Scienxt Journal of Recent Trends in Information Technology
Volume-2 || Issue-1 || Jan-Apr || Year-2024 || pp. 21-36

Latest technologies influencing the growth of the IT industry

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Abstract:

Technology is mainly characterized by being changed rapidly. In other words, it is recognized as the ever- changing playing field. Those who aim to stay in the technology field need to quickly get adapted to such constant changes in this field. Due to the high pace of information technology advances, it is required to identify and implement appropriate technologies by which the organizations can effectively stay and compete in the business through the accurate and real-time efficiency delivered by such technologies as cloud computing, internet of things (IoT), artificial intelligence, blockchain, big data analytics, virtual and augmented reality, 5g network, and, etc. These trends are critically important because turning and adapting to the latest trends in information technology and systems are largely contributing to meeting the consumers' technology-enabled demands. In this paper, the most widely used trends in information systems and technology will be discussed.

Keywords:

Information system, cloud computing, Internet of Things (IoT), Artificial Intelligence (AI), blockchain technology, virtual reality

1. Introduction:

New technology trends arise annually and systems need to get familiar with trending technologies to survive and grow in the competitive environment. Technologies such as cloud computing, the internet of things (IoT), artificialintelligence, blockchain, big data analytics, virtual and augmented reality, 5g network, and etc are broadly contributingto promoting existing information systems in different aspects. This survey paper aims to provide an overview of trending technologies in information systems, their characteristics, advantages, and challenges by referring to a number of papers that are specifically focused on this subject. Thus, researchers and practitioners in this field can read this paper that summarizes points of 98 papers to gain insight regarding trending technologies in information systems instead of reading 98 papers to understand the topic and gather the results of various studies. Therefore, a classification of existing literature, features, advantages, and challenges of each technology is provided to develop a perspective on the area and evaluate trends. To summarize each technology, five to eight papers are extracted as references through searching various digital libraries and getting deep into the work and points of research groups or faculties in the area. Then, papers that are related to each other in concept or are in the same field are picked. As the rate of growth in the technology area is fast, papers that are published in recent years are prioritized over other extracted papers. Then, the scheme of the survey paper is shaped based on classifications and relevant sections from each paper are extracted.

2. Artificial intelligence (AI):

According to John McCarthy, artificial intelligence is referred to as “the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence; however, AI does not have to confine itself to methods that are biologically observable”. AI makes use of computer and machine systems in combination with robust datasets to mimic the decision-making and problem-solving capabilities of humankind. In AI, massive amounts of labeled training data are fed into artificial intelligence systems, which evaluate the data to identify correlations and patterns, and then utilize these patterns to anticipate future circumstances.

Data-intensive techniques and rapid iterative processing enable AI to learn automatically from patterns or characteristics in data. Artificial intelligence programming relies on three

cognitive skills: learning, reasoning, and self-correction. Artificial Intelligence (AI) learning is based on the acquisition of data and the creation of rules on how to turn the data into applicable knowledge. Algorithms are rules that tell computers how to do a certain activity. Next, AI programming focuses on picking the appropriate algorithm to achieve a specific goal, which is called Reasoning. As the last point, AI programming employs self-correction algorithms that are constantly fine-tuned to produce the most precise results possible.

2.1. Use of AI:

There are two types of AI in terms of performance including weak and strong. Weak AI or artificial narrow intelligence (ANI) are AI algorithms that are implemented to accomplish sets of specific tasks and do not encompass thefull range of human cognitive capabilities. Accordingly, the term weak is referred to limited functionality. Thereis a lot of narrow AI around us, and it is by far the most effective implementation of artificial intelligence. Narrow AI has made major advances in the previous decade by focusing on particular activities which have had a positive impacton the economy of nations. Specific AI programs such as google search, image recognition software, Siri, and Alexa areaccounted as weak AI.

The advancements in the Narrow AI area can be majorly attributed to two subfields of deep learning and machine learning, specifically, deep learning is the evolution of machine learning. Although both terms are interchangeably used, there are delicate differences between them. Machine learning is attributed to the application of AI through the implementation of complex algorithms to analyze and learn from data and further apply those learning algorithms in decision-making.

The associated AI algorithms are developed to be learned with flowing data constantly to proceed withdecision-making practices with high accuracy. As the dataset implemented for training an AI system is larger, the associated algorithms processing and proceeding with informed decisions would be more accurate. However, as a potential way of training an AI system, structuring algorithms in specific layers called artificial neural networks would be efficient which is referred to as deep learning. Artificial neural networks are developed from the biological human brain's neural network.

