ASSIGNMENT OF WEEK 1

SMART FUSION (TR-102)

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Class – CSB1

Q1. Introduction to IoT: a) Define the term **Internet of Things (IoT)**.

b) Explain the **architecture of IoT** with a neat diagram.

c) List and explain the major **components of an IoT system**.

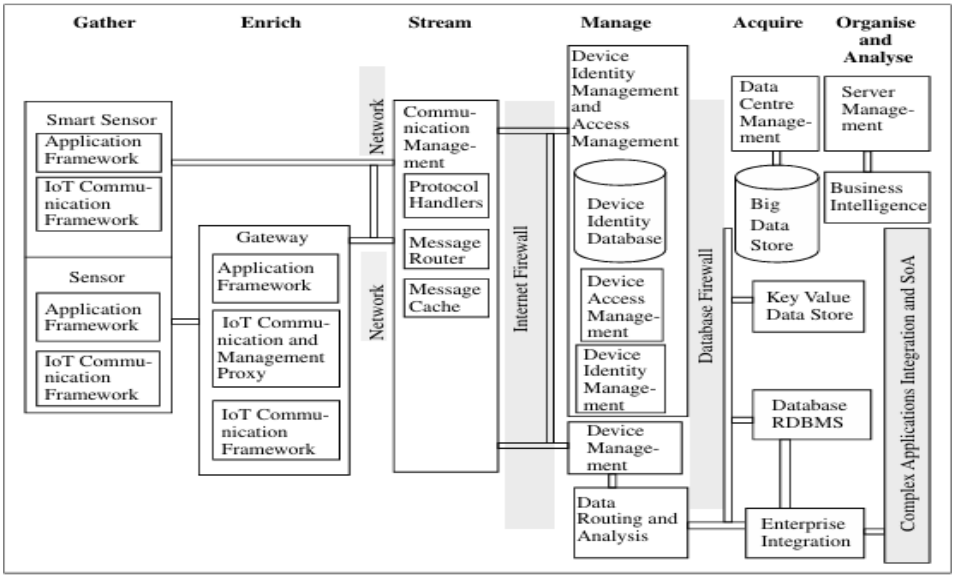
d) Mention at least **five real-life applications of IoT** with brief descriptions.

Ans. a) The **Internet of Things (IoT)** is a system where **physical devices** like sensors, machines, or home appliances are connected to the **internet**. These devices are equipped with **sensors, software, and network connectivity**, allowing them to **collect, exchange, and process data** without human interaction.

Examples:

- **Smart thermostat** – adjusts room temperature automatically.
- **Connected car** – shares location and performance data.
- **Wearable health monitor** – tracks heart rate and sends alerts.

b) IOT Architecture



1. Gather

- **Smart Sensor / Sensor:** These are physical devices that collect data (e.g., temperature, motion).
- **Application & Communication Frameworks:** Software that supports data collection and basic device operation.

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2. Enrich

- **Gateway:** Acts as a bridge between sensors and the internet. It may clean, preprocess, or enrich data.
- **Communication Management Proxy:** Helps manage data transmission securely and efficiently.

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3. Stream

- **Communication Management / Protocol Handlers:** Ensure proper communication protocols (like MQTT, HTTP) are used.
- **Message Router & Cache:** Routes data to the correct destination and may temporarily store it to manage load.

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4. Manage

- **Device Identity & Access Management:** Manages which devices are allowed in the system and what data they can access.
- **Device Management:** Handles device health, updates, and configurations.
- **Data Routing and Analysis:** Directs data to appropriate systems for storage or further processing.

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5. Acquire

- **Data Storage:**
    - **Big Data Store:** For large-scale unstructured data.
    - **Key-Value Store:** For fast, simple data storage.
    - **RDBMS (Relational Database):** For structured data.

- **Enterprise Integration:** Links IoT systems to existing business software (ERP, CRM).

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6. Organise and Analyse

- **Server & Data Centre Management:** Manages backend servers and resources.
- **Business Intelligence (BI):** Analyses collected data to support decision-making.
- **Complex Applications Integration and SOA:** Integrates IoT insights into broader applications and services.

c) COMPONENTS OF IOT:

1. Sensors/Actuators:

- Collect real-world data (temperature, humidity, motion, etc.) or act upon the environment.

2. **Connectivity:**
   - Enables devices to connect and communicate via the internet.
   - Examples: Wi-Fi, Bluetooth, Cellular, Zigbee.
3. **Data Processing Unit:**
   - Analyses collected data using edge or cloud computing.
   - May use AI/ML for smarter decisions.
4. **User Interface (UI):**
   - Allows users to interact with the IoT system (e.g., mobile apps, dashboards).
5. **Cloud/Storage:**
   - Stores large volumes of data for real-time or future use.

