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SHIFTING PARADIGM FROM MOBILE COMPUTING TO UBIQUITOUS/PERVASIVE COMPUTING

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ABSTRACT: - 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. The aim of this research paper has been to throw light on how the future of human beings will be governed in the light of Ubiquitous/Pervasive Computing. The difference between mobile computing and pervasive computing are highlighted. The working in a Ubiquitous Environment through the use of sensors in different environments is also explained with the help of a figure. Two more technologies Zigbee for connecting multiple devices together and Near Field Communication (NFC) that leverages RIFD are also highlighted. The classification of ubiquitous/pervasive systems into infrastructural and personal systems has been defined. The applications of Pervasive/Ubiquitous systems in different areas have been highlighted. The challenges which this concept faces in terms of risk and security associated with them are brought into light. In the end how pervasive computing can change the mobile environment by sensing and analysis of human behavior are summarized in the form of a conclusion.

Keywords: - Mobile Computing, Pervasive Computing, Ubiquitous Computing, Sensors, Computing Devices

1. INTRODUCTION

The term "ubiquitous computing" was first introduced by Mark Weiser, a researcher at Xerox's Palo Alto Research Center (PARC). In an article in Scientific American in 1991, Mark Weiser said, "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" [1]. Pervasive Computing is an architecture and marketing concept predominantly promoted by IBM (presently) to connect mission-critical SAP applications and databases from pervasive devices (PDAs, Palm Pilot, Windows CE and smart telephones) using IBM mobile software technology[8]. Beyond mobility, today we have entered the era of pervasive computing, where scalability and localization have been added to mobility. We are moving toward integrating these technologies with context awareness and adaptability, resulting in smarter devices—and leading to ubiquitous computing. Ubiquitous computing is also known as ubicomp and it is a post-desktop model where information processing has been placed into every day activities or objects. The process is also known as pervasive computing, everywhere, and ambient intelligence. Pervasive computing involves devices like handhelds -- small, easy-to-use devices -- through which we'll be able to get information on anything and everything. That's the sort of thing that Web-enabled cell phones promise. Ubiquitous computing, though, eschews our having to use computers at all. Instead, it's computing in the background, with technology embedded in the things we already use. That might be a car navigation system that, by accessing satellite pictures, alerts us to a traffic jam ahead, or an oven that shuts off when our food is cooked [2]. Mark Weiser's thoughts ring true as we see more and more smart devices integrating with each other in the background and behaving as one [1]. For the past 20 years, the pervasive computing community has developed technology that allows sensing, computing, and wireless communication to be embedded in everyday objects, from cell phones to running shoes, enabling a range of context-aware applications. While these apps are useful, the time has come to develop the next generation of pervasive computing systems. These future systems will support applications that have much deeper awareness of users and their activities, context, and goals. They will be able to learn and adapt continuously to user’s habits, routines, and preferences. These future apps will be capable of supporting complex tasks, such as cooking a soufflé or building a complicated piece of furniture. In the process, they will deliver far richer user experiences than the technologies of today can offer. Some of this is already happening. When one enters his office, the lights come on automatically. When one leaves, they go off. In the near future, several actions may be triggered as one set out to work: the smart car will suggest the optimal route by assessing the traffic along a smart city network. As one swipe his card at the portal, his assistant will receive an alert and the office temperature will adjust to one’s preference. When many smart devices connect, there will be an intelligent environment- “the world of ubiquitous computing”! .The goal of this is to contribute to the advancement of ubiquitous information societies, where computers and humans are part of the same ecosystem [3]. One crucial property of entities living in the same ecosystem is that they mutually influence and affect each other's behavior in a variety of ways. One of the advantages of the use of ubiquitous computing is that it is designed to place computers into a human environment instead of making humans enter computer environments and adding extra stress to learning the process. Another advantage of the use of ubiquitous computing is the inexpensive processors that are used that require very little memory and have persistent storage. The processing removes complexity and allows users to be more efficient when using the computing for everyday activities or work. It also allows real time attributes to be captured [5].

