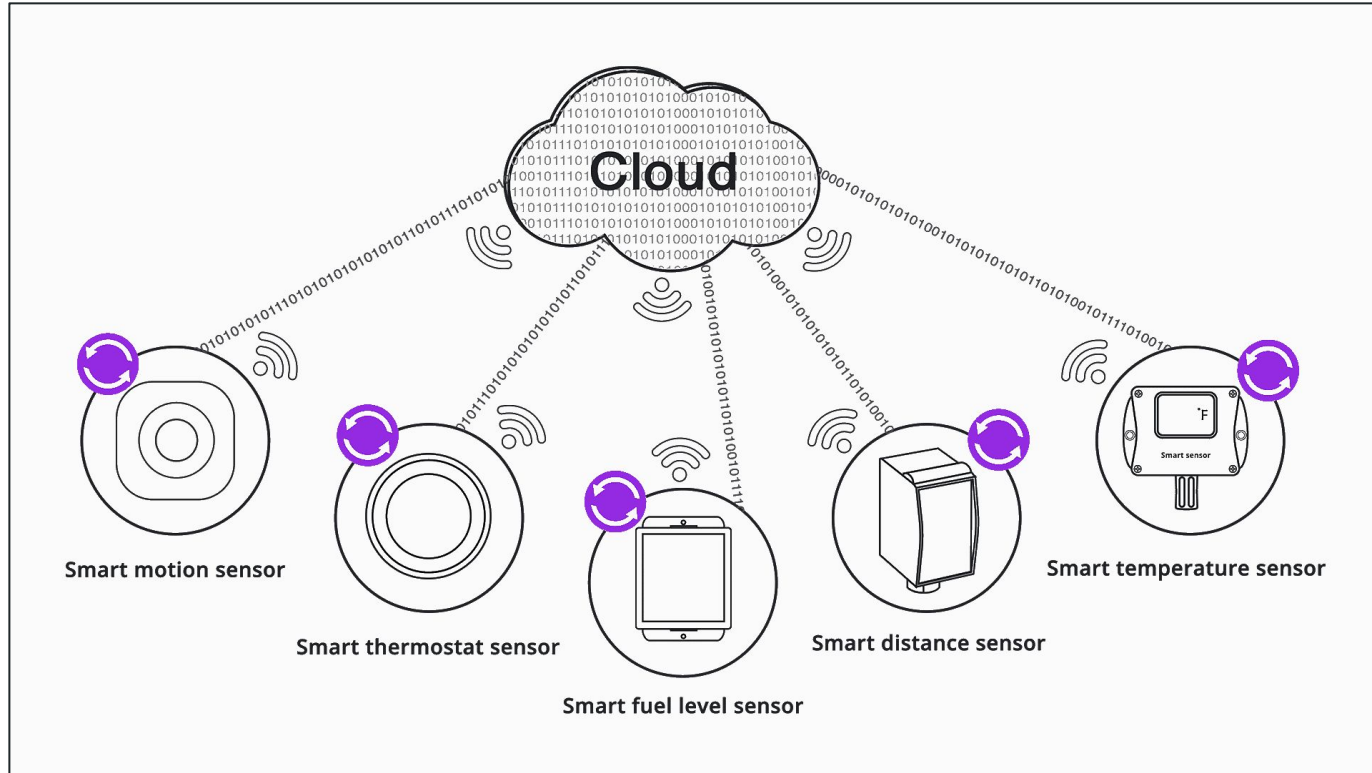
Intelligent Sensors:

- **Definition:** Intelligent sensors go beyond basic data collection. They incorporate processing capabilities, enabling them to analyze data locally and provide meaningful information or respond to specific conditions without relying on a centralized system.

- **Features:** Intelligent sensors may have built-in microprocessors, memory, and algorithms. They enhance efficiency by reducing the need for continuous data transmission and enable faster response times.

- **Applications:** These sensors are used in applications where real-time decision-making is critical, such as autonomous vehicles, smart homes, and industrial automation.

