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A Survey on Big Data Issues and Challenges

P. Muthulakshmi[1*], S. Udhayapriya[2]

[1] Department of Computer Science, Cauvery College for Women, Bharathidhasan University, Trichy, India
[2] Department of Computer Science, Cauvery College for Women, Bharathidhasan University, Trichy, India

[*]*Corresponding Author: lakshmipalraj@gmail.com, Mobile: 9788987593*

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Abstract— Data is the new science and it powers everything that we do. Big Data is a phrase that describes the huge collection of structured, unstructured and semi-structured data. It is a mixture of new hardware and algorithms that allow us to ascertain new sequence of structure in large volume of data sets. These structures can used to make effective predictions and, eventually, better resolutions which bring huge benefits to the business organization. Today, organizations are bringing Big Data in such assorted fields, like healthcare, smart cities, education, IOT, banking, marketing, finance and etc. Big data analytics is crucial to work and grow Internet of Things. Big data is combined with IOT for making real-time decisions, such as predicting the behaviour of a gene, suspicious activities of banking transactions, controlling the traffic signals and so on. Big Data has the tremendous power to progress lives with enhanced services and goods, but obstacles remain between Big Data's commitment and realism. This paper presents an overview of big data and its significance, applications, Technical elements, issues and challenges and review on it.

Keywords—Bigdata, Architecture,Characteristics,Tools, Issues, Challenges, Applications.

I. INTRODUCTION

Big data shows the huge and swiftly increasing amount of information that is mostly unused by obtainable analytical applications and data warehousing systems [1]. Examples of this data include ample amount of sensor data and social media information from web sites such as Face Book and Twitter. It is significant to recognize that big data comes in many aspect and scope. It also has many different uses in various fields like real-time scam detection, web advertising and aggressive investigation, call centre optimization, social media and sentiment analysis, intellectual traffic management and smart power grids. All of these analytical solutions involve massive (and increasing) amount of both multi-structured and structured data.

Positive aspect of applying Big Data analytics application includes information search, suggestion system, dynamic pricing and customer service to interact with the community member [2]. Information search implies that quality of both information and searching service. Information quality is a measure of accuracy and relevance provided by a website [3]. Suggestion systems help individuals to categorize items based on their interest from aggregating inputs from all individuals [4]. The main goal of dynamic pricing is to allow a company that sells goods or services over the Internet to adjust prices on the fly in response to market demands [2]. Big Data is used to enhance business processes. Retailers can optimize their stock based on predictions from web search trends, customer behavior and weather forecasts. From that, the customer services can be improved and increase customer satisfaction [2].

Due to enormous amount of data it becomes very tedious to execute and evaluate the data using existing technologies [5]. Since big data is trending technology which helps in analyzing huge amount of data, which intern brings benefits to the many private and government organization. It is must that challenges and issues related to big data needs to be understood. The obscurities can be related to data capture, storage, search, sharing, analytics and visualization etc.

In section II we discuss the architectural framework for Big Data. In section III we define the 7 V's of Big Data and in section IV we discuss the significances of Big Data and section V shows various applications of Big Data in different sector. In section VI we list out the technical elements used in big data analytics and section VII talks about the security challenges and issues in big data and in section VIII we conclude the paper to encourage fundamental research towards addressing the technical challenges.

II. BIGDATA ARCHITECTURE

Big data framework consists of ingesting, securing, executing, and transforming data into file systems or database structures. Creating big data environment entails interconnecting and organizing existing resources to serve

big data needs. Fig.1. represents four different logical layers [6].

1. **Data source layer:** Data can be retrieved from any kind of data sources or providers and ingest data in batch mode or real-time. A few data source models such as ERP, CRM, MS Office documents, data warehouse and relational database management systems (RDBMS), databases, cloud, mobile devices, sensors, social media, and email.

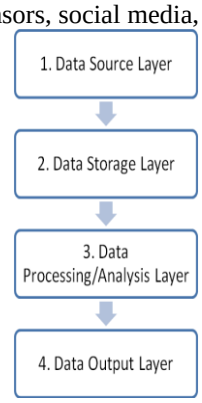

Fig.1. Layers of Bigdata

2. **Data storage layer:** This layer is responsible for acquiring data from the data sources and, if necessary, converting it to a format that suits how the data is to be analyzed. It stores structured data in a RDBMS, and unstructured data in a specialized file system like Hadoop Distributed File System (HDFS), or a NoSQL database.
3. **Data Processing/Analysis layer:** This layer extracts business intelligence from stored data. Multiple analytics tools operated in this environment. Structured data supports mature technologies like sampling, while unstructured data needs more advanced (and newer) specialized analytics toolsets.
4. **Output layer:** This layer receives analysis results and presents them to the suitable output layer. Many types of outputs include human viewers, applications, and business processes.

