

Internet of Things (IoT) – Unit 02

RGPV Topper-Level Notes (One Night Exam Preparation)

1. Sensor

Definition

A **Sensor** is a device that detects physical changes in the environment and converts them into electrical signals.

Easy Introduction

Sensor IoT system ka “sense organ” hota hai.

Jaise humans ki eyes, ears aur skin environment ko feel karti hain, waise hi sensors temperature, pressure, light, motion etc. detect karte hain.

Why This Topic is Important

Sensors ke bina IoT possible nahi hai because:

- ✓ Sensors data collect karte hain
 - ✓ Real-world information ko digital form me convert karte hain
 - ✓ Smart devices ko intelligent banate hain
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Detailed Explanation

Sensor environment se information collect karta hai.

Example:

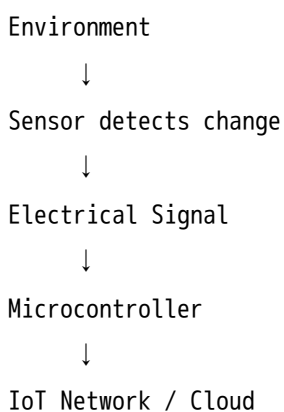
Sensor	Detects
Temperature Sensor	Heat
Light Sensor	Light intensity
Motion Sensor	Movement
Gas Sensor	Gas leakage
Humidity Sensor	Moisture

Sensor output analog ya digital ho sakta hai.

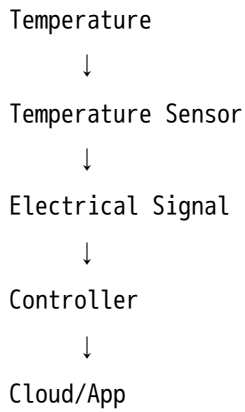
Working / Steps

1. Sensor environment observe karta hai
 2. Physical quantity detect hoti hai
 3. Sensor signal generate karta hai
 4. Signal controller/system ko bheja jata hai
 5. IoT system decision leta hai
-

Flow of Process



Diagram



Real-Life Analogy

Sensor human body ke sense organs jaisa hota hai.

Human Organ	Sensor
Eyes	Camera Sensor
Nose	Gas Sensor
Skin	Temperature Sensor

Advantages

- ✓ Automatic data collection
 - ✓ Fast response
 - ✓ Real-time monitoring
 - ✓ High accuracy
 - ✓ Automation support
-

Disadvantages

- ✗ Costly in large systems
 - ✗ Calibration needed
 - ✗ Sensitive to environment
 - ✗ Power consumption
-

Applications

- Smart home
 - Smart agriculture
 - Healthcare
 - Smart city
 - Industry automation
-

Important Keywords

Sensing, Transducer, Signal Conversion, Real-Time Monitoring, Automation

Conclusion

Sensor IoT system ka most important component hai because it collects real-world data and makes smart automation possible.

2. Basic Components of Sensor Node

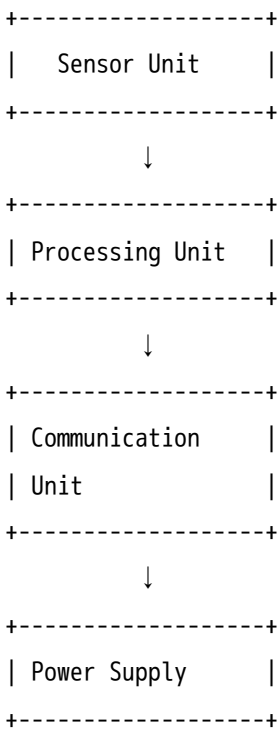
Definition

A **Sensor Node** is a small electronic device that collects data using sensors and sends it to other devices or cloud.

Basic Components

Component	Function
Sensor Unit	Data collection
Processing Unit	Data processing
Communication Unit	Data transmission
Power Unit	Energy supply
Memory Unit	Data storage

Diagram



Challenges of Sensor Node

1. Power Consumption

Battery jaldi discharge ho sakti hai.

2. Memory Limitation

Storage limited hota hai.

3. Communication Range

Signal weak ho sakta hai.

4. Security

Data hacking risk hota hai.

5. Environmental Issues

Heat, moisture sensor performance affect karte hain.

Applications

- Wireless Sensor Networks
 - Smart Farming
 - Health Monitoring
 - Military Systems
-

Important Keywords

Sensor Node, Power Unit, Processing Unit, Communication Unit

Conclusion

Sensor node IoT network ka basic building block hai which senses, processes and communicates data.