Vision Systems:
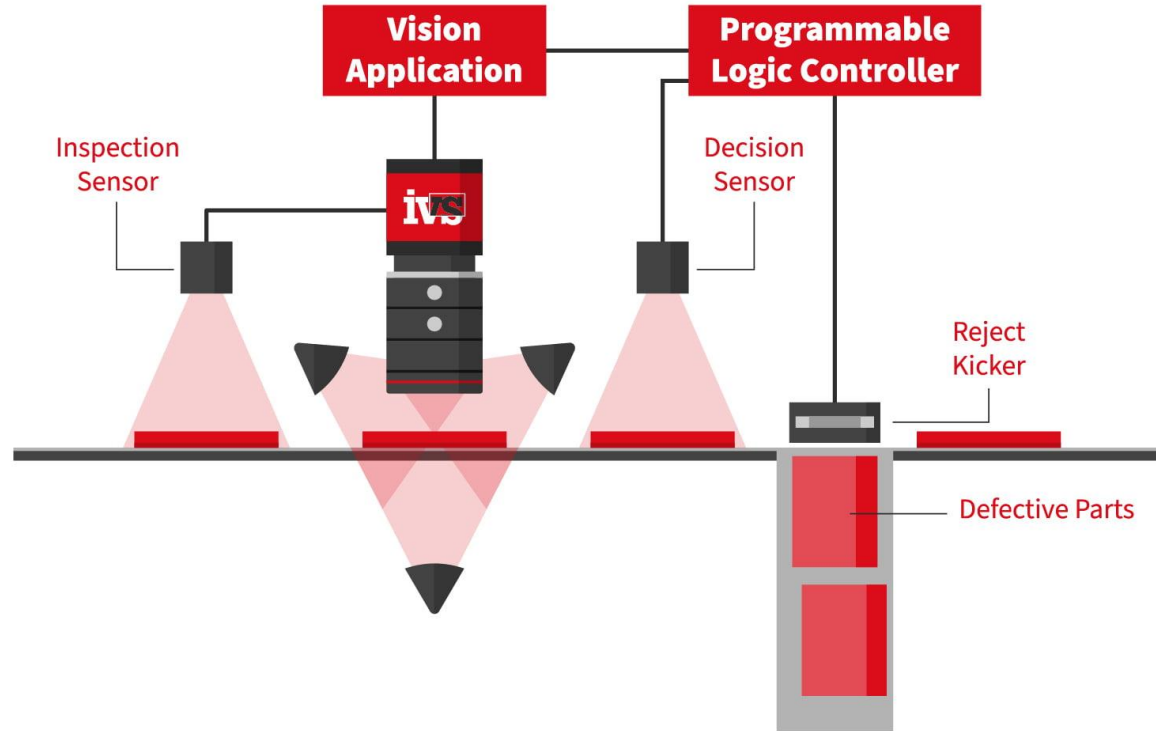
Vision Systems:

Definition:

Vision systems, also known as machine vision systems, are technologies that enable machines or computers to interpret and make decisions based on visual data. These systems mimic human vision processes by using cameras, sensors, and algorithms to capture, analyze, and understand visual information from the environment.

Components of Vision Systems:

Cameras and Sensors:

- Vision systems rely on cameras equipped with image sensors to capture visual data. These cameras can vary in resolution, sensitivity, and spectral capabilities based on the application requirements.

Processors:

- High-performance processors are essential for image processing and analysis. These processors handle tasks such as image recognition, feature extraction, and pattern matching.

Software Algorithms:

- Vision systems use sophisticated software algorithms for image processing and analysis. These algorithms enable the system to interpret and extract meaningful information from visual data.

Key Features of Vision Systems:

1. **Object Recognition:** Vision systems can recognize and identify objects within images or video streams. This capability is crucial in applications like industrial automation, where machines need to identify and handle specific products.

2. **Pattern Recognition:** These systems can recognize patterns, textures, and shapes, allowing them to make decisions based on the visual characteristics of the objects or scenes they observe.

3. **Image Analysis:** Vision systems analyze images to extract relevant information. This includes measurements, color analysis, and other parameters that provide insights into the visual data.

4. **Scene Interpretation:** Vision systems go beyond individual object recognition and can interpret entire scenes. This is important in applications like autonomous vehicles, where the system must understand the overall environment.

Challenges and Future Trends of Vision Systems:

Complexity of Scenes:

- Dealing with complex and dynamic scenes remains a challenge, as vision systems need to adapt to various lighting conditions, object orientations, and environmental changes.

Deep Learning Integration:

- Integration with deep learning techniques, such as convolutional neural networks (CNNs), enhances the capabilities of vision systems, allowing them to learn and recognize patterns more effectively.

Real-Time Processing:

- Achieving real-time processing capabilities is crucial for applications like robotics and autonomous systems, where quick decision-making is essential.

Heres the breakdown of key aspects related to Intelligent Sensing Systems:

1. Integration of Intelligence:

- Processing Capabilities: Smart sensors have built-in brains to process data.

- Algorithms: They use rules or machine learning to make sense of information.

2. Real-time Decision-making:

- Local Decision-Making: Smart sensors can act on data without waiting for a central system.

- Adaptive Responses: They can adjust to changes on the fly.

Heres the breakdown of key aspects related to Intelligent Sensing Systems:

3. Applications:

- Industrial Automation: Used in factories for better control.

- Smart Buildings: Make buildings energy-efficient and secure.

- Healthcare: Used in wearables and medical devices.

- Autonomous Vehicles: Enable cars to "see" and make decisions.

4. Data Fusion and Context Awareness:

- Multi-Sensor Integration: Combining data from different sensors.

- Context Awareness: Understanding the situation for better decisions.

Heres the breakdown of key aspects related to Intelligent Sensing Systems:

5. Energy Efficiency:

- Selective Data Transmission: Transmitting only necessary data.

- Low-power Designs: Designed to use less energy.

6. Security and Privacy:

- On-device Processing: Processing data locally for privacy.

- Secure Communication: Ensuring data transmission is secure.

Heres the breakdown of key aspects related to Intelligent Sensing Systems:

7. Challenges and Future Trends:

- Algorithm Complexity: Making sure smart systems are efficient.

- Interoperability: Ensuring different smart sensors can work together.

- Edge Computing: Moving processing closer to where data is collected.

8. Ethical Considerations:

- Bias and Fairness: Avoiding unfair decisions based on data.

- Transparency: Making sure the decisions made are understandable.

Thank You!!