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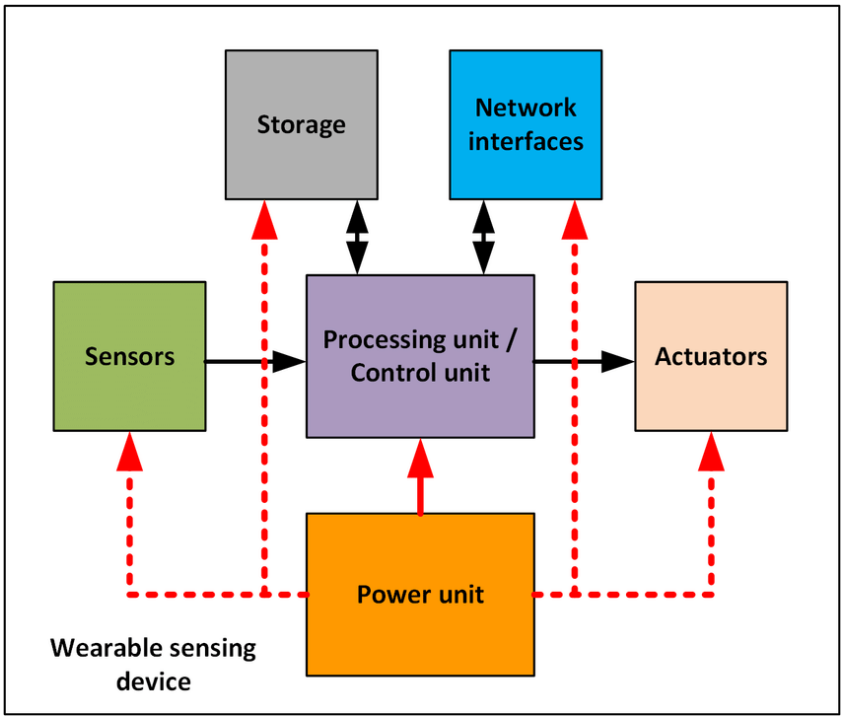
Department of Biomedical Engineering

VI Semester

CBM 370 - Wearable Devices

Unit- 1 INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS

1.4 Components of Wearable System:



The diagram illustrating the key components of a wearable sensing device.

1. Sensors

Sensors are the core of wearable systems, enabling the device to collect data:

- **Motion Sensors**: Accelerometers, gyroscopes, and magnetometers for tracking movement, orientation, and activity.

- **Physiological Sensors**:
    - Heart rate sensors.
    - Blood oxygen (SpO2) sensors.
    - Electrocardiogram (ECG) sensors.
    - Glucose monitoring sensors.
    - Skin temperature sensors.
- **Environmental Sensors**: Measure external factors such as UV exposure, air quality, temperature, and humidity.

2. Processing Unit

This component handles the data collected by the sensors:

- **Microcontroller Unit (MCU)**: Processes basic tasks with low power consumption.
- **System-on-Chip (SoC)**: Combines processing, memory, and communication features in a compact design.
- **AI/ML Processors**: Enables advanced analytics and pattern recognition directly on the device.

3. Control Unit

- This is the brain of the device. It receives data from the sensors, processes it, and makes decisions based on the information gathered.
- It might perform calculations, analyze trends, and trigger actions.
- Controls the operation of all device components.
- Manages power consumption to optimize battery life.
- Triggers actuators or alerts based on the analyzed data

4. Communication Module / Network Interfaces:

Enables connectivity with external devices or networks:

- **Bluetooth/Bluetooth Low Energy (BLE)**: Short-range communication with low power.
- **Wi-Fi**: Allows direct internet access.
- **Cellular (e.g., 4G/5G)**: Provides long-range connectivity without relying on other devices.

- **NFC (Near Field Communication)**: For contactless interactions like payments.
- **GPS**: For location tracking and navigation.

5. Power Unit:

Provides the energy needed for the wearable system:

- **Rechargeable Batteries**: Commonly lithium-ion or lithium-polymer.
- **Energy Harvesting**: Solar panels, thermoelectric generators, or kinetic energy systems.
- **Wireless Charging**: Enables convenient charging without physical connections

6. Storage

Stores the data collected and processed by the system:

- **On-Device Storage**: Flash memory for temporary or local data storage.
- **Cloud Integration**: Offloads data to cloud storage for advanced analysis and long-term storage.

7. Actuators

Components that perform actions based on processed data:

- **Haptic Actuators**: Provide vibrations or other tactile feedback.
- **Motors**: Enable mechanical movements in devices like exoskeletons.
- **Light Emitters**: Flashlights or UV lights for specific functions.

8. Software & User Interface:

- Includes operating systems, applications, and AI algorithms for data analysis.
- Examples: Wear OS, watch OS, Tizen, custom firmware.

9. Mechanical & Structural Components

- ❑ The wearable's casing, straps, textiles, and ergonomic design for user comfort and durability.
- ❑ Examples: Smart textiles, flexible materials, waterproof casings.

10. Display & Feedback Mechanism

- ❑ Provides real-time user feedback through visual, auditory, or haptic means.
- ❑ Examples:
  - ✓ **Visual**: OLED, LCD, E-ink displays, LED indicators.
  - ✓ **Auditory**: Speakers, buzzers.
  - ✓ **Haptic**: Vibrations, force feedback.

The above figure shows the diagram of the **Wearable Data Processing Lifecycle**. It outlines the stages involved in processing data collected from wearable devices.