DEPARTMENT OF SOFTWARE ENGINEERING

Courser: Internet of Things (IoT)

Course Code: XAI402

UNIT - II : TECHNOLOGIES BEHIND IoT

Control Units Communication modules Bluetooth Zigbee Wifi GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc), MQTT, , - RFID, Wireless Sensor Networks Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT

Course Content Preparation

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UNIT - II: TECHNOLOGIES BEHIND IoT

2. Control Units in IoT

Control units play a crucial role in the Internet of Things (IoT) ecosystem, serving as the central processing units that manage data processing, decision-making, and device control. In essence, control units act as the brains of IoT devices, orchestrating their functionalities and interactions within the network. Let's delve deeper into the significance and functionalities of control units in IoT:

2.1.1 Definition and Purpose:

Control units, also known as microcontrollers or microprocessors, are embedded computing devices designed to execute specific tasks and control operations within IoT systems. They are responsible for processing data collected from sensors, analyzing it, and triggering appropriate actions based on predefined algorithms or rules. Control units enable IoT devices to au tonomously respond to environmental changes, user inputs, or external stimuli, making them integral components of smart and interconnected systems.

2.1.2 Functionalities

Data Processing: Control units process raw data collected from sensors, converting it into meaningful information that can be used for decision-making. This involves filtering, aggregating, and analyzing data to extract insights and detect patterns relevant to the application.

Decision Making: Based on the processed data, control units make decisions or execute commands to control actuators, devices, or systems. Decision-making algorithms may be simple rule-based systems or complex machine learning models depending on the application requirements.

Device Control: Control units send commands to actuators or devices to perform specific actions or tasks. This could include adjusting environmental conditions (e.g., temperature, lighting), activating or deactivating equipment, or initiating communication with other devices in the network.

Communication: Control units facilitate communication between IoT devices and the central system or cloud platform. They handle data transmission, protocol implementation, and network connectivity, ensuring seamless integration and interoperability within the IoT ecosystem.

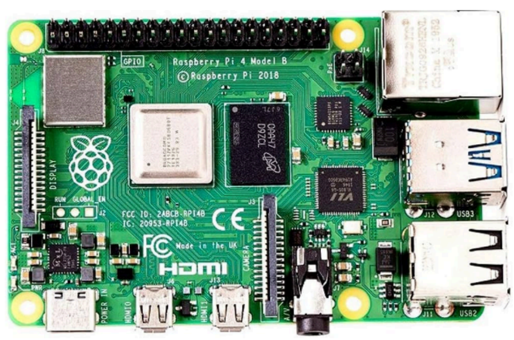
2.1.3 Power Management: Control units optimize power consumption in IoT devices by regulating energy usage, entering low-power modes when idle, and managing sleep cycles. This helps prolong battery life and maximize device autonomy in battery-operated or energy-constrained environments.

2.1.4. Examples of Control Units:

Arduino: Arduino is a popular open-source hardware platform widely used for prototyping and building IoT devices. It features a microcontroller unit (MCU) based on various architectures such as AVR, ARM, or ESP8266/ESP32, offering flexibility and scalability for different IoT applications.

(Source : https://store.arduino.cc/ products/ arduino-uno-rev3-smd)

Raspberry Pi: Raspberry Pi is a credit card-sized single-board computer equipped with a microprocessor, memory, and I/O ports. It can run a variety of operating systems and software applications, making it suitable for IoT projects requiring higher computational capabilities and multimedia processing.



(Source : https://www.raspberrypi.com/ products / raspberry-pi-4-model-b/)

ESP8266/ESP32: ESP8266 and ESP32 are low-cost, low-power Wi-Fi modules with integrated microcontrollers, ideal for IoT applications requiring wireless connectivity. They are commonly used in projects such as home automation, sensor networks, and IoT gateways.

(Source: https://www.espressif.com/en/products/socs/esp8266)

2.1.5. Control units Importance in IoT

Control units are the backbone of IoT systems, enabling devices to sense, process, and act upon real-world data autonomously. They empower IoT solutions with intelligence, responsiveness, and adaptability, driving efficiency, innovation, and value creation across various industries and domains.

2.2. Communication Modules in IoT: Enabling Connectivity

In the realm of the Internet of Things (IoT), communication modules are pivotal components that facilitate seamless data exchange and connectivity among devices. Let's explore their significance and functionalities:

2.2.1. Definition and Purpose:

Communication modules are hardware components or technologies designed to enable communication between IoT devices and central systems or networks. They facilitate the transmission of data, commands, and information, fostering interaction within IoT ecosystems.

