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Pervasive Computing

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ABSTRACT : *Pervasive computing refers to the embodiment of computing devices into physical objects connected into networks and these devices communicate with each other without any interactions required by the user. It plays a major role in our daily lives and has a vast range of applications in many fields. This paper presents a brief introduction to pervasive computing.*

Key Words : *pervasive computing, ubiquitous computing, Internet of things*

I. INTRODUCTION

Pervasive computing (PvC), also synonymously known as ubiquitous computing, deals with computers that are accessible anywhere and anytime. (Pervasive means "penetrate everywhere"). It is fundamentally shifting the computing paradigm toward everywhere computing. It allows the vision of invisible computation that weaves into the fabric of day-to-day life to be an objective within reach. It is so pervasive that it covers all aspects of human activity and becomes so banal as to be seemingly invisible. The term "ubiquitous computing" was coined in1988 by Mark Weiser, then chief technology officer for Xerox's Palo Alto Research Center. He described a future where invisible computers would be embedded in objects to enable everyday activities. The terms ubiquitous and pervasive signify "existing everywhere. Pervasive computing is an advanced computing paradigm which makes computing available everywhere and anywhere. Unlike desktop computing, pervasive computing can occur using any device, in any location at anytime. Pervasive computing is about making our lives simpler by creating environments that are sensitive, adaptive, and responsive to human needs. Both wired and wireless devices can be used to provide service.

The main idea behind pervasive computing is that almost any device (ranging from home appliances to cars to the human body) can be imbedded with microchips (or microprocessors) to connect the device to a boundless network of other devices. The goal of pervasive computing is a billion people interacting with a million businesses online via a zillion intelligent, interconnected devices. Pervasive computing devices are network-connected and always available. It is useful to think of the devices as forming a three-tier pyramid with each tier representing a different device class, as shown in Figure 1 [1]. Pervasive computing subsumes Internet of Things (IoT); it covers all that IoT covers and more. It is assumed that IoT will be one of the main requirements of pervasive computing. As pervasiveness increases, IoT will become "Internet of Things and People" [2]. Technologies that enable pervasive computing include wireless communications, mobile computing, voice recognition, global networking, artificial intelligence, embedded systems, wearable computers, sensors, and RFID tags.

II. APPLICATIONS

The technological advances required to develop a pervasive computing environment fall into four broad areas [3]:

- **Devices:** These include of light-emitting diodes (LEDs), palmtops, mobile devices, cell phones, smart devices, and embedded sensors. These devices will have small, inexpensive processors with limited memory and little storage.
- **Networking:** The pervasive computing devices will be connected by networks without the direct intervention of users. Global networks like the Internet must integrate these devices into existing social systems.
- **Middleware:** The middleware consists mostly of firmware and software bundles designed to support application development. Middleware resides between the operating system and the application layer. It helps the programmer develop applications in several ways.
- **Applications:** Applications are often developed for specific system platforms, leading to separate versions of the same application for handhelds, desktops, and cluster-based servers.

Although pervasive computing can be applied in almost every aspect of human life and activity, only few applications are currently made. This lack of applications stems largely from the fact that it is currently too hard to design, build, and deploy applications in the pervasive computing environment. In spite of this, a significant number of prototypes, applications, and interaction interfaces have emerged. Pervasive computing applications have expanded from smart appliances in the early days to systems of broader scope such as smart cities and smart transportation.

They include smart-spaces, logistics, health-care, elderly care, assisted living, and entertainment. Pervasive computing has be used to address common challenges faced by those caring for individuals with autism or elderly individuals with chronic conditions, such as diabetes or cancer [4]. The introduction of pervasive computing into car technology provides better security, safety, comfortableness, and conveniences for drivers. Microprocessors can be found in almost any subsystem of a car, and the applications of embedded computers in enhancing the qualities of cars. Pervasive computing is also used in car to find free space for parking the car [5].

