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UNIT- V

NEW IT INITIATIVES

5.3 Pervasive Computing

Pervasive Computing is also called as Ubiquitous computing, and it is the new trend toward embedding everyday objects with microprocessors so that they can communicate information. It refers to the presence of computers in common objects found all around us so that people are unaware of their presence. All these devices communicate with each other over wireless networks without the interaction of the user.

Pervasive computing is a combination of three technologies, namely:

1. **Micro electronic technology:**
   This technology gives small powerful device and display with low energy consumption.
2. **Digital communication technology:**
   This technology provides higher bandwidth, higher data transfer rate at lower costs and with world wide roaming.
3. **The Internet standardization:**
   This standardization is done through various standardization bodies and industry to give the framework for combining all components into an interoperable system with security, service and billing systems.

Thus, wireless communication, consumer electronics and computer technology were all merged into one to create a new environment called pervasive computing environment. It helps to access information and render modern administration in areas that do not have a traditional wire-based computing environment.

Pervasive computing is the next dimension of personal computing in the near future, and it will definitely change and improve our work environment and communication methods.

Pervasive computing will provide us with small portable personal assistant devices having high speed, wireless communication, lower power consumption rate, data storage in persistent memory, coin sized disk device, small color display video and speech processing technology. All these features will give the users freedom to effectively communicate and access information from any place in the world at any time.

Key Characteristics of Pervasive computing:

1. Many devices can be integrated into one system for multi-purpose uses.
2. A huge number of various interfaces can be used to build an optimized user interface.
3. Concurrent operation of online and offline supported.
4. A large number of specialized computers are integrated through local buses and Internet.
5. Security elements are added to prevent misuse and unauthorized access.
6. Personalization of functions adapts the systems to the user's preferences, so that no PC knowledge is required of the user to use and manage the system.

These type of functions can be extended into network operations for use in workplace, home and mobile environments.

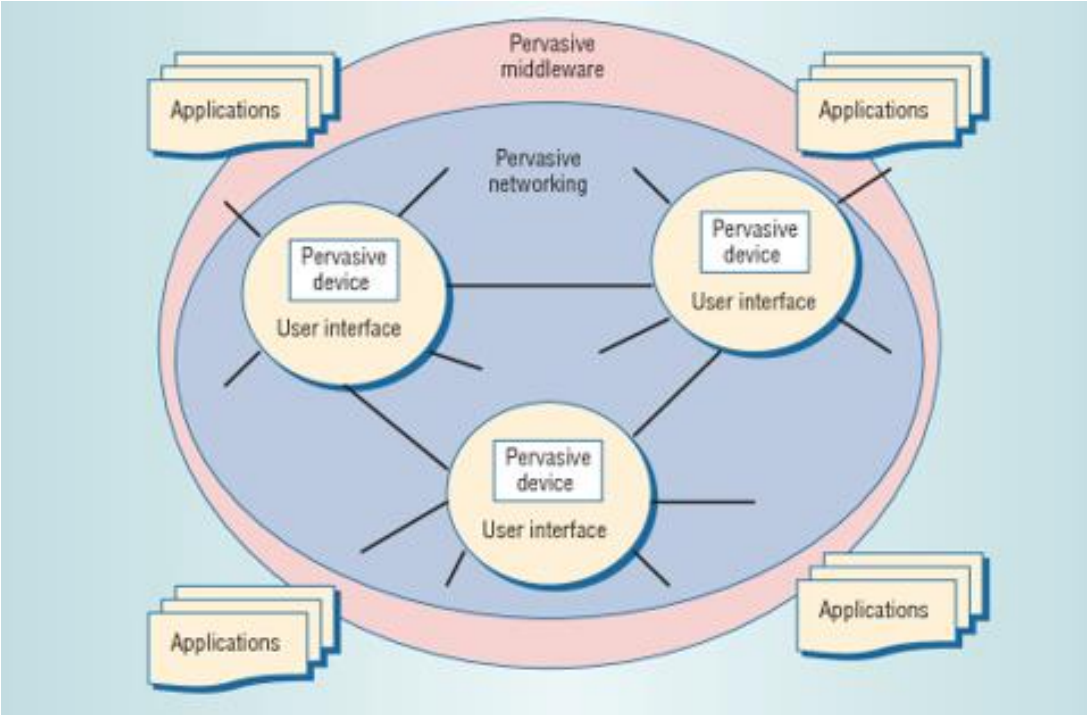
Four Principles of Pervasive Computing:

There are four key principles of pervasive computing:

1. **Decentralisation.** All computing is done by basic, small devices that are unintelligent, yet communicate in an open community where the structure of connections changes dynamically. (The Hive concept)
2. **Diversification**. Devices are small and special purpose, supplying a few, or even just one type of information.