This particular structured neural network is highly responsible for the unique characteristic of deep learning in comparison to basic machine learning systems. Deep learning serves similar functionalities butwith different capabilities. The self-awareness characteristics in deep learning systems are placed at a higher level in comparison to basic AI systems. In basic and conventional AI systems, if an inaccurate prediction results, human intervention will be

required to ensure the effective operation of the system while in deep learning a self-awareness exists through which an inaccurate function through neural networks can be identified with no human interference.

However, strong AI is referred to as a theoretical form of intelligent algorithm aiming to obtain an intelligent system that can perform at the level of human consciousness. This type of AI is aimed to accomplish and implement complex tasks with no human intervention and through a self-aware consciousness manner. However, all of the developed AI systems are accounted for as artificial narrow intelligence.

2.2. Impact of AI on information systems:

Computing with artificial intelligence determines the future and whatever it covers. Not only has artificial intelligence (AI) altered traditional computer processes, but it has also penetrated numerous sectors, causing them to undergo major transformations as well. Because of the increasing digitization of the globe and the increasing sophistication of all sectors, IT firms require to keep up with the increasing complexity of processes and the rapid speed of technological innovation. Accordingly, the integration of AI with information systems is responsible for unique advancements to solve the main challenges within these systems. AI is placed at the core of such developments through which it contributes to specific advantages including:

2.2.1. Highly enhanced security:

Information development and data security play pivotal roles in information systems management. The organizations involve and store large volumes of data and information regarding different areas including customers and strategic data which should be strictly secured. In this regard, AI can accurately specify the particular patterns through which the security systems are enabled to be learned and upgraded from past and existing experiences. Accordingly, it contributes to mitigation in the incident response time and also a significant reduction of costs associated with the recovery process which has been reported to be about $3.86 million for each data breach. Accordingly, AI contributes to improved cybersecurity through

(i) hunting the traditionally undiscovered threats,

(ii) identifying anomalous risk vulnerabilities via analyzing the baseline behavior of users and servers,

(iii) improving network security through implementing learning networks allowing for

efficient maintenance of network policies and network topography.

2.2.2. Improving the programming productivity:

Software development is an important practice in information systems through which various methodologies are employed. AI can profoundly contribute to strengthening software development through augmented coding. Augmented coding is generally referred to as an AI-powered tool aiming to enforce the coding process via covering compliance needs in the retrieval of codes, reusing them, and also over documentation. The implemented neural networks can provide suggestions through the coding process leading to enhanced productivity and also bug fixing. Along with contributing to the coding process, AI integration can profoundly play a critical role in other phases of software development including software testing and versioning. Since AI provideseffective predictions of possible issues, it can largely contribute to avoiding or fixing the anticipated problems during this stage and before the next stages.

2.2.3. Enhanced quality assurance:

Quality assurance plays an important role within software development lifecycles. There are various methodologies employed in developing specific software that mostly has an iterative behavior through which the program is tested in associated increments to ensure further responsiveness. According to the inherent characteristics of AI, during these iterative increments, it can profoundly enhance the effectiveness of the process as it can be learned and trained more and more.

2.2.4. Effective server optimization:

Since the hosting server is dealing with great amounts of requests ina constant manner. According to the constant flow of such requests, particular problems may result including the unresponsiveness of pages or reduced response speed in the long run. In this regard, AI can establish a highly optimizedsystem through which the effective operation of server requests can be established.

2.3. Challenges of AI on information systems:

Despite the beneficial impacts of AI on information systems, it also brings along several challenges and issues in information systems as well. AI alters data governance since it is reliant on data to learn and improve its performance. Thus, data governance is making significant shifts in the industry. Besides, a massive amount of data is collected from people from all over the world to be used for AI purposes. This data may be sensitive in case of fraud

or identity theft. To ensure the security and privacy of data that is collected for AI purposes, a solid infrastructure should be established. Another issue of AI is the ambiguity that can happen due to complex algorithms that lead to layers of variables and difficult-to-understand black boxes. Finally, data that is used as the food for AI is the potential to be biased and it may affect the information systems and decision-making processes as well. Leading to unethical and unfair conclusions.

