CHAPTER 1

Introduction to Pervasive and Ubiquitous Computing

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1.1 INTRODUCTION

The concept of pervasive computing emerged in 1996 through IBM research efforts, while the term "ubiquitous computing" was coined back in 1991 (Weiserm, 1991). Pervasive computing encapsulates a range of modern technologies, such as the Internet of Things (IoT), Cloud Computing, Green Computing, Automotive Computing, and Blockchain. These technologies find applications across diverse fields, including e-learning, e-health, and smart cities. Simply said, people today use a variety of devices to access, communicate, post, and upload content through technological platforms, such as smart phones and tablets (Satyanarayanan, 2001). While ubiquitous computing accurately depicts how technology is used in a way that is both widely accessible and compatible, pervasive computing specifically outlines how technology is employed in an invasive and stealthy manner (Lyytinen & Yoo, 2002).

The landscape of pervasive and ubiquitous computing is marked by significant technical challenges. With an array of devices being constantly connected and available, limitations in areas like memory, performance, cost, and energy consumption are critical factors that need to be addressed (Farooq et al., 2022).

Pervasive computing hinges on the convergence of three key technologies:

(1) Microelectronic technology, which empowers powerful devices with high resolution and less energy consumption.

(2) Digital communication technology, facilitating high bandwidth and swift data transfer rate at a cost-effective scale across global networks.
(3) Internet standardization, governed by various authoritative bodies and industries, helping create a well-defined models and frameworks that underpin seamless connectivity (Bell et al., 2009).

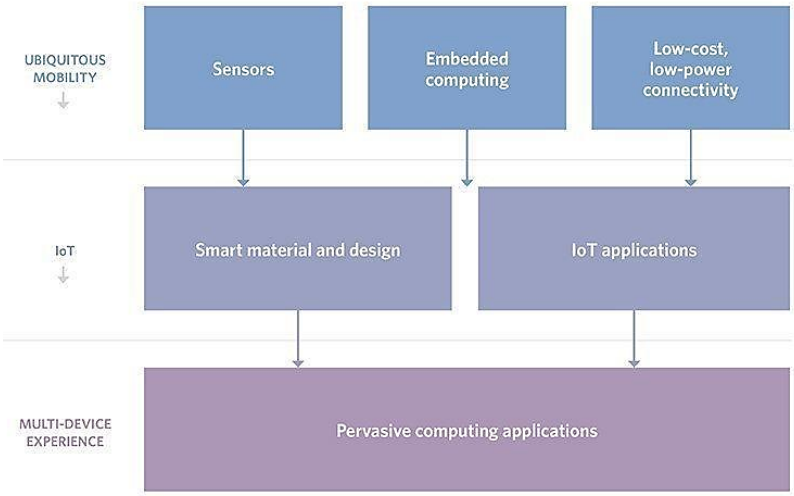

Figure 1.1 Pervasive and ubiquitous computing

However, the relentless advancement of technology also introduces novel terminologies that reshape that landscape. Notably, network technologies such as IoT, blockchain, and cloud computing play pivotal roles in enhancing the accessibility of accurate and secure information. The proliferation of pervasive computing, ubiquitous computing, and ambient intelligence exerts an increasing influence across diverse research domains, spanning areas like smart healthcare, smart homes, and active learning.

Pervasive computing offers a remarkable capacity to automate tasks, thereby amplifying efficiency and productivity in daily routines. Beyond efficiency gains, it substantially

enhances the quality of life by delivering timely information, bolstering safety measures, and fostering meaningful connections among individuals. Through pervasive computing technologies, data is safeguarded through secure sharing and storage mechanisms, effectively curtailing the risk of unauthorized access. Additionally, the technology contributes to optimizing network performance by minimizing latency and maximizing throughput. By facilitating more intuitive and natural interactions between people and computers, pervasive computing enhances user experiences.

As the journey of pervasive and ubiquitous computing unfolds, there arises a pressing need for future research endeavours. The deployment of these technologies holds vast potential, ranging from e-health and e-learning to e-tourisms, Industry 4.0, Industry 5.0, IoT, and blockchain integration. Within this Chapter 1, we delve into the foundational principles of pervasive computing in Section 1.2. Subsequently, Section 1.3 delves into the challenges and issues inherent to pervasive and ubiquitous computing, setting the stage for future research endeavours, The chapter concludes by encapsulating these insights in the final section.

1.2 PRINCIPLES OF PERVASIVE COMPUTING

Pervasive computing is guided by four fundamental principles (Hansmann et al., 2013), shaping its essence and functionality. These guiding principles underpin the core attributes of this paradigm, fostering a seamless integration of technology into everyday life.

1.2.1 Decentralisation

Decentralisation means all computing are done by basic and small devices that are unintelligent yet communicate in an open community where the structure of connections changes dynamically. It requires the distributed systems, synchronising