

Pervasive Computing goals and its Challenges for Modern Era.

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Abstract

The information age was born a scant 50 years ago and – with the realities of *Moore's Law* – is already permeating our way of life. Now we are entering the age of the *Pervasive (or ubiquitous)* computing which is a concept based on a vision described by *Mark Weiser* nearly a decade ago. "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" – so began Mark Weiser seminal 1991 paper that described his vision of ubiquitous computing, now also called pervasive computing. The essence of that vision was the creation of environments saturated with computing and wireless communications capability, yet gracefully integrated with human users. Many key building blocks needed for this vision are now viable commercial technologies: wearable and handheld computers, high bandwidth wireless communication, location sensing mechanisms, and so on.

Keywords: pervasive computing

1. Introduction

Computing is no longer a discrete activity bound to a desktop; network computing and mobile computing are fast becoming a part of everyday life and so is the Internet. Rather than being an infrastructure for computers and their users alone, it is now an infrastructure for everyone. We expect devices like *PDA*s (Personal Digital Assistants), mobile phones, offices PCs and even home entertainment systems to access information and work together in one integrated system and the challenge is to combine these technologies into a seamless whole and on the Internet. The aim of Pervasive Computing is for computing available wherever it's needed. It spreads intelligence and connectivity to more or less everything. So conceptually, ships, aircrafts, cars,

bridges, tunnels, machines, refrigerators, door handles, lighting fixtures, shoes, hats, packaging clothing, tools, appliances, homes and even things like our coffee mugs and even the human body and will be embedded with chips to connect to an infinite network of other devices and to create an environment where the connectivity of devices is embedded in such a way that it is unobtrusive and always available. Pervasive computing, therefore, refers to the emerging trend toward numerous, easily accessible computing devices connected to an increasingly ubiquitous network infrastructure.

Pervasive computing aims to make our lives simpler through the use of tools that allow us to manage information easily. These "tools" are a new class of intelligent, portable devices that allow the user to plug into powerful networks and gain direct, simple, and secure access to both relevant information and services. Pervasive computing devices are not personal computers as we tend to think of them, but very tiny - even invisible - devices, either mobile or embedded in almost any type of object imaginable; all communicating through increasingly interconnected networks. Information instantly accessible anywhere and anytime is what Pervasive Computing is all about!

2. What's the difference between a traditional networking and a pervasive computing?

These connections are fundamentally unlike those we associate with networks. Rather than using the network to connect computers that are being used directly by people, these appliances communicate over networks such that people do not directly monitor the communication between machines and programs. The majority of these communications will occur in an end-to-end structure that does not include a human at any point.

The number of machines connected to the Internet has been increasing at an exponential rate and will continue to grow at this rate as the existing networks of embedded computers, including those that already exist within our automobiles, are connected to the larger, global network, and as new networks of embedded devices are constructed in our homes and offices. The kinds of devices that will be used to access the Internet are no longer confined to desktops and servers, but include small devices with limited user interface facilities (such as cell phones and PDAs); wireless devices with limited bandwidth, computing power, and electrical power; and embedded processors with severe limitations on the amount of memory and computing power available to them. Many of these devices are mobile, changing not only geographic position, but also their place in the topology of the network.

Unlike traditional Desktop Computers and existing networks, the new devices will have the following characteristics:

- Many will have small, inexpensive processors with limited memory and little or no persistent storage.
- They will connect to other computing elements without the direct intervention of users.
- Often, they will be connected by wireless networks.
- They will change rapidly, sometimes by being mobile, sometimes by going on and offline at widely varying rates. Over time, they will be replaced (or fail) far more rapidly than is now common.
- They will be used as a source of information, often sending that information into the center of the network to which they are attached.

2.1 The advantages of Pervasive Computing

We increasingly rely on the electronic creation, storage, and transmittal of personal, financial, and other

confidential information, and demand the highest security for all these transactions and require complete access to time-sensitive data, regardless of physical location. We expect devices -- personal digital assistants, mobile phones, office PCs and home entertainment systems -- to access that information and work together in one seamless, integrated system. Pervasive computing gives us the tools to manage information quickly, efficiently, and effortlessly.