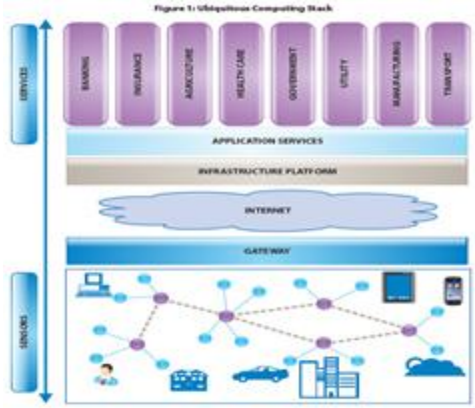
2. DIFFERENCE BETWEEN MOBILE COMPUTING AND UBIQUITOUS /PERVASIVE COMPUTING

1. Mobility sets you free to connect and use smart devices while on the move while ubiquitous computing lets the environment connect to you in many unobtrusive ways.
2. Mobility took computers from the desktop and put them on your lap and in your palm and pocket. Ubiquitous computing sends information seamlessly into your environment, where numerous tiny devices monitor you, connect with you, and even think for you.
3. While current mobility patterns are based on menu-driven, GUI-based tools (however small), ubiquitous computing holds the promise of understanding natural human interactions such as presence, movement, or speech [3].

3. HOW UBIQUOTOUS/ PERVASIVE COMPUTING WORK?

For these devices to usher in true ubiquitous computing, two closely linked concepts must be understood: the Internet of Things (IoT) and Machine-to-Machine (M2M) communication. The IoT involves connecting ordinary things, equipped with sensors, to the Internet. The IoT can be seen as an implementation framework for ubiquitous computing. The specific object-identification, addressing, sensor, and connection capability will serve as the basis for the development of independent and federated services and applications. M2M communication is a specific subset of the IoT, where two machines talk to each other, mostly over the Internet, and exchange data. The IoT creates a horizontal system for connecting devices, networks, service enablers, and applications. Together these two concepts lay the foundation for deploying heterogeneous devices and integrating them across a homogeneous network and service infrastructure. The success of ubiquitous computing rests with the proper integration of various components that talk to each other and behave as one. The Figure 1 shown below shows such a ubiquitous computing stack. At the bottom of the stack is a “physical” layer. Tiny sensors are attached (carried, worn, or embedded) to people, animals, machines, homes, cars, buildings, campuses, and fields. Today, some smartphones come with a host of sensors that capture various bits of information from the immediate surroundings. Beyond the microphone and camera, they integrate multiple sensors such as GPS, accelerometer, compass, and so on.

Figure 1: Ubiquitous Computing Stack



Above the sensors lies the wireless communication infrastructure, which can be provided by the 802.11 family of networks. Newer standards such as 802.11 have lower latency. Together with mesh networks, such standards ensure the connectivity of sensors and devices. Another technology called ZigBee is a low-cost alternative for keeping multiple devices connected, allowing parent devices to wirelessly control child sensors. Near field communication (NFC) is yet another technology standard that leverages RFID and can be used for ubiquitous computing, especially in scenarios where non-battery-operated passive points are concerned. NFC-powered devices can also interact with one another. The next level includes a range of application services. The data from the sensors and handheld devices is gathered, mined, and analyzed for patterns. The patterns help provide options to smart applications that proactively make changes to environments through smartphones, tablets, netbooks, notebooks, handhelds, or other smart devices. The smartphone, for instance, can transform itself into a barcode or quick response (QR) code reader to identify and get details of a product from a retail store, or display the barcode of your airline ticket so that the barcode code reader at the check-in kiosk can read it and issue a boarding pass [3].

4. CLASSIFICATION OF UBIQUITOUS/ PERVASIVE COMPUTING SYSTEMS

Pervasive computing systems can be classified in two ways: as an infrastructure or personal system. Infrastructure systems are well suited to create smart environments such as classrooms that automatically record, index, and publish lectures to the web; conference rooms that allow presenters to effortlessly present slide-shows, write on an electronic white board and move between various control points; and homes that suggest the best techniques for warming and cooling, while maintaining optimal energy efficiency. Personal systems are carried and interact with other devices and people on an ad-hoc basis. Infrastructure systems have been developed to monitor the elderly in specially designed residences. Not only does these assist elderly caretakers, but also gives residents more freedom. Wearable computers coupled with a database infrastructure allow warehouse workers to easily inventory incoming and outgoing goods. Portable devices with wireless connectivity can offer location-specific information to tourists and residents, for example, listing all fast-food restaurants within three blocks [1].

