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Review Article

An Overview of Trends in Information Systems: Emerging Technologies that Transform the Information Technology 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), artificial intelligence, blockchain, big data analytics, virtual and augmented reality, 5g network, and etc are broadly contributing to 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

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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" [1]. 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 [2]. 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 [3-4].

2.1 *How AI is used*

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 the full range of human cognitive capabilities. Accordingly, the term weak is referred to limited functionality [5-6]. There is 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 impact on the economy of nations. Specific AI programs such as google search, image recognition software, Siri, and Alexa are accounted as weak AI [5].

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 with decision-making practices with high accuracy [7]. As the dataset implemented for training an AI system is larger, the associated algorithms processing and proceeding with informed decisions would be more accurate [8-9]. 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 but with different capabilities. The self-awareness characteristics in deep learning systems are placed at a higher level in comparison to basic AI systems [10]. 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 [5].

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:

(i) **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 [11-12]. 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 [13]. Accordingly, AI contributes to improved cybersecurity through (i) hunting the traditionally undiscovered threats [14], (ii) identifying anomalous risk vulnerabilities via analyzing the baseline behavior of users and servers [15-16], (iii) improving network security through implementing learning networks allowing for efficient maintenance of network policies and network topography [17].

(ii) **Improving the Programming Productivity:** Software development is an important practice in information systems through which various methodologies are employed [18]. 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 provides effective predictions of possible issues, it can largely contribute to avoiding or fixing the anticipated problems during this stage and before the next stages [19-20].

(iii) **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 [21-22].

(iv) **Effective Server Optimization:** Since the hosting server is dealing with great amounts of requests in a 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 optimized system 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 [23]. 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 [24].

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 [25]. 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 of transparency during materials development [26].

Blockchain is regarded as a sequence of blocks that, similar to a conventional public ledger, store a full list of transaction records [27]. 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. From the 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 [26].

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 to a digital signature. This phase is referred to as the signing phase. while they are being spread throughout the network via the public key. While these are sent to another user, the second user employs the first user's public key to establish a verification by comparing the public key with the original hash codes. This phase is called the verification phase [26, 28-29].

Blockchain suggests particular characteristics which are responsible for its wide range of applications. It mainly includes:

(i) The transactions in blockchain, in contrast with conventional systems, are no longer required to be validated via a centralized trusted agency. This decentralization largely contributes to the considerable mitigation in server costs and also the performance bottlenecks at the central server [30-31].

(ii) The persistent nature of blockchain provides no chance for tampering. Specifically, the block-structured nature of blockchain is responsible for such characteristics as all transactions are required to be recorded and confirmed in blocks and since each spread block is further validated via other nodes, any falsification is detectable [32-33].

(iii) Since the interaction of users with the blockchain network is established via a generated address, no identities exposure occurs within the network. Also, there is no specific party for holding users' identity which leads to the establishment of a high level of privacy within the network [34].

(iv) Within the blockchain network, each specific transaction can be traced back to the previous ones in an iterative manner as each of the transactions is recorded and validated along with a timestamp. This specific suitability characteristic of blockchain is highly responsible for higher transparency and traceability within the blockchain network [35-36].

These specific characteristics have largely enabled the utilization of blockchain in various fields, specifically in the Internet interaction systems, such as smart contracts and security services. While blockchain technologies are still in their infancy, they provide a wealth of opportunities to improve current information systems. In fact, in different ways, a blockchain network can benefit an information system.

With blockchain technology integrated into information systems, a group can benefit from its wide range of possibilities. Data manipulation may be done in a variety of ways with its general-purpose approach, given that the implementation using it has a certain level of knowledge or maturity regarding its use. While blockchain implementations might be abstract, establishing a suitable use case is important to encourage functional implementations and limit or prevent instances in which blockchain implementations perform less wonderfully than current utilities [26, 37].

Blockchain can be used to minimize the influence of third-party agents, apps, or other objects. Businesses, government organizations, and other entities that manage information systems rely on third-party agents or tools to execute certain tasks. This necessitates the existence of a trusted network among the people involved, which becomes much more important when sensitive information is involved. As explained, blockchain has the potential for the development and more secure integration of third-party products, while also minimizing the danger of transmitting sensitive information to third parties [38]. Increased interoperability helps to promote and adopt blockchain technology by allowing agents and involved parties to communicate with each other via blockchain ledgers and integrated networks. It is possible to describe the real link between blockchain and interoperability in terms of fundamental interoperability, structural interoperability, and semantic interoperability. Accordingly, the idea of foundational interoperability does not require the involvement of the user [39]. Communication should not be based on interpreting statistics. On the other hand, structural interoperability outlines an anticipated schema and ensures that it is adhered to. As the last point, semantic interoperability is the understanding of semantical data. When taken together, these interoperability ideas provide a clear picture of what blockchain may provide as a decentralized technology [38].