3. Blockchain:

Blockchain technology was first implemented in 2009 which is simply regarded as a public ledger through which a chain of blocks is designed to store the committed transactions. This chain grows continuously as new blocks are joined to it. Although it was first introduced for cryptocurrency, it is now developed and applied in a vast range of areas, specifically information systems. It holds promise for specific supply chain management, allowing the presence oftransparency during materials development.

Blockchain is regarded as a sequence of blocks that, similar to a conventional public ledger, store a full list of transaction records. Each specific block is composed of a block header and a block body. The block header encompasses the block version indicating the validation rules to be followed, parent block hash, timestamp, nonce consisting of a 4-byte field increases with every hash calculation, and Merkle tree root hash demonstrating the hash value of the whole transactions within the block.

The block body comprises the transactions and their counters. The block size and each transaction size determine the exact number of transactions that can be held within a block. Fromthe structural point of view, there is a parent-child relationship between the blocks throughout the chain through which each block is characterized by a parent block (the immediately previous block). Through this relation, using a reference,each specific block refers to the immediately previous block which is particularly accounted for as a hash value of its parent block. However, in this chain of blocks, the first block is regarded as the genesis block which has no parent block.

Blockchain makes use of specific digital signatures to validate the authentication in transactions. More specifically,each user encompasses both a private and a public key. The transactions are signed via the private key. An associated hash value is first generated during the transaction signing which is further encrypted via the private key giving rise toa digital signature. This phase is referred to as the signing phase. While they are being spread

throughout the networkvia the public key. While these are sent to another user, the second user employs the first user's public key to establisha verification by comparing the public

4. Internet of things (IoT):

Decades after the introduction of ARPANET, the Internet now covers a remarkable range of applications established based on large sets of complex and interconnected computer networks. Along with the high pace of technological advancements today, communication and connectivity are no longer accounted as a challenge, and accordingly, the efforts have been shifted to seemingly incorporate the virtual environment into people and devices which is referred to as the Internet of Things (IoT). IoT is known as an important component of the 4th generation in industry developments. It is generally based on two pillars of things and the Internet. For more clarification, the term thing is a general concept that refers to every specific entity which exhibits a level of awareness of its own context and is capable of establishing communications with other entities in an already accessible manner. There are several specific characteristics that IoT suggests:

(i) **Connectivity:** IoT connectivity is referring to the connection and the interrelation between all points withinan IoT network. It exists in each level of associated networks, and it occurs at close ranges like between different devices, or large ranges like between device and cloud. Connectivity is a crucial and common feature of all definitionsof IoT, and it acts as the foundation of IoT. Within this concept, the volumes of data transmission and required power would contribute to determining the connectivity standards to be established and various types of network solutions implemented within this network [48-49]. The continuously growing IoT connectivity concept is now concentrating on fulfilling the demands of data-intensive settings dealing with customer Internet of Things applications equally, owing to the enormous amount and diversity of available alternatives. In a perfect world, the ultimate one-size-fits-all connection solution would enable gadgets to consume very little power. As a result, choosing the optimum solutions for a particular project usually entails striking a compromise between three key connection parameters: range, bandwidth, and power consumption. As a result, being able to detect the requirements of a project at every step of its deployment, as well as having a thorough understanding of IoT use, can considerably be assistive in selecting the optimal connection network for a specific smart organization. There are various connectivity solutions that, according to the associated needs, are used which mainly include cellular IoT, satellite, Wi-Fi, Bluetooth, and Ethernet.

(ii) **Intelligence and Identity:** Getting value out of data is crucial. When a sensor, for example, provides data, it is important to understand how to analyze it. A unique identifier is assigned to each IoT device. This identifier can be used to trace the equipment and, at times, to inquire about its condition and whereabouts.

(iii) **Scalability:** As an important goal of IoT is to broaden the network, it may include any "thing" that can be remotely found and recognized without the requirement for a communication middleman between these "things". Dueto the rapid advancement of new technologies, the device would inevitably become more scalable both horizontallyand vertically. Horizontal scalability is concerned with boosting the network capacity to handle a growing numberof hardware devices or software entities. Vertical scalability, on the other hand, refers to the capacity to increase the efficiency of current software or hardware by adding additional resources. The number of connected devices is growing at an exponential rate. As a result, an IoT setup should be able to handle the huge growth. In the end, there will be a huge amount of data that has to be managed appropriately. The fast-paced world is becoming increasingly technologically advanced, which means that the number of internet-connected gadgets is rising dramatically, as is the volume of data being moved over the web.

