SMART COMPUTING

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ABSTRACT

Smart computing is an emerging multi-disciplinary area that employs hardware, software, communication networks and smart devices to realize innovative applications. It uses computing technology to design smart things that will make human life better. It solves the current issues like complex problems on the large data sets. New technologies are needed to support smart computing. Candidate technologies garnering attention include cloud computing and mobile Internet. This paper provides a brief introduction on smart computing.

Key words: Smart Computing, Smart Technologies.

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1. INTRODUCTION

We will soon realize a world in which the environment anticipates and adapts to usage and changes. Such smart environments are becoming a reality due to the rapid advancements in technologies. There have been emerging needs for advances in the underlying science, which we call smart computing and algorithms. New intelligent systems are often due to the fusion, hybridization, and adaptation of smart computing and algorithms. Smart computing (SC) should not be considered a brand new creation; it is rather an evolution as well as an extension of generations of computing. It is the next big wave, a fourth wave coming after mainframe, personal, and networked computing, as shown in Figure 1 [1]

 Today, we hear a lot about smart phones, smart homes, smart transportation, and smart cities. "Smart" means adding computing power to our phones, houses, or public facilities, and connecting them to a network such as the Internet. Smart computing refers to integrated hardware, software, and network technologies that provide IT systems with real-time awareness of the real world. The basic components of smart systems are networked devices for wearable computing, wireless and wireline sensor, next generation cellular networks, energy efficient computing, and sensing systems. Thus smart computing systems include smart phones, smart water systems, smart transportation,. smart grids, smart offices, smart factories, precision agriculture, and other societal applications contributing to smart living. These smart technologies continue making huge societal and economic benefits in many nontraditional areas.

2. CONCEPT OF SMART COMPUTING

Smart computing (SC) refers to systems that are not isolated but interconnected with communication networks, and capable of remote data collection, processing, exchange, and analysis. A smart system assumes sensing and computing capabilities that are interconnected and can collect, process, and evaluate data. Smart computing systems are built using a set of new and existing technologies. Smart computing can be classified into two major categories: how to design and build smart computing systems and how to use computing technology to satisfy all the needs of the society [2]

The five A's of smart computing are portrayed in Figure and explained as follows [1,3]:

- *Awareness:* New technologies such as RFID, GPS, sensors, embedded chips, video cameras, smart cards, and other tools will capture data on the identity, status, condition, and/or location of people and physical systems. SC provides IT systems with real-time awareness of the real world.
- *Analysis:* This is done using standard business intelligence tools. Analyzing and storing the massive amounts of data is only possible with the servers and storage devices enabled by server virtualization, data center automation, and storage life-cycle management.

- *Alternatives:* This refers to the decision-making process, i.e. evaluating alternatives and making decisions. Rules engines and workflow are the existing technologies for deciding which alternative courses to pursue, either automatically or through human review.
- *Actions:* These are based on the results of analysis, either automatic or with human intervention. The action may be as simple as placing a new order or as complex as adjusting thermostats in tens of thousands of households to avoid an electricity brownout.
- *Auditability:* This is a feedback system to ensure that the action has taken place, complies with legal regulations and company policies, and provides some way to evaluate for improvement. Technology needs to capture, track, and analyze information on each stage of this cycle.

3. APPLICATIONS

Smart computing is a multi-disciplinary area where advanced computational methods and technologies are used in designing and building smart computing systems, applications, and services that meet the needs of the society. It improves the performance of HVAC systems, data centers, vehicles, and other resource-intensive physical assets. Smart technologies have been of intense research in various application areas.

- *HPC Systems*: High-performance computing or high-productivity computing (HPC) refers to the use of supercomputers and parallel processing techniques for solving complex computational problems. It emerged to meet the need of increasing demands for processing speed. It is efficient in solving complex programs such as weather forecasting systems, medical systems, and aerodynamic simulations [4].
- *Cluster Systems:* Individual systems are connected to a common network and works for the common problem. Cluster system works on the cloud environments or shared networks. It serves to retrieve the static/ dynamic web pages, web services, and conventional distributed file system applications, where the data are taken as priority requirements [5].
- *Animal Welfare:* They can be used to track, monitor, and control pets and wild animals regionally or even globally. Wireless sensor networks are the dominant smart technology for monitoring the behavior and physical characteristics of animals. Wearable sensors are used for GPS-based tracking. Smart technologies can be used to learn from the animal world. It is well known that animals can provide early warnings for impending natural disasters like earthquakes, floods, and hurricanes, and diseases like heart attacks, cancer, or seizures [6].
- *Cost Optimization of Autotransformer:* Autotransformer is a main component of the power transmission system. It needs to be critically investigated to find a room for most economic and commercial viable manufacturing. Smart computing techniques, finite element method based simulation, and genetic algorithm may be applied to optimize transformer design [7].
- *Engineering Education*: Smart computing plays a major role in education sector for generating smart learning environments. It incorporates hardware, software, communication network, and smart technologies to realize various applications in education domain. Also, the advancements of computing technologies can lead smart computing to a new dimension and improve the way in which learning can be made more effective in engineering education [8].

These are just typical examples of SC applications that are emerging. Other application areas include business, healthcare, energy, transportation, environment, security, crowdfunding, surveillance, industrial systems, information retrieval, entertainment, and social activities.

