Pervasive Computing Issues, Challenges and Applications

Lathies Bhasker T
Department of Computer Science and Engineering
Manonmaniam Sundaranar University
Tirunelveli

Abstract-*This paper describes about the recent research topic pervasive computing which focus on the characteristics, architecture, issues and challenges. The pervasive architecture relates how the end-user interacts with the pervasive network using the middleware support. Finally it describes about the future focus for the pervasive computing through the real time applications.*

Keywords: Pervasive, Middleware, LAN, WAN, User Interface, Heterogeneity

1. Introduction

Pervasive Computing is the latest computing technology which is available in all over the place where the communication taken place. In this pervasive environment any device from any where can access by the user. In here the user can interact with the system by using laptops, tablets, terminals, mobile phones and smart phones. The major technologies such as internet, advanced middleware, operating systems, sensors/actuators, microprocessros, and mobile protocols are used to give support for this pervasive computing.

Pervasive network presumes an altogether different vision. A device can be a portal into an application-data space, not a repository of custom software that a user must manage. An application is a means by which an end user can performs a task, not software written to exploit a device's capabilities. And a computing environment is information enhanced physical space, not a virtual environment that exists to store and run software. [2].
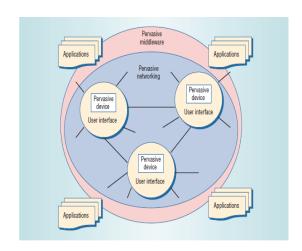
2. Characteristics of Pervasive Computing

Pervasive computing can be classified by a set of attributes and capabilities that describe the extent of its functionality. Mobility and ad-hoc networking capabilities are expected to emerge relatively soon, that is within the next one to two years. Characteristics such as autonomy, context awareness and energy autarky are not expected until later, taking anywhere from five to ten years. Context awareness and embedment in day-to-day objects are viewed as pervasive computing's ultimate and determining characteristics. Energy autarky and the autonomy of components and systems, in contrast, are considered secondary characteristics.

It therefore stands to reason that pervasive computing will establish itself step-by-step as its own isolated characteristics develop gradually. Although market-ready pervasive computing applications are anticipated in the next four to eight years, the feature of autonomy is not expected for another ten years. Also, the individual characteristics vary in significance depending on the field of application. For example, the autarkic power supply of pervasive computing components and their mobility are relatively unimportant for the smart home, whereas these characteristics are important to communications applications. [4].

3. Architecture for Pervasive Computing

The Pervasive computing architecture has the following four important areas, they are

- Devices
- Networking
- Middleware
- Applications

3.1 Devices

The ubiquitous environment consists of many different types of input and output devices. Some of the system devices such as keyboard, mouse, touchpad ,wireless mobile devices, sensors, pagers, mobile phones and smart phones these systems can be used as a input device for a pervasive environment.

In that the sensors automatically collect the information about the environment and feed this input directly to the pervasive network.

3.2 Networking

All the Pervasive devices are connected with other pervasive or any other communication devices through the distributed network. Why this pervasive device connected through distributed network means, because of the global accessibility of the device. The pervasive devices can be connected through the Local Area Network (LAN) or through Metropolitan Area Network (MAN) or through Wide Area Network (WAN) for the global availability.

3.3 Middleware

In order to make a communication between a end-user and a system the pervasive network should need a middleware "kernel". The middle either may be a web application (Web Page) or set of software-bundle. The software-bundle is executing in client-server mode or peer-to-peer mode. [2].

3.4 Applications

The Pervasive computing is more environment-centric than web-based or mobile computing. The data which are collected through pervasive environment will be processed by the middleware software and the output will generated based on the present environmental inputs.

4. Issues in Pervasive Computing

4.1 Mobility Issues

- How to integrate mobile communicators into complex information infrastructures?
- What effect will they have on work and leisure?
- Privacy
- How to develop and manage adaptable, context-aware software systems?
- What support is needed within the network?
- Power supplies

4.2 Wireless Problems

- Too many similar standards
- Shortage of spectrum
- Use low power + multiple base stations with intelligent antenna.
- Overlapping spectrum usage can cause interference eg Bluetooth and IEEE 802.11
- Unregulated bands lead to chaos
- Health risks? [6]

4.3 Open Issues

In the pervasive computing environment, we need a security policy that will simultaneously be an unobtrusive mechanism to the user as well as have the ability to discover the services available for the user in a transparent manner. The system needs a dynamic security policy which is flexible enough to update and modify on the fly.

Heterogeneity

Due to the distributed and ad hoc nature of the pervasive computing environment, this system is open to several unique vulnerabilities and suffers from quite a number of well-known problems whose reputed solutions are not applicable here.

Location Detection

In this surrounding and because the number of devices can be really vast, it is very hard to detect the physical device with which I am interacting. For this we need a secure communication channel along with device authentication. Again the request for establishing this trust channel is flowing through the shared, unreliable wireless channel

Access Control

In case of access control, the system is based on user's role and identity. Again this freedom of accessing system resources and services is a variable which depends on the time, situation and other contextual information. Here the user needs to trust the pervasive computing environment including the resources and services available. At the same time the system needs to ensure the identity and access privileges of the user.

Privacy

In case of privacy two issues come up with equal priority:

1) Is privacy of the user being maintained?
2) Is privacy of the data being maintained?

Unlike distributed computing, pervasive computing likes to take user information and consider it as important contextual information. Though this contextual information plays an important role in updating the system dynamically, it sometimes poses some risk to the

privacy of the user, especially in situations where people do not want to disclose their identity or location.

Data Communication

Privacy of the data encompasses two aspects. First, it has to ensure that data being shared or communicated is not being hacked by any active or passive attackers. As an initial thought, we consider several encryption and decryption techniques. But at the same time we need to think about the other side of the coin which reminds us about the memory, battery power and other limitations. Along with that, the users in pervasive computing environment have much more elasticity and sovereignty in mobility. This includes a large variety of domains ranging from well protected environments to totally open unprotected situations which makes the data protection issue worse. Secondly, how can it be guaranteed that the user data which is being collected almost obviously will not be used maliciously? Or how we can ensure wit certainty that the complicated data is not being processed by any unauthorized user

Trust

In order to overcome several constraints, mutual cooperation, interconnectedness and inter dependability have been exposed as the obvious uniqueness of pervasive computing environment. Along with these occurs the issue of trust. If data is shared with an unwarranted device, the probability of data security reduces automatically. [8].

5. Conclusion

As we have seen, today the pervasive/ubiquitous computing is a fertile source of challenging problems in computer systems. In this Paper we have gathered the information about the pervasive computing technologies, architecture, applications, issues and challenges. In future we focus our research for creating applications such as smart home or office or university etc..without any technical challenges by using the advanced embedded systems or by efficient soft computing techniques.

References:

1) http://en.wikipedia.org/wiki/Pervasive_Computing

2) Debashis Saha and Amitava Mukherjee *"pervasive computing: A Paradigm for 21st century" Published by the IEEE Computer Society,March 2003,* **0018-9162.**

3) Federal office for information security "Pervasive computing:Trends and Impacts" SBN 3-922746-76-4 .,www.bsi.bund.de ,2006.

4) http://www.doc.ic.ac.uk/~mss/UbiquitousComputing.pdf ,2003.

5) Munirul Haque and Sheikh Iqbal Ahamed "Security in Pervasive Computing: Current Status and Open Issues", International Journal of Network Security, Vol.3, No.3, PP.203–214, Nov. 2006