In addition, the blockchain's unique decentralized design enhances security and stability [40]. Although blockchain technology is relatively new, many people are skeptical about its ability to manage large amounts of data at the scale that most organizations would require to properly use it. Since each change must be updated throughout the whole record, the decentralized design is particularly helpful in security situations, offering a measure of intrinsic security. Therefore, forgeries and falsifications are more difficult to commit without being noticed and investigated. As a result of its inherent security measures, blockchain stands apart from traditional client-server architectures in a serious way [38].

Moreover, "Big Brother"-style concerns can be minimized by integrating blockchain systems with IoT devices. IoT data is typically stored in a single place, which can pose problems with server failures or data loss linked to centralization components in many current IoT systems. It is possible to preserve information consistency without the fear of a single point of failure by using blockchain technology to distribute data across a device-independent platform [38, 41-43].

3.1 *Challenges of blockchain on information systems*

Blockchain technology is not nearly as secure as it may seem, the blockchain community is actively working to improve upon these faults. The design has many intrinsic security vulnerabilities, and the same characteristics that make it look safe also make it cumbersome. There is a limit to how far the distributed ledger technology can be scaled up. For example, systems with varying computational capacities may encounter ledgers that are incompatible with each other. Transactions may be erroneously delayed, terminated, or otherwise discontinued if two parties detect a discrepancy in a ledger and are unable to diagnose this as a computer architecture issue rather than a ledger discrepancy issue [38, 44-45]. Besides, blockchain technology requires a broad infrastructure and skills to be effectively adopted in information systems which may make it uninteresting for decision makers to invest significantly. To address this issue, blockchain technology can be employed as a service in information systems to realize the benefits that it may bring to the systems and decide on greater investments accordingly. Communication of information systems as different organizations tend to adopt blockchain in their information systems with varying characteristics gets more complicated that should be addressed using standard frameworks [5].

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) [46-47]. 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. Hence, the accessibility of entities with no specific temporal and local limitations is a crucial prerequisite for IoT implementation and thus, the applications are required to exhibit specific features of supporting various sets of communication protocols including small sensor sets and back-end servers used for data assessments and knowledge extraction [46-48]. Through the implementation of such systems, it is clear that mobile devices, routers, smart hubs, and humans are integrated. Basically, IoT concerns obtaining meaningful information and enhanced human productivity through implementing sensors and actuators in establishing linking structures and devices. More specifically, the term Internet of things is used to reflect the development of the Internet and web within the physical world via the vast employment of various devices with enriched sensors and actuators. It simply aims to strictly entangle the physical and digital entities with the employment of information and communication technologies which brings about a vast range of advantages and capabilities [46, 49]. There are several specific characteristics that IoT suggests:

(i) **Connectivity:** IoT connectivity is referring to the connection and the interrelation between all points within an 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 definitions of 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 [50-52].

(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". Due to the rapid advancement of new technologies, the device would inevitably become more scalable both horizontally and vertically. Horizontal scalability is concerned with boosting the network capacity to handle a growing number of 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 [52]. 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 [52].

(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 [53-55].

(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 [55-56].

(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 [52, 57].

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 to technology and intelligence. Over-reliance on the Internet that depends on the power supply to work may lead to make irreparable harm to human life [4]. 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 issue to consider while employing IoT in information systems [5]. 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 variety of management-related tasks, deliver correct information to all levels of management in a company, as well as analyze various data. According to cloud computing concepts, it is specifically based on five particular attributes of shared resources, enormous scalability, and elasticity, coupled with pay-as-you-go and self-provisioning of resources. The cloud computing paradigm differs from earlier computing models, which assumed reserved resources. Instead, cloud computing is built on a commercial model where resources are shared at the network, host, and application stages [58-59].

When the need arises, customers can scale up or down their computer capacity using cloud computing. There is a growing demand for cloud computing since cloud solutions allow businesses to reduce the cost of computer resources. When it comes to cloud computing, there are three different deployment methods. The public cloud is the first type of cloud. Private cloud is the second type and hybrid is the third one. One or more data centers are used to host a public cloud, which is administered and managed by a third party. However, most private cloud activities, including security management, are managed by the implementing company or by contractual SLAs with third parties. It is feasible for companies to establish a hybrid cloud system comprising various internal and external providers. As part of hybrid cloud architecture, companies may run non-essential apps on a public cloud while retaining key applications and sensitive data on a private cloud [58, 60].