(iv) **Dynamic and Self-Adapting (Complexity):** IoT devices should be able to dynamically adapt to changing circumstances and settings. Assume that you have a camera that is used for surveillance. It should be able to function in a variety of environments and lighting conditions.

(v) **Architecture:** As a result, the IoT architecture cannot be homogenous. For the Internet of Things (IoT) to succeed, it should be hybrid, allowing devices from various manufacturers to work together. The Internet of Things (IoT) is not owned by any engineering department. When various domains join together, IoT becomes a reality.

(vi) **Safety:** A user's sensitive personal information might be compromised when all of his/her gadgets are connected to the Internet at the same time. The user may suffer a loss because of this. Therefore, data security is a key issue to overcome, and the equipment required is enormous as well. There is a possibility that IoT networks are also at risk of attack thus, the safety of the equipment is equally crucial.

4.1. Challenges of internet of things on information systems:

The Internet of Things is expected to make a significant impact on information systems; however, personal interaction and human activity are reduced considerably as the usage of

IoT increases. Smart environments, smart wearable devices, and smart cars are making significant shifts in lifestyle as long as getting people are more adaptable totechnology and intelligence. Over-reliance on the Internet that depends on the power supply to work may lead to make irreparable harm to human life. As more devices get connected to the Internet, the quality of services may be reduced accordingly that highlights the necessity of improving relevant infrastructure. Besides, security and privacy of data are critical to be considered in IoT technology which may jeopardize the stability of information systems seriously.

The interoperability of different types of devices that get connected to each other via a single IoT platform is another issueto consider while employing IoT in information systems. The employment of standard protocols and platforms can facilitate the compatibility of different IoT devices in information systems.

5. Cloud computing:

The use of digital data has become an important part of our daily lives, and it has a significant impact on our comfort and security. Organizational growth is dependent on managerial actions and tactics. However, adopting a strategy that would achieve the organizational goals after evaluating numerous facts is exceedingly challenging. As previously discussed, an excellent management information system is therefore utilized to store and analyze a large quantity of data and assist managers in developing a plan. One of the potential trends which strongly strengthens information systems management is cloud computing.

"Computing-Based Management Information System (CMIS)" is an information system that can handle a varietyof management-related tasks, deliver correct information to all levels of management in a company, as well as analyzevarious data.

5.1. Impact on information systems:

Similar to the impact of cloud computing on other aspects of businesses, it has a significant influence on the effectiveness of information systems. Because the Information System is used to increase the profitability of a company, cloud computing makes the Information System cost-effective and superior, making it more useful to an organization asa whole. The main influences of cloud technology on information systems are as follows:

5.1.1. Affordable infrastructure:

The expense of managing and maintaining an IT infrastructure might be prohibitivefor a company. In addition, it requires a team of highly skilled IT professionals to reduce downtime and guaranteethe security of the system. As a result, companies may store as much data as they want in the cloud without having to purchase huge, expensive physical storage devices. Businesses may save a lot of money by not having to acquire and maintain hardware. If an organization needs either public or hybrid cloud, they can pick any of the three options according to their needs and pay accordingly.

5.1.2. Information on the go:

To keep up with the ever-increasing client demands, modern firms need to be always on their toes, implementing new tactics and adopting new effective decisions. However, cloud computing has changed everything in this regard since it allows for on-demand access to all corporate information from anywhere in the globe, without requiring physical presence. All of your information is available through an internet-connected device whether you are at home, on a vacation, or on your way to or from the office.

5.1.3. Scalability:

It is critical for a firm to be able to scale up or down operations and storage requirements rapidly as needed to guarantee seamless business operations. While a typical management information system would necessitatethe acquisition and installation of hardware to meet the update, a cloud-based information system just necessitates a request to the cloud service provider, and the rest is handled for you. Cloud storage systems and applications are quickly updated by the service provider to ensure scalability and save a considerable amount of time and effort.

5.1.4. Improved integration and collaboration:

An efficient management information system typically necessitatesa business's collaboration with a third party. To draw meaningful conclusions from data, the firm may benefit from a new analytical application supplied by another company. It may also assist the company to provide superior service to the clients. This type of cooperation or integration would be impossible without the cloud since it would require third- party apps to be installed on systems that contain

the data and their IT personnel's physical access to the systems in order to draw the required conclusions. Leveraging the cloud enables seamless collaboration without forcing anybody to move a single inch from their current position, thereby eliminating the need for such transactions.