3. **Connectivity**. Dumb devices can produce powerful and intelligent behaviour, if multiple devices act in parallel linked by an underlying infrastructure eg. the Internet.
4. **Simplicity**. We must never notice that it exists. If people have to constantly tweak, adjust, enter data to manage the connections, then the hive will never become pervasive. The standards need to be open, to be as non-restrictive as possible.

Pervasive Computing Infrastructure :



The aim of ubiquitous computing is to design computing infrastructures in such a manner that they integrate seamlessly with the environment and become almost invisible. The essence of that vision was the creation of environments saturated with computing and communication capability, yet gracefully integrated with human users.

Device heterogeneity. We believe that heterogeneity in computing systems will not disappear in the future, but instead will increase as the range of computing devices widens. Devices in a pervasive computing environment will include sensors and actuators that mediate between physical and virtual environments; embedded devices in

objects such as watches and shoes; home and office appliances such as videos, toasters and telephones; mobile devices, such as handheld organizers and notebooks; and traditional desktop machines. Heterogeneous devices will be required to interact seamlessly, despite wide differences in hardware and software capabilities. This will require an infrastructure that maintains knowledge of device characteristics and manages the integration of devices into a coherent system that enables arbitrary device interactions (for example, between a mobile phone and a desktop workstation).

Device mobility. Mobility introduces problems such as the maintenance of connections as devices move between areas of differing network connectivity, and the handling of network disconnections. While protocols for wireless networking handle some of the problems of mobility, such as routing and handovers, some problems cannot be solved at the network level, as they require knowledge of application semantics. It should be the role of the computing infrastructure to cooperate with applications in order to perform tasks related to device mobility, such as management of replicated data in cases of disconnection.

Software components: The responsibility of the pervasive computing infrastructure with respect to applications includes supporting application requirements such as context awareness, adaptation, mobility, distribution and interoperability; facilitating the rapid development and deployment of software components; providing component discovery services; and providing scalability. This section addresses the challenges involved in meeting these requirements.

Applications of Pervasive Computing:

Pervasive computing, also known as ubiquitous computing, involves embedding computing capabilities into everyday objects and environments to make them smart, connected, and capable of interacting with each other. Here are some applications of pervasive computing across various domains:

1. **Smart Homes**:

   Home automation for controlling lighting, heating, and security systems.

   Intelligent appliances that can communicate with each other.

   Context-aware systems that adapt to residents' preferences.

2. **Healthcare**:

   Wearable devices for continuous health monitoring.

   Smart medical devices for remote patient monitoring.

   Ambient assisted living for the elderly.

3. **Retail:**

   RFID technology for inventory management and tracking.

   Personalized shopping experiences using location-aware services.

   Mobile payments and contactless transactions.

4. **Transportation**:

   Intelligent transportation systems for traffic management.

   Vehicle-to-vehicle communication for safer driving.

   Public transportation systems with real-time updates.

5. **Education**:

   Smart classrooms with interactive whiteboards and connected devices.

   Location-aware learning materials and personalized education.

   Campus-wide pervasive computing for administrative tasks.

6. **Smart Cities:**

   Smart grids for efficient energy distribution.

   Intelligent traffic management and parking systems.

   Environmental monitoring for pollution control.

7. **Industrial IoT (IIoT):**

   Predictive maintenance for machinery and equipment.

   Supply chain optimization using real-time tracking.

   Smart factories with connected sensors and actuators.

8. **Entertainment:**

   Location-aware content delivery for immersive experiences.

   Interactive and personalized media streaming services.

Augmented reality (AR) and virtual reality (VR) applications.

9. **Agriculture:**

   Precision farming with sensor-equipped equipment.

   Soil and crop monitoring for optimal yield.

   Automated irrigation systems based on real-time data.

10. **Financial Services:**

    Mobile banking and contactless payments.

    Location-based fraud detection.

    Personalized financial advice.

11. **Tourism and Hospitality:**

    Location-based recommendations for tourists.

    Smart hotel rooms with automated services.

    Beacon technology for wayfinding in tourist destinations.

12. **Security and Surveillance**:

    Intelligent surveillance systems with facial recognition.

    Intrusion detection using sensors and cameras.

    Location-based access control.

13. **Wearable Technology:**

    Fitness trackers and health monitoring devices.

    Smartwatches with contextual notifications.

    Augmented reality glasses for hands-free information access.

14. **Social Networking:**

    Location-aware social media updates.

    Context-aware content delivery in social apps.

    Event recommendations based on user preferences.

15. **Emergency Services:**

    Location-based emergency response systems.

    Wearable devices for first responders.

Disaster management and early warning systems.

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