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 as a whole. The main influences of cloud technology on information systems are as follows:

(i) **Affordable infrastructure:** The expense of managing and maintaining an IT infrastructure might be prohibitive for a company. In addition, it requires a team of highly skilled IT professionals to reduce downtime and guarantee the 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 [61]. 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.

(ii) **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 [58-61].

(iii) **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 necessitate the 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 [62-63].

(iv) **Improved integration and collaboration:** An efficient management information system typically necessitates a 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 [64-65].

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 [66].

(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 [66].

(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 [67-68].

While cloud computing has its problems, they are by no means a deal-breaker for a company considering a move to cloud computing. Businesses may overcome current difficulties and reap the benefits of the cloud by selecting the right cloud service provider and adopting the necessary, proactive actions.

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 [69].

There are a lot of organizations that gather, store, and analyze large volumes of information. We refer to this data as "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 analyze with 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 [69-71].

6.1 *Characteristics of big data*

Big data is defined based on three main characteristics including volume, variety and velocity. Although there may be other characteristics, these are the first three characteristics of big data.

6.1.1 *Volume*

The key characteristic of big data is unquestionably its data volume. Volume is a measure that incorporates all the data that is currently accessible and has to be evaluated for relevancy. Considering the number of users on Facebook and YouTube in billions, billions of photos, videos, and tweets that these users produce every day are the outcomes of their efforts. Thus, it is clear how much data is created each minute and every hour. That is the reason why big data is usually measured in terabytes or even petabytes. Despite this, big data may also be measured by quantifying the number of records, transactions, tables, or files that have been created. Substantial quantities of big data may be quantified in terms of time, which is more helpful to some companies [71-72].

6.1.2 *Variety*

There is a great deal of variability in different sorts of data sources, the structures from which they came, and the types of data that are available to everybody. There are three forms of big data: structured, semi-structured, and unstructured. Though technically relevant to all levels of analytics, these three concepts are crucial in big data. Working with large data makes it even more necessary to understand where the raw data originates from and how it must be handled before it can be analyzed. A lot of information must be extracted efficiently to make the effort worthwhile [71-72].

6.1.3 *Velocity*

Data throughput and latency are closely connected to high data velocity. The term “huge velocity” refers to the speed at which data enters and leaves the networked systems in real-time. Also known as real time data flow, it refers to the rapid pace at which data and information enter and leave interconnected systems. When it comes to many real-world applications, speed is more essential than volume. Speed may also be measured by latency, which is a measure of time. Latency is a need for contemporary enterprises and individuals. In turn, for example, it performs analytics in 10 milliseconds to place ads in internet advertising networks, such as Facebook [71-73].

Acquisition, preservation, discovery, spreading, analysis, and visualization are some of the specific problems associated with big data. Today companies explore enormous numbers of extremely comprehensive information to find facts that they did not previously know. Big data analysis is therefore used in large data sets with advanced analytical approaches. Big data samples, analyze, reveal and harness changes in the company.

The greater the database, the harder it is to administer. Technology also forms part of the Big Data idea. In addition to the enormous complexity of big data, the use of state-of-the-art technologies for assessment and processing is also required. The NIST Big Data Workgroup recommended the following big data definition in 2013, with emphasis on using new technologies: big data exceeds the capacity, capacities, and capabilities of current or traditional methods and systems and enables innovative approaches to frontier issues that were previously inaccessible or unworkable using existing and conventional methodologies [73-74].

The application of analytics is a key to maximizing the value of big data. Big data collection and storage have minimal value at this stage; it is merely data infrastructure. A value-adding process requires analysis of this data, as well as the utilization of the results by decision-makers. Accordingly, big data analytics is regarded as the analysis of vast and varied data sets, including structured, semi-structured, and unstructured information from various sources, ranging in size from terabytes to zettabytes. Big Data Analytics reflects the challenges of data that are too vast, too unstructured, and too fast-moving to be managed by traditional methods [73].

Meaningful information and competitive benefits from vast volumes of data have become even more vital for companies in the world. It is difficult to rapidly draw useful insights from these data sources. Hence, analytics is indispensable to harness the full potential of big data aiming to boost their company performance and market share. Available instruments for managing the volume, speed, and range of large data have substantially increased in recent years. These technologies are often not excessively costly, and there is several open-source software [70-74].

The analytical tools can propose the most advantageous future planning by examining “why” and “how” in conjunction with what, who, where, and when. The analytics now in use are descriptive, predictive, and prescriptive analysis. A thorough understanding of the three analytics will make it possible for an organization to develop the most appropriate action plan, considering various likely results.