2.2.2. Types of Communication Modules:

- **Bluetooth**: Enables short-range wireless communication suitable for applications like wearables and smart home devices.
- **Zigbee**: Low-power protocol ideal for home automation and industrial control with robust mesh networking capabilities.
- **Wi-Fi:** Provides high-speed wireless communication over longer distances, enabling internet connectivity in IoT devices.
- **GPS:** Offers location-based services and tracking capabilities for asset management and geolocation services.

2.2.3. Functionalities and Features:

- **Data Transmission:** Facilitates the exchange of information between devices.
- **Protocol Support:** Ensures interoperability and compatibility with diverse IoT devices.
- **Security:** Implements encryption and authentication to protect data integrity and privacy.
- **Power Management:** Optimizes energy consumption to extend battery life in IoT devices.
- **Range and Coverage:** Offers varying ranges suitable for different IoT applications.

2.2.4. Applications and Use Cases:

- **Smart Home Automation:** Enables remote monitoring and control of smart home devices.
- **Industrial IoT (IIoT):** Supports machine-to-machine communication and process automation in industrial settings.
- **Healthcare Monitoring:** Facilitates remote patient monitoring and telemedicine services.
- **Smart Cities:** Powers connected infrastructure and intelligent transportation systems.

2.2.5. Future Trends and Innovations:

- **5G Connectivity:** Promises faster, low-latency connectivity for bandwidth-intensive IoT applications.
- **Edge Computing:** Integrates communication modules with edge computing capabilities for real-time data processing.
- **Interoperability Standards:** Aims to address compatibility issues and promote seamless integration of IoT devices.
- **Security Enhancements:** Advances in security technologies to enhance resilience against cyber threats.

2.3 IoT Protocols: Simplifying Communication in the Connected World

In the realm of the Internet of Things (IoT), protocols are the rules and languages that devices use to communicate with each other. Let's explore the significance of IoT protocols and some common examples:

2.3.1. What are IoT Protocols?

Imagine IoT devices as friends who want to talk to each other, but they speak different languages. IoT protocols are like translators that help them understand each other's messages. These protocols define how data is formatted, transmitted, and received between devices, ensuring smooth communication in the connected world.

2.3.2. Common IoT Protocols:

MQTT (Message Queuing Telemetry Transport): Think of MQTT as a postman delivering messages. It's lightweight and efficient, making it ideal for IoT devices with limited resources. MQTT ensures reliable communication between devices, allowing them to exchange data without much delay.

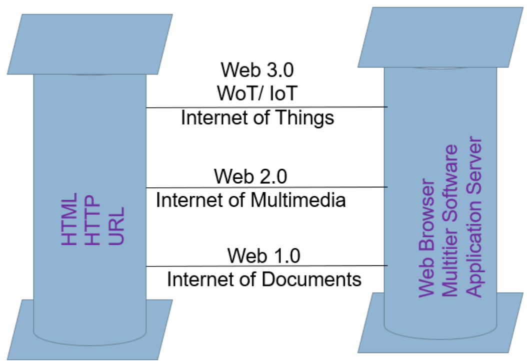
CoAP (Constrained Application Protocol): CoAP is like a streamlined version of HTTP (the language of the web). It's designed for IoT devices with low power and limited bandwidth. CoAP enables devices to communicate over the internet, making it suitable for smart home devices, wearables, and industrial applications.

HTTP (Hypertext Transfer Protocol): You're probably familiar with HTTP—it's what your web browser uses to load websites. In the IoT world, HTTP allows devices to send and receive data over the internet. It's widely used for cloud-based IoT applications and services, where devices need to interact with web servers.

IPv6 (Internet Protocol Version 6): IPv6 is like a bigger address book for the internet. With more addresses than its predecessor (IPv4), IPv6 accommodates the growing number of IoT devices connecting to the internet. It ensures that every device can have its unique address, enabling seamless communication in the IoT ecosystem.

2.4 Two Pillars of the Web: Foundational Elements of the Digital World

In the vast landscape of the internet, there exist two fundamental pillars that serve as the cornerstone of the digital realm. These pillars encompass essential technologies and components that facilitate the creation, sharing, and accessing of information across the web. Let's delve into each of these pillars and their significance:



First Pillar:

HTML (Hypertext Markup Language): HTML serves as the backbone of web pages, providing the structure and layout necessary for displaying content on the internet. Through HTML, web developers can craft text, images, links, and multimedia elements that users interact with during their online journeys.