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d) real-life applications of IoT:

1. **Smart Homes:**
   - Devices like smart lights, thermostats, and security cameras controlled via smartphone apps.
2. **Healthcare:**

    - Wearable devices monitor vital signs and send data to doctors for remote diagnosis.
3. **Smart Cities:**
    - IoT used for traffic control, waste management, energy usage, and public safety.
4. **Industrial IoT (IIoT):**
    - Sensors monitor machines for predictive maintenance and process optimization.
5. **Agriculture:**
    - IoT-based systems track soil moisture, temperature, and automate irrigation for efficient farming.

Q2. Overview of AI & ML

a) What is Artificial Intelligence (AI)? Why is it important today?

Artificial Intelligence (AI) is the branch of computer science that aims to create machines or systems that can **think, learn, and make decisions** like humans. It includes tasks like problem-solving, understanding language, recognizing images, and decision-making.

Importance Today:

- **Automation:** Reduces manual work in industries and services.
- **Efficiency:** Increases speed and accuracy in tasks like data analysis.
- **Smart Solutions:** Powers technologies like self-driving cars, voice assistants, and medical diagnosis.
- **Big Data Handling:** Helps process and analyse massive data sets.

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b) What is Machine Learning (ML)? How is it related to AI?

Machine Learning (ML) is a **subset of AI** that allows computers to **learn from data** and **improve over time** without being explicitly programmed.

Relation to AI:

- ML is one way to achieve AI.

- AI is the goal (e.g., smart behaviour), and ML is the method (e.g., training models using data).

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c) Explain how AI and ML systems work with the help of a suitable example

Example: Email Spam Filter

1. **Data Collection (ML):** The system is trained on thousands of emails labelled as "spam" or "not spam."
2. **Model Training (ML):** The machine learns patterns (e.g., common spam keywords, sender behavior).
3. **Prediction (AI):** When a new email arrives, the AI system analyses it and **decides** if it's spam.

So, ML helps **learn from data**, and AI **uses that learning to make intelligent decisions**.

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d) List three applications each of AI and ML in different fields

AI Applications:

1. **Healthcare:** AI-powered diagnosis tools (e.g., detecting tumors in X-rays).
2. **Finance:** AI chatbots for customer service.
3. **Transportation:** Autonomous (self-driving) vehicles.

ML Applications:

1. **E-commerce:** Product recommendations (e.g., Amazon, Netflix).
2. **Cybersecurity:** Detecting fraud or unusual behavior.
3. **Agriculture:** Crop disease prediction based on historical data and weather patterns.

Q3. Explain with an example how a task solved through **traditional programming** differs from an **AI/ML-based approach**.

Ans **EXAMPLE: Email Spam Detection**

Traditional Programming:

In traditional programming, the developer writes **explicit rules** to detect spam. For example, if an email contains phrases like "win money" or comes from an unknown sender, it is marked as spam.

- **Approach:** Rule-based logic manually coded.
- **Limitations:** Cannot adapt to new spam techniques. Needs frequent manual updates.

AI/ML-Based Approach:

In the AI/ML approach, the system is trained using **labeled email data** (spam and not spam). It learns patterns such as keywords, frequency, sender behavior, etc., and uses that to classify new emails.

- **Approach:** Model learns from data.
- **Advantages:** Automatically improves with more data and adapts to new types of spam.

Traditional programming relies on fixed logic, while AI/ML **learns from data** and **adapts over time**, making it more suitable for complex, changing problems like spam detection.

Q4. Role of AI-ML in IoT-enabled Smart Systems

a) Importance of Integrating AI and ML with IoT Systems

Integrating **AI and ML** with **IoT systems** helps in turning raw sensor data into **actionable insights**. IoT collects vast data from devices, while AI/ML can analyze, learn from, and act on this data in real time.

- **Improves decision-making**
- **Enables predictive and adaptive systems**
- **Reduces human intervention**
- **Enhances efficiency and automation**

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b) Examples of AI/ML Enhancing IoT Applications

1. **Smart Homes:**
    - AI learns user habits to automate lights, heating, and appliances.

- Example: A smart thermostat learns your daily routine and adjusts temperature automatically.

2. **Healthcare:**
    - ML models analyze wearable sensor data to detect irregular heartbeats or predict health issues.
    - Example: Smartwatches detecting early signs of heart problems.
3. **Industrial Automation:**
    - Predictive maintenance using AI analyzes sensor data to detect equipment failure before it happens.
    - Example: AI alerts when a machine is overheating, avoiding downtime.
4. **Smart Cities:**
    - Traffic flow is optimized using AI based on real-time data from IoT sensors.
    - Example: Smart traffic lights adjusting timings to reduce congestion.

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c) Challenges in Integrating AI/ML with IoT Devices

1. **Limited Processing Power:**
    - IoT devices often have low computing capability, making it hard to run complex ML models locally.
2. **Data Privacy and Security:**
    - Collecting and analyzing sensitive data (like health or location) raises privacy concerns.
3. **Data Quality and Volume:**
    - IoT generates large and sometimes noisy data. Poor data quality can affect ML model performance.