3. Sensor Features

Definition

Sensor features are characteristics that define sensor performance and behavior.

Important Sensor Features

Feature	Meaning
Accuracy	Correct measurement
Sensitivity	Ability to detect small changes
Resolution	Smallest detectable change
Range	Minimum to maximum value
Response Time	Speed of response
Precision	Repeatability of results
Stability	Consistent performance

Easy Explanation

Good sensor:

- ✓ Accurate hona chahiye
 - ✓ Fast hona chahiye
 - ✓ Stable hona chahiye
-

Example

Temperature sensor:

- Range = 0°C to 100°C
 - Accuracy = $\pm 1^\circ\text{C}$
 - Response Time = 2 seconds
-

Important Keywords

Accuracy, Sensitivity, Precision, Stability, Response Time

Conclusion

Sensor features decide sensor quality and performance.

4. Sensor Resolution

Definition

Resolution is the smallest change in input that a sensor can detect.

Easy Introduction

Agar sensor bahut small change detect kar sakta hai, to uski resolution high hoti hai.

Example

If temperature sensor:

- detects only 1°C change \rightarrow low resolution
 - detects 0.1°C change \rightarrow high resolution
-

Diagram

Low Resolution \rightarrow 1°C step

High Resolution → 0.1°C step

Advantages of High Resolution

- ✓ Better accuracy
 - ✓ Fine measurements
 - ✓ Better monitoring
-

Disadvantages

- ✗ Costly
 - ✗ Complex circuitry
-

Important Keywords

Resolution, Smallest Detectable Change, High Resolution

Conclusion

Higher sensor resolution means better precision and detailed measurement.

5. Sensor Classes

A) Analog Sensor

Definition

Analog sensor produces continuous output signals.

Example

Temperature sensor LM35.

Diagram

Temperature Change



Continuous Voltage Output

Advantages

✓ Simple

✓ Cheap

Disadvantages

✗ Noise affected

✗ Less accurate

B) Digital Sensor

Definition

Digital sensor produces discrete digital output.

Example

Digital temperature sensor DS18B20.

Advantages

- ✓ More accurate
 - ✓ Noise resistant
-

Disadvantages

- ✗ Expensive
-

C) Scalar Sensor

Definition

Measures only magnitude.

Example

Temperature sensor.

D) Vector Sensor

Definition

Measures magnitude and direction.

Example

Accelerometer.

Comparison Table

Basis	Analog	Digital
Output	Continuous	Discrete
Accuracy	Lower	Higher
Noise	More affected	Less affected

Basis	Scalar	Vector
Measures	Magnitude only	Magnitude + Direction
Example	Temperature	Velocity

Important Keywords

Analog Sensor, Digital Sensor, Scalar, Vector

Conclusion

Different sensor classes are used according to application requirements.

6. Sensor Types

Common Sensor Types

Sensor	Application
Temperature Sensor	Weather monitoring
Pressure Sensor	Industrial systems

Sensor	Application
Motion Sensor	Security systems
Humidity Sensor	Agriculture
Light Sensor	Smart lighting
Gas Sensor	Gas leakage detection
Proximity Sensor	Object detection

Diagram

Sensors

|

| Temp | Motion | Gas | Light |

7. Sensor Errors

A) Bias Error

Definition

Constant difference between actual value and measured value.

Example

Actual temp = 25°C

Sensor shows = 27°C

Bias = +2°C

B) Drift

Definition

Gradual change in sensor output over time.

C) Hysteresis Error

Definition

Different output for same input during increasing and decreasing conditions.

D) Quantization Error

Definition

Error due to digital conversion approximation.

Comparison Table

Error	Meaning
Bias	Constant error
Drift	Time-based error
Hysteresis	Output mismatch
Quantization	Digital approximation error

Important Keywords

Conclusion

Sensor errors reduce accuracy and must be minimized for reliable IoT systems.

8. Actuator

Definition

An **Actuator** is a device that converts electrical signals into physical action.

Easy Introduction

Sensor “detect” karta hai while actuator “action” perform karta hai.

Example

- Motor rotating
 - Valve opening
 - Fan ON/OFF
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Working

Controller Signal



Actuator



Physical Action

Real-Life Analogy

Human muscles actuator ki tarah kaam karte hain.

Advantages

- ✓ Automation
 - ✓ Fast response
 - ✓ Remote control possible
-

Disadvantages

- ✗ Power required
 - ✗ Mechanical wear
-

Applications

- Robotics
 - Smart home
 - Industrial automation
 - Medical devices
-

Important Keywords

Motion, Physical Action, Automation, Control Signal

Conclusion

Actuator IoT systems ko physical action perform karne me help karta hai.

