Chapter 1
Recent Trends in Pervasive and Ubiquitous Computing: A Survey

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ABSTRACT

Pervasive computing is the trend towards increasingly ubiquitous connected computing devices in the environment, a trend being brought about by a convergence of advanced electronic – and particularly, wireless - technologies and the Internet. Pervasive computing devices are not personal computers but very tiny - even invisible - devices, either mobile or embedded in almost any type of object imaginable, including cars, tools, appliances, clothing and various consumer goods – all communicating through increasingly interconnected networks. In the future these smart devices will maintain current information about their locations, the contexts in which they are being used, and relevant data about the users. The goal of researchers is to create a system that is pervasively and unobtrusively embedded in the environment, completely connected, intuitive, effortlessly portable, and constantly available. Among the emerging technologies expected to prevail in the pervasive computing environment of the future are wearable computers, smart homes and smart buildings. Among the myriad of tools expected to support these are: application-specific integrated circuitry (ASIC); speech recognition; gesture recognition; system on a chip (SoC); perceptive interfaces; smart matter; flexible transistors; reconfigurable processors; field programmable logic gates (FPLG); and micro electromechanical systems (MEMS).

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PERVASIVE COMPUTING MODEL

The technological advances necessary to build a pervasive computing environment fall into four broad areas: devices, networking, middleware, and applications.

Devices

An intelligent environment is likely to contain many different device types:

- Traditional input devices, such as mice or keyboards, and output devices, such as speakers or light-emitting diodes;
- wireless mobile devices, such as pagers, personal digital assistants, cell phones, palmtops, and so on;
- Smart devices, such as intelligent appliances, floor tiles with embedded sensors, and biosensors.

Ideally, pervasive computing should encompass every device worldwide that has built-in active and passive intelligence.

Pervasive Networking

The number of pervasive devices is expected to multiply rapidly over the next few years. There will be more than 300 million PDAs; two billion consumer electronic devices, such as wireless phones, pagers, and set-top boxes; and five billion additional everyday devices, such as vending machines, refrigerators, and washing machines embedded with chips and connected to a pervasive network. As a consequence of this proliferation, many current technologies must be revamped. In addition to extending the backbone infrastructure to meet the anticipated demand, global networks like the Internet also must modify existing applications to completely integrate these pervasive computing devices into existing social systems.

Pervasive Middleware

Like distributed computing and mobile computing, pervasive computing requires a middleware "shell" to interface between the networking kernel and the end-user applications running on pervasive devices. This pervasive middleware will mediate interactions with the networking kernel on the user's behalf and will keep users immersed in the pervasive computing space. The middleware will consist mostly of firmware and software bundles executing in either client-server or peer-to-peer mode. User interfaces are another aspect of middleware. Standard Web browsers represent the high end of interface sophistication. They use more color, graphics, and controls than users typically expect on pervasive devices. Mobile computing has already introduced micro-browsers.

Pervasive Applications

Pervasive computing is more environment-centric than either Web-based or mobile computing. This means that applications will guide the middleware and networking issues to a large extent. Consider a heart patient wearing an implanted monitor that communicates wirelessly with computers trained to detect and report abnormalities. The monitor should know when to raise the alarm, based on its knowledge about the environment. So this is much more than simple wireless communication.

PERVASIVE COMPUTING TECHNOLOGIES

Perceptual Interfaces

Gaze Tracking

Attentive user interfaces are related to perceptual user interfaces (PUI), which incorporate Multimodal input, multimedia output, and human-like perceptual capabilities to create systems with