With technological developments and the increasing amount of information that flows into and out of companies each day, quicker and more effective means of evaluating such data have become necessary. It is no longer enough to have piles of data in place to take effective judgments at the correct moment. With standard data management and analysis methodologies and infrastructures, data sets of this kind can no longer be readily analyzed. New tools and methodologies specializing in large-scale data analytics and the necessary systems for storing and managing such data are therefore necessary.

The development of big data has consequently a substantial impact on everything from the information itself and its acquisition, the processing, to the final judgments extracted. The Big Data, Analytics, and Decisions Framework (B-DAD) were therefore suggested, which includes the tools and methodologies of big data analytics in the Decisions Process. The framework maps the various large-scale storage, management, and management tools, analytical tools and techniques, and displays and evaluation tools into the many decision-making processes. Thus, developments in big data analytics are represented in three key fields: the storage of big data and architecture; the processing of data and analysis; and, eventually, the analysis of big data which applies to the discovery of knowledge and informed decision-making. Big data, however, continually expanding into a significant area of study and research revelations and instruments, is not exhaustive of all possibilities and concentrates on a basic notion, rather than a list of all the prospective prospects and technology [70, 75].

When dealing with big data, one of the first things companies must consider is where and how the data will be stored after it has been obtained. Relational databases, data marts, and data warehouses are examples of classic techniques of organized data storage and retrieval. The data is transferred to storage from operational data repositories, transformed to meet operational requirements, and then put into the database. As a result, the data is cleansed, processed, and classified before it is made accessible for data mining and online analytical activities [76].

The Big Data environment requires Magnetic, Agile, Deep (MAD) analytical capabilities that are different from that of the conventional Enterprise Data Warehouse (EDW) context. Firstly, typical EDW techniques prevent new data sources from being included until they are cleaned and integrated. Because of the omnipresence of data nowadays, the big data ecosystem must be magnetic and thus capture all the data sources irrespective of their quality. Big data storage should also allow analysts to readily create and modify data quickly, given the rising quantities of databases and the complexity of data analytics. This necessitates an agile database that can synchronize the physical and logical contents with rapidly evolving data. Ultimately, because contemporary data analysis uses complicated statistical methodology and analysts need to analyze large volumes of data by digging, a big data repository should also be thorough and have a smart, algorithmic operating engine [70, 76-77].

The analytical processing occurs after massive data storage. There are, accordingly, four key criteria for the processing of large data. Firstly, rapid loading of data. Since network traffic interacts with query runs during data load, data loading time requires to be reduced. Secondly, rapid query processing is required. Many inquiries are important in terms of response speed to fulfill the needs of large workloads and real-time requests. The data placement architecture must be then able to keep fast query processing as query quantities rise rapidly. Thirdly, efficient utilization of storage space is the key to big data processing. Limited space on the disk requires the efficient storage of data during the whole processing since a rapid increase in user activity might require scalable storage capacity and power [70, 78-79]. Finally, it is necessary to adjust highly to exceedingly dynamic workload patterns. Since a large range of applications and users analyze masses of data sets for a variety of reasons and in different ways, the underlying system must be very flexible to unexpected dynamics of data processing and must not be constrained by predetermined working load patterns [70, 80-81].

6.2 *Challenges of big data on information systems*

As data is getting more bulky and complex coming from various independent sources, technological and managerial challenges raise as well. The amount of data is making managing and processing data a real problem and facing information systems with heavy data loads that in turn reduce the quality of services offered by information systems [82]. Lack of effective coordination between databases is another issue of big data in information systems since the food for big data analytics is provided by integrated databases. To address this issue an integrated protocol should be designed throughout information systems to map data covering its origin; otherwise, the process of analyzing big data gets excessively time-consuming and complicated [83].

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 [84-85].

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 [85].

Real constructions can be actual (e.g., physical items that we can touch) or virtual (e.g., virtual assistants like Siri or Alexa that are nowhere in actuality). Possible constructions, on the other hand, are identical to the real except for the fact that they do not yet exist. This distinction is critical because we now overgeneralize reality as referring to genuine, physical existences and augmented and virtual realities as digital versions thereof. Not only is this a basic viewpoint, but it also reminds us that virtual is not opposed to real, but rather to actual, whereas real is opposed to potential [85].

7.1 *Virtual reality*

Virtual reality (VR) refers to comprehensive three-dimensional virtual reconstructions of the actual environment or its items. Solidworks software, for example, allows design experts, developers, and engineers to produce exact 3-drawings of real items before they modify them. Virtual tours of 360 degrees enable people to see distant locations [84-85].