9. Types of Actuators

A) Hydraulic Actuator

Uses liquid pressure.

Applications

- Heavy machinery
- Industrial systems

B) Pneumatic Actuator

Uses compressed air.

Applications

- Factory automation

C) Electrical Actuator

Uses electric energy.

Examples

- Motors
- Relays

D) Thermal / Magnetic Actuator

Uses heat or magnetic field.

E) Mechanical Actuator

Uses gears and mechanical movement.

F) Soft Actuator

Flexible material-based actuator.

Applications

- Medical robotics
 - Artificial muscles
-

Diagram

Actuators

|

| Hydraulic | Pneumatic | Electric |
| Thermal | Mechanical | Soft |

Comparison Table

Type	Energy Source	Example
Hydraulic	Liquid	Crane

Type	Energy Source	Example
Pneumatic	Air	Air brake
Electrical	Electricity	Motor
Thermal	Heat	Thermostat
Mechanical	Mechanical force	Gear system
Soft	Flexible material	Soft robot

Advantages

- ✓ Automation support
 - ✓ High efficiency
 - ✓ Remote operation
-

Disadvantages

- ✗ Maintenance required
 - ✗ Power consumption
-

Important Keywords

Hydraulic, Pneumatic, Electrical Actuator, Soft Actuator

Conclusion

Different actuators are used based on application and required motion/control.



MOST IMPORTANT TOPICS

- ★ Sensor and Sensor Node
 - ★ Sensor Features
 - ★ Sensor Errors
 - ★ Actuator and Types
 - ★ Analog vs Digital Sensors
 - ★ Scalar vs Vector Sensors
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★ MOST IMPORTANT 7-MARK QUESTIONS

1. Explain sensor node and its components.
 2. Explain sensor features.
 3. Explain sensor errors.
 4. Differentiate between analog and digital sensors.
 5. Explain scalar and vector sensors.
 6. Explain actuator and its types.
 7. Explain challenges of sensor node.
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★ MOST IMPORTANT 14-MARK QUESTIONS

1. Explain sensor node architecture with diagram and challenges.
 2. Explain different classes and types of sensors.
 3. Explain sensor errors in detail.
 4. Explain actuator and various actuator types with applications.
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PYQ-BASED EXPECTED QUESTIONS

★ Very High Probability

- ✓ Sensor Node
 - ✓ Sensor Features
 - ✓ Actuator Types
 - ✓ Analog vs Digital Sensors
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★ High Probability

- ✓ Sensor Errors
 - ✓ Scalar vs Vector Sensors
 - ✓ Soft Actuators
-

★ Medium Probability

- ✓ Sensor Resolution
 - ✓ Quantization Error
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⚡ ONE-NIGHT REVISION NOTES

Topic	Quick Revision
Sensor	Detects environment
Actuator	Performs action
Resolution	Smallest detectable change
Bias Error	Constant error
Drift	Time-based error
Analog Sensor	Continuous output
Digital Sensor	Discrete output
Scalar	Magnitude only
Vector	Magnitude + direction



MEMORY TRICKS

Sensor Features

👉 “ARPRS”

- A = Accuracy
 - R = Resolution
 - P = Precision
 - R = Response Time
 - S = Sensitivity
-

Sensor Errors

👉 “BDHQ”

- B = Bias
 - D = Drift
 - H = Hysteresis
 - Q = Quantization
-

Actuator Types

👉 “HPETMS”

- H = Hydraulic
 - P = Pneumatic
 - E = Electrical
 - T = Thermal
 - M = Mechanical
 - S = Soft
-

SMART STUDY PLAN

2-Hour Revision Strategy

Time	Topic
25 min	Sensor basics
25 min	Sensor node
20 min	Sensor features/errors
25 min	Actuator
25 min	Sensor classes/types

TOPPER ANSWER WRITING TIPS

- ✓ Draw diagrams in every answer
- ✓ Make comparison tables
- ✓ Underline keywords
- ✓ Write applications separately
- ✓ Add conclusion at end

FINAL EXAM PREDICTION

MOST EXPECTED LONG QUESTION

- ★ “Explain sensor node architecture and challenges.”

MOST EXPECTED COMPARISON

- ★ “Differentiate between Analog and Digital sensors.”

MOST EXPECTED THEORY QUESTION

★ “Explain actuator and its types.”