It aims to enable people to accomplish an increasing number of personal and professional transactions using a new class of intelligent and portable appliances or "smart devices" embedded with microprocessors that allow users to plug into intelligent networks and gain direct, simple, and secure access to both relevant information and services. It gives people convenient access to relevant information stored on powerful networks, allowing them to easily take action anywhere, anytime.

Pervasive computing simplifies life by combining open standards-based applications with everyday activities. It removes the complexity of new technologies, enables us to be more efficient in our work and leaves us more leisure time and thus pervasive computing is fast becoming a part of everyday life.

3. Ongoing Research

A number of leading technological organizations are exploring pervasive computing. *Xerox's Palo Alto Research Center (PARC)*, for example, has been working on pervasive computing applications since the 1980s. Although new technologies are emerging, the most crucial objective is not, necessarily, to develop new technologies. *IBM's project Planet Blue*, for example, is largely focused on finding ways to integrate existing technologies with a wireless infrastructure. *Carnegie Mellon University's Human Computer Interaction Institute (HCII)* is working on similar research in their *Project Aura*, whose stated goal is "to provide each user with an invisible halo of computing and information services that persists regardless of location." *The Massachusetts Institute of Technology (MIT)* has a project called *Oxygen*. MIT named their project after that substance because they envision a future of ubiquitous computing devices as freely available and easily accessible as oxygen is today.

3.1 What is this next generation going to look like?

Today the uses of Internet are limited as its users look for read-mostly information. As we move to a world where the Internet is used as an infrastructure for embedded computing, all this will change. We can hypothesize that the individual utility of mobile communication, wireless appliances and the respective mobile services - pervasive technologies in general - will be exploited through a digital environment that is –

- aware of their presence
- sensitive, adaptive and responsive to their needs, habits and emotions
- and ubiquitously accessible via natural interaction .increasingly, many of the chips around us will sense their environment in rudimentary but effective ways. For Example -
- Cell phones will ask the landline phone what its telephone number is and will forward our calls to it.
- Remote computers will monitor our health statistics and will determine when one is in trouble and will take appropriate action for rescue.
- Amplifiers will be implanted and used in the inner ear.
- New machines that scan, probe, penetrate and enhance our bodies will be used.
- Refrigerators will be connected to the Internet so one could find out, via cell phone or PDA, what is in it while one is at the store. A refrigerator may even sense when it is low on milk and order more directly from the supplier or rather than this, the connection will enable the manufacturer to monitor the appliance directly to ensure that it is working correctly and inform the owner when it is not.
- Stoves will conspire with the refrigerators to decide what recipe

makes the best use of the available ingredients, and then guide us through preparation of the recipe with the aid of a network-connected food processor and blender. Or they will communicate to optimize the energy usage in our households.

- Cars will use the Internet to find an open parking space or the nearest vegetarian restaurant for their owners or to allow the manufacturer to diagnose problems before they happen, and either inform the owner of the needed service or automatically install the necessary (software) repair.
- Wrist watches will monitor our sugar.



- *Digi-tickers* or implanted heart monitors in heart patients will talk wirelessly to computers, which will be trained to keep an eye open for abnormalities.



- In a nutshell, our personal network will travel around with us like a surrounding bubble, connecting to the environment through which we move and allowing our mobile tools to provide us with more functionality than they ever could alone.

4. Conclusions

Pervasive computing provides an attractive vision for the future of computing. Well, we no longer will be sitting down in front of a PC to get access to information. In this wireless world we will have instant access to the information and services that we will want to access with devices, such as *Smartphone's, PDAs, set-top boxes, embedded intelligence* in your automobile and others, all linked to the network, *allowing us to connect anytime, anywhere seamlessly, and very importantly, transparently*. Computational power will be available everywhere through mobile and stationary devices that will dynamically connect and coordinate to smoothly help users in accomplishing their tasks.

We are heading toward a reality that plays like a scene from *Star Trek*. We may have difficulty envisioning these possibilities, but they are not remote anymore. Technology is rapidly finding its way into every aspect of our lives. Whether it's how we shop, how we get from one place to another or how we communicate, technology is clearly woven into the way we live. Indeed, we are hurtling "towards pervasive computing".

When Edison finally found a filament that would burn, did he see the possibility of silent but pervasive electrical current flowing throughout our homes, cars and communities?

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