EMERGING TRENDS AND FUTURE COMPUTING TECHNOLOGIES: A VISION FOR SMART ENVIRONMENT

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Abstract: With the rapid technology augmentation, it becomes necessary to find complementary emerging computing technologies. This paper highlights future computing technologies, emerging trends and industry buzz to identify most prominent technologies in India. In the emerging technologies, the market is perceiving the entry of local vendors covering such areas as the Internet of Things (IoT), Robotic Process Automation offerings and Machine Learning based technologies. Some technologies are of transformational nature and result in the foundation of new ecosystem; these are "Internet of Things" with its associated applications and "Machine Learning". Technologies on innovation trigger take more time for wide market acceptance. The main objective of this paper is to present a future vision for a smart environment which can provide knowledge accumulation and new directions to new researchers in the related field.

Keywords: emerging trends; future computing technologies; edge computing; artificial general intelligence; deep learning; digital twin.

I. INTRODUCTION

We are blessed that we are living in rapidly growing and fascinating times. Technology advancement makes thinking artificial and realities look like the norm. From "Internet of Things" to Neuromorphic hardware, technology is incredibly changing our lives. Though there are a number of new and innovative technologies that are ongoing but still some of them are more promising and grounded in reality as compared to others. As per empirically correct Gartner, from these large numbers of technologies, some technologies show most prospective to deliver a modest advantage over the next coming years. Some of the technologies in near future (5 to 10 years) will be more dominating as compared to others, like “Artificial Intelligence Everywhere”, “Digital Platforms” and “Transparently Immersive Experiences”. Gartner identified some key technologies such as “IoT Platform”, 5G, “Quantum Computing”, “Serverless PaaS”, and “Software-Defined Security” [1]. It is the first time that Edge Computing is included in the Gartner hype cycle which aims to improve cloud service performance by leveraging intelligent computing procedures at specific locations viz. mobile user or embedded microsystem. In the next coming 10 years, Artificial Intelligence Everywhere will turn out to be the most disruptive technology as there is tremendous computing power which will be available along with neural networks adaptive ability and big data that no one has come across before [2].

Now a days, a number of new technologies are introduced like, Commercial drones, Edge Computing, Software Defined 5G adoption, Human Augmentation, Augmented Reality, Quantum Computing, Artificial General Intelligence Everywhere, Deep Learning, Software Defined Security, Digital Twin, Serverless PaaS, Machine Learning, and etc. Most of the newly introduced technologies make use of Internet of Things whereas some technologies merges two or more technologies to take the benefit of other. AI such future transforming technologies that can participate to make world smart are described in this paper in brief.

This paper highlights most dominating trends and technologies involved in the creation of smart environment that grow rapidly to change our future and requires attention and active participation.

The rest of the paper is structured as: Section II explains Gartner Hype Cycle and enumerates technologies on-the-edge and at-the-peak. How much time it takes a technology to come into existence/ adoption, is also explained. Main focus must be given to those technologies which are on the peak of the inflated expectations. Emerging trends and technologies are discussed in Section III. Section IV concludes the findings.

II. GARTNER HYPE CYCLE

A Hype Cycle is a way to represent the emergence, adoption, maturity, and impact on applications of specific technologies. It is a perception of technologies from the viewpoint of CIOs and senior IT leaders that are considered when transitioning to digital businesses. Fig. 1 depicts year 2017 Gartner Hype cycle for emerging technologies provide most significant technologies by assessing industry buzz and emerging technologies. As per Gartner Hype Cycle for the year 2017, there are a total of 26 key computing technologies. Some are at-the-peak and some are on-the-rise. First time, Edge Computing is also included with prominent technologies in the Hype cycle, for the year 2018.

In the hype cycle, “Human Augmentation” is at the opening of innovation trigger phase. Technologies like “Machine Learning”, “Blockchain”, “Drones” and “Software Defined Security” are still under emerging technologies since 2016. It is the Deep Learning tools that dominate around 80% of data scientists’ toolboxes in the upcoming years. Robotic Process Automation Offerings and Big Data are such technologies which becomes obsolete before plateau. Technologies like DevOps, Machine Learning, Smart City Framework, Internet of Things, Digital Commerce Platform,
Disaster Recovery as a Service, Virtual Desktop Infrastructure, Personalization Systems, and AIOps requires 5-10 years to mature and requires keen attention of new researchers, as these emerging techniques provide a good scope of work.

According to Gartner prediction, use of these tools will empower other augmented data discovery applications especially to learn on production data in real-time, and also enable data scientists to apply learned insights directly in IT and OT contexts.

![Hype Cycle for ICT in India, 2017](https://www.gartner.com/newsroom/id/3791063)

Figure 1. The Hype Cycle for ICT in India, 2017 (Source: https://www.gartner.com/newsroom/id/3791063)

Technologies like Internet of Things and Machine Learning are of transformational nature and these technologies along with their associated applications results in the foundation of new ecosystem. Technologies on innovation trigger take more time for wide market acceptance; these are Artificial General Intelligence Everywhere and Virtual Support Agents.

### III. Emerging Trends and Technologies

#### A. IoT Platforms

Internet of Things (IoT) connects physical things over a network to communicate information about things or their surroundings to which sensors are attached. In IoT, everyday objects are connected to a network providing enormous applications in almost all areas including smart homes, smart city, smart health, smart agriculture, smart transport, and etc. [3]. Authors in [4] discussed key enabling technologies that are expected to drive IoT research in the upcoming years. IoT has wide variety of scope in the near future in resource control, energy management, quality of service, interoperability, interface management, security and privacy [5].