5. UBIQUITOUS/PERVASIVE COMPUTING TECHNOLOGY SYSTEMS AND APPLICATIONS

Pervasive Computing will be accomplished through interdisciplinary, multi-faceted technology developments in the areas of [7]:

• Information access	• Mobility and networking
• Text retrieval	• Device discovery
• Multimedia document retrieval	• Wireless protocols
• Automatic indexing	• Security
• Pervasive devices	• Voice and video over IP
• Palm top computers	• Perceptive interfaces
• Smart badges	• Biometric person ID
• Electronic books	• Speech recognition
• User sensitive devices	• Gesture recognition

6. CHALLENGES OF PERVASIVE/ UBIQUITOUS COMPUTING

Most challenges of pervasive computing fall into five main classifications: attention, complexity, privacy, security, and extensibility. Other challenges in pervasive computing include the way social interaction is changed because of technology,"' methods for evaluating pervasive computing applications, development cycle issues,' the semantic Rubicon, costs, and hardware and software limitations (such as size and weight, energy use, user interface, and "disappearing software").In the study of pervasive systems and their components, there are consistent messages from public users concerning privacy and security. The advantage of pervasive computing is that computers are transparently integrated into people's lives, but this benefit raises the fear: what exactly are the computers doing? Research has found that people are generally willing to accept invasive technologies if the benefits are thought to outweigh the risks. It follows, then, that in order for a person to make this judgment, they must first fully understand both benefits and risks. Awareness of benefits and risks is a challenge for developers to show users, especially since pervasive computing is meant to be transparent in its workings. Development of real-world applications of pervasive computing requires teams with diverse backgrounds in the fields of computer science, computer and electrical engineering, human-computer interaction, and psychology, among others [4]. Before computers will be spread pervasively throughout environments, transparently integrating themselves as an extension of human ability, many of technical, psychological, and ethical challenges remain. However, in applications where user privacy and security are not at high risk, systems are already being implemented. The disadvantage of ubiquitous computing is the cost and it takes time to construct [5]. Many technical challenges remain, including the difficulty of assessing the long-term effects of interventions. Additionally, these systems require careful preservation of privacy and the maintenance of appropriate levels of control by users. Once the ethical and legislative framework is in place, researchers from different fields will have access to first-hand, empirical data on how computer-induced change works in realistic contexts, as well as to models and paradigms for initiating new projects for behavioral change.

7. CONCLUSION

The next great computing paradigm shift to pervasive computing is already well under way, and will have no less of an impact on industry, government and daily life than the personal computing revolution. Pervasive computing refers to the emerging trend toward numerous, easily accessible computing devices connected to an increasingly ubiquitous network infrastructure. This trend will likely create new opportunities and challenges for the Information Technology (IT) companies to place high-performance computers and sensors in virtually every device, appliance, and piece of equipment in buildings, homes, workplaces, and factories, and even in clothing. Within five years vendors will offer portable and embedded devices containing low-cost systems-on-a-chip (SOC) that include enough CPU, memory, and input/output logic to support execution of complex software applications interconnected via pico-cellular wireless communications. Pervasive computing will require a revolution in human-computer interaction and information access technologies for interacting with small, distributed, and often embedded devices which must present a unified interface to users. ITEO funds R&D projects that fall between basic research and product development. Ubiquitous computing, though evolving, is promising and cannot be ignored. This next wave in technology will forever change the way we interact with machines. Not only will we be connected always, from everywhere, but we are approaching a time where smart devices will take actions by predicting user inputs. To approach autonomous human-like behavior, machines must also be able to affect human behaviors and attitudes. Indeed, this possibility is intrinsic to the overall vision of machines acting as autonomous agents in constantly changing environments, which lies at the heart of research areas such as artificial intelligence, cognitive systems, embedded systems, ambient intelligence, and pervasive and ubiquitous computing. Such capabilities are also an essential ingredient for applications that aim to turn those technological and scientific advances into valuable services for users [6].

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