5.2. Challenges of cloud computing on information systems:

Since the cloud's inception, security has been one of the major concerns that cloud users face. The safety and security of user data are at risk from a variety of threats. In recent years an increase in cyber-attacks and data breaches has happened which puts cloud service providers at risk of losing their clients' confidential information. The most prevalent reasons for cyber assaults and account theft include insecure APIs, poor firewalls, and weak or insecure passwords, amongst many others.

(i) **Service Provider Dependency:** Independent cloud service companies provide hassle-free services to individuals and businesses alike. A corporation must find a cloud service provider that can fulfill both its business objectives and security criteria. It is possible for the cloud host to intentionally or unintentionally access, edit, or even delete.

(ii) **Lack of Expertise and Knowledge:** With the popularity of the cloud surging ahead, cloud technologies are also advancing rapidly. It becomes extremely important for companies to train their employees with the right skill set to keep pace with the technology and to choose the right cloud solutions for them. Lack of knowledge or expertise may be disastrous for an organization moving to the cloud. Cloud technologies are likewise evolving at a quick pace as cloud adoption grows. For organizations to keep up with technology and pick the proper cloud solutions, it is imperative that they train their workers with the right skill set, and that they do it on a regular basis. For a company going to the cloud,a lack of knowledge or experience can be strongly disastrous.

6. Big data analytics:

Information technology is developing at a rapid pace, and much of today's data was created digitally that is being transferred through the Internet. Problems with large-scale data analysis are not new; they have existed for plenty of years since generating data is typically simpler

than extracting valuable information from the data. Even though today's computers are far quicker than those of the 1930s, vast amounts of data remain difficult to be evaluated by today's computers.

There are a lot of organizations that gather, store, and analyze large volumes of information. We refer to this dataas "big data" because of its volume and velocity as well as the wide range of formats it might take. Big data is a phrase used to describe data sets that are too large or complex for standard relational databases to gather, maintain, and analyzewith low latency. It is fully defined in three ways: volume, diversity, and velocity. Because of the explosion of data, we witness an entirely new generation of decision support management. In response to this, businesses are putting in place the technology, people, and procedures necessary to take advantage of the prospects.

7. Virtual reality and augmented reality:

In the world of technology, some new trends are almost imperceptible, allowing new applications to work behind the scenes. However, virtual reality (VR) and augmented reality (AR) is not accounted as these kinds of trends as they are in front of the end user's eyes, and while there are certain obvious consumer applications, organizations may not necessarily grasp how to maximize their potential.

The more prevalent of the two trends are virtual realities, although within a corporation it might have more restricted potential. Most people know VR through the video gaming business, which has developed for many years. The essential element of a VR system is a kind of headset that fully takes over the view field of the user and offers an immersive experience. More sophisticated VR systems include aural immersion, high resolution, and position tracking which enables users to move around and interact with the virtual environment by using their hands.

8. Limitations and future directions:

This survey paper provides an overview of trending technologies including cloud computing, the internet of things (IoT), artificial intelligence, blockchain, big data analytics, and virtual and augmented reality. To provide an understanding of each topic of technology about five to eight papers were studied and relevant knowledge based on the classification of the paper is extracted from papers. However, technology is a dynamic area and there are many

other papers in this field. Thus, the provided summary in this survey is limited to extracted reference papers and selected trending technologies. Broadening the study to other technologies such as the Internet of Drones and novel algorithms such as Aquila Optimizer, Reptile Search Algorithm, and other optimization algorithms by using the most recently published papers is suggested for future studies.

9. Conclusion:

The IT sector is in a boom like never before and increasing numbers of firms in this field are trying to develop due to their vast potential [90]. It has several applications, which is why it has proven to be a highly helpful elementin the complete structure that is presently available to companies. With the increasing significance of this, the significant elements of this industry and the main components that make it an innovative instrument are crucial to be understood. New trends develop each year in this sector, and experts need to know these distinct trends and everything that they include. Today, new functionalities in the domains of medical, entertainment, business, training, marketing, law enforcement, etc. are being improved and introduced, however, end users' acceptance and engagement need tobe considered for successful implementation of the new technology. IT innovations impact internal business operations; however, they also change the way consumers purchase and provide assistance regardless of mentioning fundamental habits such as house locking, doctor visits, and keeping records. Regardless of the field, one works in; it may enhance one's professional standing and learn what the possible improvements are for a given sector.

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