However, the most remarkable virtual realities are situations that need VR headgear looking like big matt, black sky guns. By wearing a specific Gear VR, the customers are fully immersed in the 3D computer environment. Realistic pictures, sonorous sounds, and other sensations replicate the physical presence of surroundings in a person. A certain famous example of RV is Google Art through which VR tours to over 1200 museums and art exhibitions have been launched. There are numerous attempts toward making virtual reality experiences much more impressive by specializing them for different people [85].

Virtual reality is extremely important and unique from reality and augmented reality, and it also sets the groundwork for all other types of realities on the virtual reality continuum. Unlike a conventional computer or smartly planned presentation, which offers people a glance to the left and right and the impression that they are still in the real world, virtual reality is like looking at or moving into a distinct reality from what they do. Users often overlook the situation where they are and even experience a condition termed VR sickness: the pure visual impression that leads to symptoms like dizziness, malaise, headache, and nausea, instead of actual motion. These genuine symptoms-related to a supposed presence-show how strong VR may be and how vital it is to ensure that the powers are not misused [80, 85-86].

Virtual reality is applied for any commercial purpose. Applications for virtual reality grow every day into new areas that may be customized to meet the demands of a company and associated visions. VR enables companies with immersing and engaging marketing efforts to reach their customers. In the era of internet purchasing, this is especially significant since VR experiences allow clients to examine 3-D renditions of a company's offerings without having to leave their homes [86-87].

7.2 *Augmented reality*

Virtual reality is far more engrossing than enhanced reality. In augmented reality, a device is placed between a user and his environment, so that information may be given as the person regularly views his environment. It is usually accomplished today via a smartphone or wearable technology like Google Glass or Hololens of Microsoft. The technology may be placed in standard eyeglasses, construction windows, and devices built for future circumstances [85-88].

The integration of the actual world with digital information is regarded as augmented reality (AR). Real objects and people create a shadow of information: a cloud of data that may give great value to customers if collected and processed appropriately. People can access such a layer of knowledge through an enlarged reality that blends their real eyesight with computer software that produced digital things. This technique comes in several shapes, ranging from smart wearables with retinal projection to the more common smartphone display in the eyeball of the wearer. Sensory (for example, music, video, graphics, or haptics), or data-based, might be the extra AR-layers [87, 89].

AR may also allow the user to generate real-world data, rather than merely presenting the user with already obtained data. An AR program measured by Lowe allows people to evaluate and share measurements of real items using their smartphone cameras, instead of requiring a tape measure. It is essential to highlight that the user is completely aware that they are in the actual world when utilizing augmented reality [87].

As far as commercial prospects are concerned, AR apps may be utilized to transform the way ever-connected customers work and shop today. AR may improve the real experience of a consumer in unique ways by presenting more information about current offers [89].

Companies considering mixed realities (the term used for any mixture of VR and AR), as with many new technologies, should recognize that more than the research of techniques to improve existing technologies, it is imperative to build brand new applications that can employ new technology. It is better, to begin with, business objectives and cooperate on new trends, instead of asking "Where might we set VR/AR?"

In addition to conferencing, non-IT activities comprise the bulk of modern VR/AR applications. The IT team is instead responsible for establishing a proper technical model and aims at enhancing customer experience and extending the corporate brand identity. This is not the same as traditional IT, but for digital companies it rapidly becomes standard. Following a collaborative agreement on a new application idea, IT must assist business partners in understanding the system as a whole. This goes well beyond user device and software support, particularly in the case of greater realism. Back-end components are required and must work with the present IT infrastructure and business processes. There are other societal repercussions to consider, most notably the extent to which issues with utilizing the system may impede its acceptability [86-89].

7.3 *Challenges of virtual and augmented reality on information systems*

Augmented Reality and Virtual Reality are among the most prominent emerging technologies recently that bring a considerable range of benefits to information systems. Although virtual reality and augmented reality provide interesting new interfaces and applications, there are several challenges that a firm is expected to overcome to successfully employ this growing technology since the employment of AR and VR is based on getting equipped with expensive devices that increase the costs of information systems significantly. Besides, technologies in AR and VR are constantly changing, and making constant shifts to get adapted to new trends requires considerable resource allocation; otherwise, significant technical issues may happen. IT workers may help to make the right judgments in this developing trend by knowing about all of the components, starting with a business requirement, and collaborating with business units [6, 86].

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 element in the complete structure that is presently available to companies [90]. 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 to be considered for successful implementation of the new technology [91]. 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.

Conflicts of interest

Author declares no conflict of interest.

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