III. ISSUES AND CHALLENGES

Pervasive computing introduces some challenges that are not present in traditional desktop computing. Privacy is the most often-cited challenge of pervasive computing and may be the greatest barrier to its long-term success. Since pervasive computing devices will be everywhere and will affect every aspect of our life, they introduce many privacy risks at a rate that social and legal mechanisms norms cannot keep up [6]. The privacy may be in form of threats to the loss of control over personal information. In order to enjoy a distraction-free experience, users may have to sacrifice some of their privacy. Another related problem with pervasive computing is that devices and technologies do not lend themselves well to typical data security because they are combined in an ad hoc manner. Pervasive computing poses some potential risks to health, society, and environment, particularly in emission of electromagnetic radiation, stress on users, and threats to ecological sustainability [7]. Battery powered computing devices are limited by their energy efficiency. This raises design questions in terms of the energy transmission's range, physical size of the transmitters and receivers. Wireless energy transfer (using Qi chargers that exploit magnetic induction and resonance) is a promising solution when recharging is necessary and feasible [8]. Mobility in pervasive computing introduces severe constraints on resource supply and usage. Mobility is the ability to guarantee uninterrupted computing experiences when users move across devices. It breaks down all fixed and static bindings between the user, device, application and environment. But in order to support seamless application mobility, one must face some challenges in breaking the bindings between users, devices, and the execution environments [9].

IV. CONCLUSION

Pervasive computing is a multidisciplinary field which has evolved substantially since its inception. It is gaining attention in academia and industry. It is being taught at several institutions. It's impact on education, cannot be ignored [10]. Personalized learning can benefit from the ability of pervasive computing to transparently collect and utilize information about a student's background, interests, and needs. More information on pervasive computing is available in several books in Amazon.com and journals. Two major journals are exclusively devoted to providing information on pervasive computing. They are *IEEE Pervasive Computing* and *Pervasive and Mobile Computing* Journal (PMC). These are professional, peer-reviewed journals that publish articles covering all aspects of pervasive computing. They are designed for researchers, practitioners, and educators.

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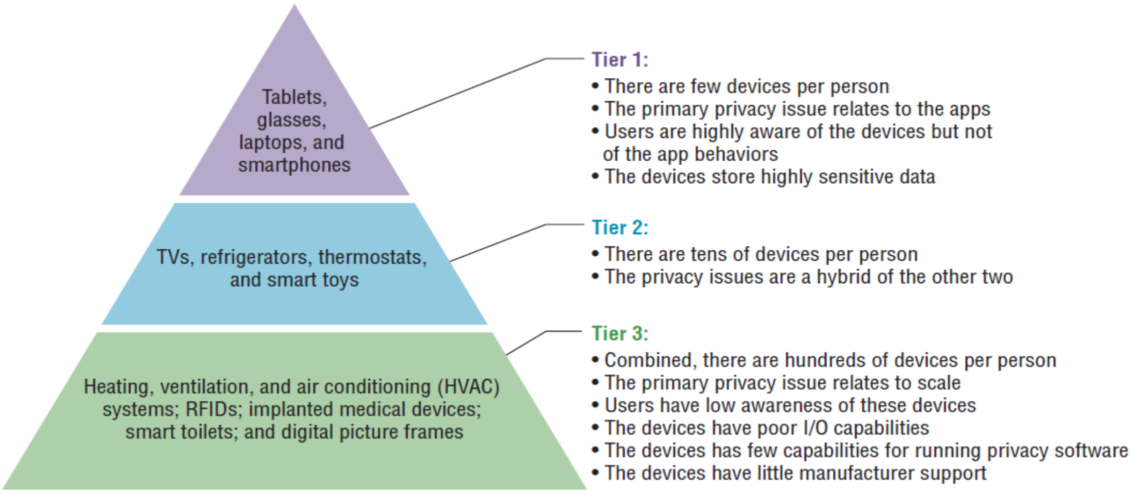

Figure 1: The three tiers of pervasive computing [1].