HTTP (Hypertext Transfer Protocol): HTTP acts as the communication protocol between web servers and browsers, enabling the seamless transfer of data across the internet. This protocol ensures that web pages load correctly and efficiently, facilitating smooth interactions between users and web servers.

URL (Uniform Resource Locator): A URL functions as the address of a web page, directing users to specific resources on the internet. By entering a URL into their browser's address bar, users can access the desired web page, document, or multimedia content hosted on remote servers.

Second Pillar:

Web Browser: A web browser serves as the gateway to the internet, allowing users to navigate and interact with web pages. Popular browsers like Google Chrome, Mozilla Firefox, and Safari interpret HTML files received from web servers, rendering them as visually appealing web pages for users to explore.

Multitier Software: Multitier software architecture divides web applications into distinct layers or tiers, each responsible for specific functions such as presentation, logic, and data storage. This architecture enhances scalability, flexibility, and efficiency in developing and managing complex web-based systems.

Application Server: An application server functions as the engine behind dynamic web applications, hosting and managing the business logic and data access components. These servers handle user requests, execute application code, and interact with databases, ensuring the seamless operation and performance of web applications.

The Three Stages of Web:

Web 1.0 (Internet of Documents): During the Web 1.0 era, the internet primarily consisted of static web pages with limited interactivity. Users accessed information in the form of documents and articles, with minimal user-generated content or dynamic interaction.

Web 2.0 (Internet of Multimedia): The emergence of Web 2.0 revolutionized internet usage, introducing dynamic, interactive, and multimedia-rich content. Social media platforms, online collaboration tools, and user-generated content became prevalent, enabling active participation and engagement on the web.

Web 3.0 (WoT/IoT - Web of Things/Internet of Things): Web 3.0, also known as the Web of Things (WoT) or Internet of Things (IoT), represents the integration of physical devices into the internet ecosystem. In this era, interconnected devices autonomously collect, exchange, and analyze data, ushering in smart environments and predictive analytics capabilities.

What is the Web of Things (WoT)?
Imagine a world where your toaster, thermostat, and even your plants are all connected to the internet and can communicate with each other seamlessly. That's the essence of the Web of Things (WoT). It's about extending the principles of the web—like accessibility and interoperability—to the realm of physical devices.

The Web of Things (WoT) is a transformative concept that connects everyday devices to the internet, enabling smarter living and working environments. By harnessing the power of web technologies, WoT empowers users to control their devices remotely, fosters innovation, and paves the way for a more connected and intelligent future.

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IoT (Internet of Things) - Unit-II – MCQ

1. IPv6 addresses have a size of

a. 8 bits b. 16 bits c. 128 bits d. 256 bits

2. Which of the following is the way in which an IoT device is associated with data?

a. Client Server b. Cloud c. Automata d. Network

3. What is the main purpose of WoT (Web of Things) in the IoT?

a. Reduce the security b. Increase the cost c. Complex the development d. Improve the usability and interoperability

4. MQTT is based on ___________

a. client-server architecture b. publish-subscribe architecture c. Virtual architecture d. None of the mentioned

5. Identify the lightweight protocol.

a. HTTP b. IP c. CoAP d. MQTT

6. Simple examples of Actuators are ________

a. Barcode b. Light c. Touch Sensor d. UV Sensor

7. What is the full form of the LPWAN?

a. Long Protocol Wide Area Network b. Long Power Wide Area Network c. Low Protocol Wide Area Network d. Low Power Wide Area Network

8. What is the maximum read range of the RFID Module?

a. 1 cm b. 2 cm c. 5 cm d. 10 cm

9. What is the use of the RFID Module?

a. Object Identification b. To provide 3G Connectivity c. To measure temperature d. To measure Wi-Fi strength

10. Bluetooth is the wireless technology for ___________

a. local area network b. personal area network c. metropolitan area network d. wide area network

Two Mark Questions

1. Write a List of protocols are used in IoT
2. List out the best wireless protocols
3. Identify the uses for Zigbee
4. Write a shot note on RFID.
5. Mention the MQTT Services
6. What are the wireless sensor networks?
7. What are Wireless technologies for the IoT?
8. What is the full form of MQTT?
9. Explain IPv4 and IPv6.