4. BENEFITS AND CHALLENGES

Smart computing enables various networks and technologies to work together in unprecedented ways to solve complex business problems that the last generation of computing could not address. It adds to existing technologies new capabilities of real-time situational awareness and automation. SC is widely adopted because it allows businesses, governments, and organizations to tackle previously unsolvable critical problems. This will generates more revenues for businesses and governments. Rather than letting hardware and software systems be standalone, SC combinates them in order to allow computing technologies to become smarter [1].

However, smart computing is multi-disciplinary in nature and presents many challenges. Smart computing is complex, blending elements of hardware, software, and network technologies. Businesses and governments are slow in adopting new technology. The healthcare industry has been slow to adopt technology. New technologies like SC will be resistant to outsourcing.

5. CONCLUSION

Smart computing fosters innovations in computing science and technology. It will help us realize smart living, the next frontier toward a secure, sustainable society with healthy life experience. There is a need for computer science and engineering research in ultra-low power and ultra-low-cost hardware devices, and efficient algorithms for collecting and storing large amounts of data.

   With smart computing looming on the horizon, it is critical to recognize that end users and consumers will only accept it if they have control of the results. Businesses will adopt SC technologies if they help them address the key challenge of optimizing the value of their balance sheets. More information about smart computing can be found in the books in [9-13] and the magazine and journal devoted to it: *Smart Computing Magazine* and *International Journal of Smart Computing and Artificial Intelligence.*

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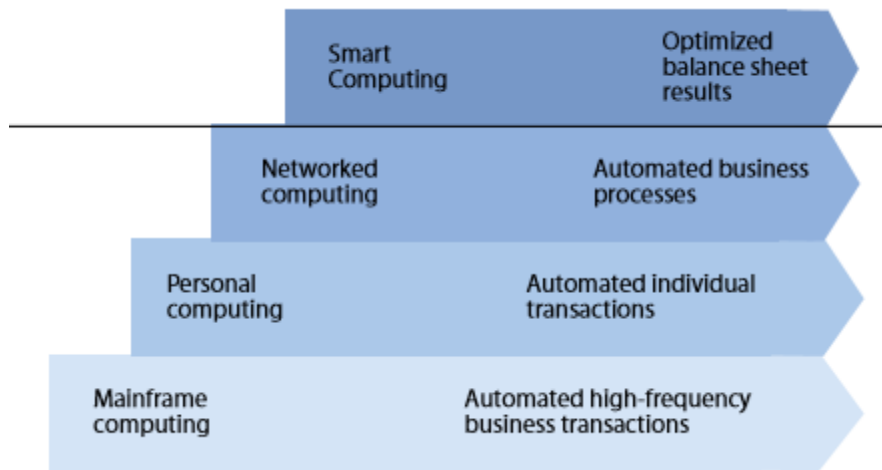
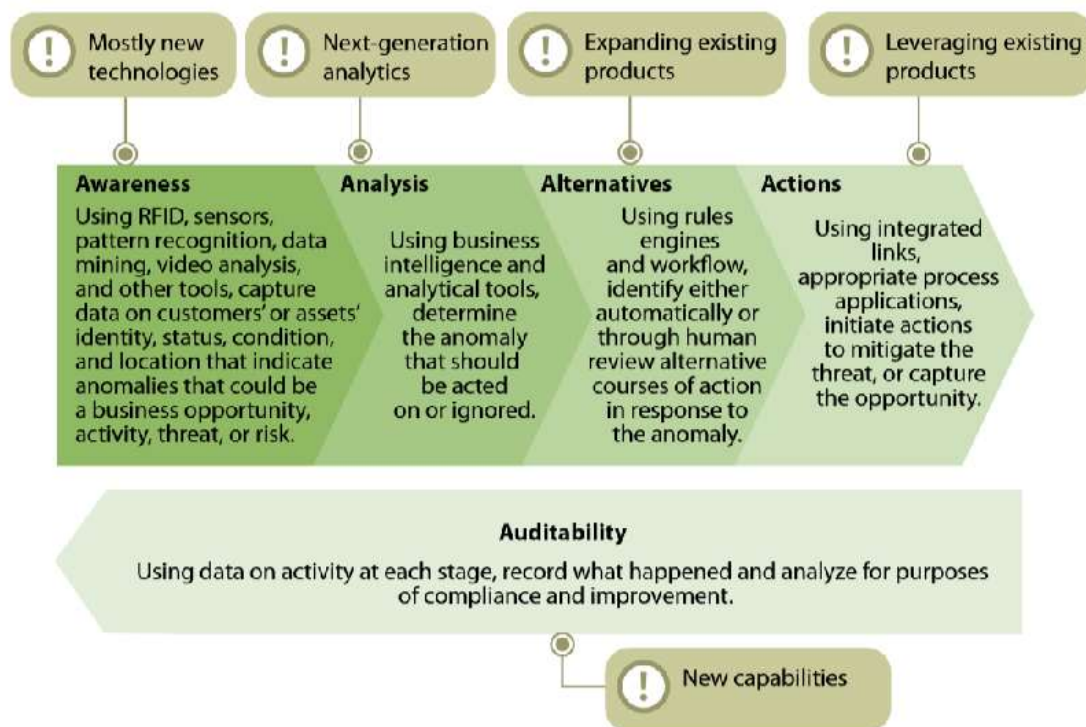**Figure 1   Smart computing is the fourth wave coming after mainframe, personal, and networked computing [1].**

Figure 2 The five A's of smart computing [1].