#### B. Edge Computing

The rise of Internet of Things (IoT) and the realization of rich cloud services resulted a new computing paradigm, Edge Computing [6]. Working on both downstream data on behalf of cloud services and upstream data on behalf of IoT services, Edge Computing provides new horizon to various applications [7]. It provides way to work on high volumes of data created at the IoT edge and enables applications to perform Machine Learning (ML), Deep Learning, and Augmented Data Discovery in-context, where the data is being generated. By reducing cost and complexity progressively in the cloud, Edge Computing makes it easier to use Deep Learning visions in applications [8].

#### C. Virtual Reality

Virtual Reality systems uphold situated learning through the combined experience of interactive objects, environments and processes. It mainly focus on interactions with other humans and environment by providing virtual experiences and interactions [9].

#### D. Commercial UAVs (drones)

Drones are unmanned commercial aerial vehicles which are gaining importance in the area of society, science and technology with wide range of applications including surveillance, military, entertainment, videography and etc. It has an impact on our outset of security, privacy, and safety of individual and government processes [10]. Drones have some limitations like limited range and limited power, so it requires...
recharging at specified times for the seamless working of the device [11].

E. Software Defined 5G adoption

Software Defined Networks (SDN) has evolved to overcome the limitations posed by hardware-based designs which rely on closed and uncompromising cellular architecture. SDN 5G adoption has given a way to proficiently create centralized network construct with the provisioning of programmability over the entire network [12]. An SDN architecture, SoftAir is proposed by the authors in [13] for 5G wireless systems. It has some security issues which are discussed in [14] and it is assumed that Software Defined Mobile Networks will evolve as a big thing in mobile industry [15].

F. Artificial General Intelligence Everywhere

“Artificial General Intelligence” has a wide range of applications in areas including “Deep Learning”, “Deep Reinforcement Learning”, “Artificial General Intelligence”, “Autonomous Vehicles”, “Cognitive Computing”, “Commercial Drones”, “Conversational User Interfaces”, “Machine Learning”, “Smart Dust”, “Smart Robots”, and “Smart Workspaces”. So, it is known as “Artificial General Intelligence Everywhere” and in near future, it will breach all areas as a hi-tech service immersed in the cyberspace [2].

G. Deep Learning and Machine Learning

Complex and complicated data structures in big data are discovered by Deep Learning with the help of backpropagation algorithms. Deep convolutional nets have conveyed about developments in processing images, video, speech, and audio, whereas recurrent nets have excelled sequential data for instance text and speech [16]. Deep Learning is a kind of Machine Learning which assists computers to learn from understanding and experiencing the world as a hierarchy of concepts. In view of the fact that the computer collects knowledge from experience therefore human intervention for knowledge accumulation is not required. Concepts hierarchy allows computers to learn complex concepts from simpler ones by utilizing many deep layers [17] [18].

H. Digital Twin

Digital Twin idea refers to a comprehensive physical and functional description of a component, product or system. It takes in all information beneficial for current and following lifecycle phases [19] [20]. It is the cyber images of physical processes which are created by Digital Twin.

I. Serverless PaaS

PaaS stands for Platform-as-a-Service and Serverless PaaS is a hardware-free architecture which is introduced for the organization and management of cloud-computing processes [2]. Serverless computing is the next generation cloud technology well known as Function-as-a-Service (FaaS). Third party services widely known as Backend-as-a-Service (BaaS) or custom code that's run in transient containers known as FaaS are used in Serverless applications for accomplishing server’s tasks. FaaS by providing a cloud platform for development and management of applications without building infrastructure is a recent development.

J. Cognitive Computing

Cognitive Computing is a multidisciplinary research area which aims at planning computational models and decision-making mechanisms based on the neurobiological processes of the brain, cognitive sciences, and psychology [21].

K. Blockchain

The primary mechanism in a bitcoin is blockchain which serves as a civic ledger and has numerous applications including financial services, reputation system, public systems and government systems. Tampering of transactions in a blockchain is almost impossible. Main characteristics of blockchain are de-centralization, persistency, efficiency, secrecy, and auditability [22].

L. Human Augmentation

Word augmentation means enhancement so, “Human Augmentation” is a field related to come across limitations of the human body, naturally or artificially. This new and latest technology is generally used for augmenting capabilities of humans beyond existing human range.

M. Augmented Reality

“Augmented Reality” (AR) provides a live view of all real-world objects and physical objects. Through computer-generated perceptual information, elements are augmented preferably across multiple sensory modalities together with visual, auditory, haptic, and olfactory [23].

N. Quantum Computing

Computing by quantum-mechanical phenomena, like "superposition" and "entanglement", is known as Quantum Computing. It makes use of quantum computers which works on quantum bits rather than binary bits which can be in superposition of states.

O. Software-Defined Security

A recent paradigm is known as "Software Defined Systems" (SDSys), in computing technologies which work for providing a supple and centralized security solutions by conceptualizing the security solutions from the h/w layer to a s/w layer [24]. SDSys by significantly reducing the overhead in some operations (control and management) of a complex computing system has benefited the computing industry. In SDSys, data plane is isolated from the control plane to address the challenges faced by traditional security solutions like protection and efficiency.

Some other emerging trends and technologies include Autonomous Vehicles, Virtual Assistants, Smart Workspace and Neuromorphic Hardware.

IV. Conclusion

With the involvement of digitalization to a smart environment, a lot of new technologies are making their way through our lives making it better and better. In near future, more people and devices would be connected to each other. The world is heading for becoming a much better place to live with ever more communication with everyone across the world. This paper highlights most dominating trends and evolving technologies in the future computing that grow rapidly to change our future and requires attention and active participation. Some technologies show more prospective to deliver a modest advantage and most prevailing trends include Digital platforms, Artificial Intelligence Everywhere, Transparently Immersive Experiences and Internet of Things. This paper will provide new directions to the new researchers and major focus would be given to technologies requiring 5-10 years to mature.
V. REFERENCES