III. CHARACTERISTICS OF BIGDATA

In General, there are few aspects that define Big Data. These are called the big V's. In early days there were 4 V's that defined Big Data. These 4 V's can be defined as Volume, Velocity, Variety & Veracity. Recently this was changed as 7 V's as Variability, Visualization and Value was added to the list of big V's[7]. Fig.2 shows the 7 V's of bigdata.

i.VOLUME

This is the main characteristic that defines Big Data as **"Big"**. The growth of data that is being generated and required to be stored, we find that storage in Gigabytes is actually not enough. Due to this reason, in today's world, data warehouse storage is discussed in Exabytes, Zettabytes and Yottabytes. With the introduction of new technology, and the number of new devices that comes in to use, different types of data are generated and stored in an increasing manner each year. For example, the world population is somewhere around 7 Billion, and according to statistics, almost 6 billion people use mobile phones. Just imagine how much data is generated and uploaded to Internet every single second. So the volume of data that is used in data warehouses and in Big data field is so large. That is why "Volume" as a big "V" is most important.

ii.VELOCITY

Velocity can be simply defined as the speed of change. In other words Velocity means how quickly the data needs to be accessed and processed. For example, just imagine, how fast Facebook, Twitter & YouTube data are getting updated? People around the world share some sort of thing every minute and may be every second. In that case, speed of change is really fast and it is almost real-time.

iii. VARIETY

Variety can be simply defined as having different forms of data sources. When talking about different forms of data sources, data can be accessible from structured and unstructured data sources. We all know how easy to understand a set of structured data as those are well structured and have different data types such as date, amount, text etc. and set of rules that define those data. However with unstructured data the process is very much different. Unstructured data does not have any predefined set of rules that say that a particular data element should be in this particular format etc. For example, just think of Video files, text messages, Face book comments, Twitter feeds etc. These can have values in many different ways and sometimes not even in proper language. Those are ways people share their ideas and thoughts and those do not have any type of rule. The goal of big data is to use technology and make unstructured data understandable.

iv. VERACITY

Veracity refers to the reliability of the data that is being used. As we know, data warehouse is used for decision making and focuses on top management. Data should always be accurate and trustworthy. For example, most of the time, the contact numbers of clients are inaccurate or out of date. These types of uncertain data are not sure about the correctness of data and ambiguity data.

v. VARIABILITY

Variability is different from Variety in the first place. Variability mostly focuses on properly understanding and interpreting the correct meanings of raw data that depends on its context. This is mostly required when working on Natural Language Processing. As we all know, in natural

languages such as English, there are some words that can multiple meanings and the exact meaning is depending on the context it is being used. For example the word "Great" gives an positive idea, however if it is said as "Greatly disappointed", that doesn't mean as positive. Due to this reason, the exact meaning needs to be properly interpreted for an organization to do proper analysis on their business .Of course doing developing such algorithms are quite complex and challenging, but it is not impossible with current technology that is available now.

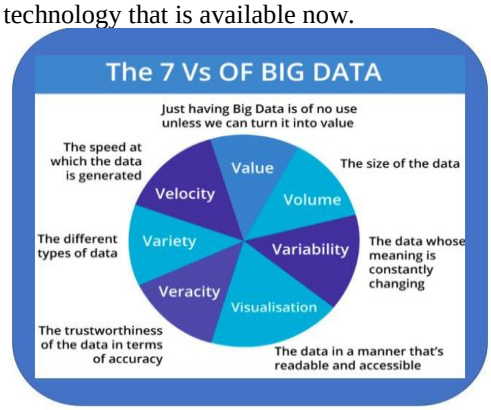

Fig.2. Characteristics of Bigdata

vi. VISUALIZATION

Visualization refers to how the data is presented to the management for their decision making. Data can be presented in many different ways such as long excel files with rows and columns of data, word docs, graphical charts etc. Whatever the format is, the data should be easily readable, understandable and accessible. This is why data visualization is important. Have a guess yourself, which one is easily readable, the excel sheet full of data or a nice graphical view or chart that represents the same set of data? Of Course, the graphical view is the best. Having a graphical view of critical data for a board of directors to take a critical decision will make their decisions much effective and accurate rather than allowing them to dig into large sheets of long data. Have a look below for few examples of different graphical views that can be used to present data for decision making.

vii. VALUE

Value being the last one on the line, it is important to understand that the organization needs to get some sort of value after the immense efforts and resources spend on the above V's. Big Data can provide the business with immense value if it is done correctly and each step is properly processed. We all know that data on its own is actually worthless. Data is worth when it's integrated and analyzed in many different views and that's what generates value by giving the ability to make effective, efficient & accurate decision making on the opportunities and threats of the organization. Once the organization gets the grip of what is done, the power of big data is limitless.

IV. IMPORTANCE OF BIGDATA

The significance of big data does not deal with quantity of a data. It mainly focuses on how the collected data can be utilized. Each and every organization uses data more efficiently towards its growth. The organization can take data from any resource and evaluate it to find better solutions which will enable the following factors [8].

1. **Consuming Low cost:** Big data analytics can bring cost advantages to business while storing the large amount of data. Hadoop and cloud based analytics tools facilitates professional ways of doing business.
2. T**ime saving**: Hadoop and in-memory analytics can easily find new sources of data which helps businesses evaluate data immediately and formulate quick decisions based on the results.
3. **Launching New Product**: By knowing the trends of customer requirements and satisfaction through analytics you can build products according to the needs of customers.
4. **Realizing the market trend**: By analyzing big data you can get a better understanding of current market trends. For example, a company can find out the products that are sold the most and produce products based on the customers purchasing behavior.
5. **Manage online reputation**: Big data tools can do sentiment analysis. Therefore, you can get feedback about who is saying what about your company. You can monitor and implement the new patterns to improve the online presence of your business, by using big data tools.

V. APPLICATIONS OF BIGDATA

The major goal of Big Data applications is to help companies to make more informative business decisions by analyzing huge volumes of data. It could include web server logs, Internet click stream data, social media content and activity reports, text from customer emails, mobile phone call details and machine data captured by multiple sensors. At present Big data is most preferably used in various fields such as banking, agriculture, chemistry, data mining, cloud computing, finance, marketing, stocks, BDA, health care etc.[9][10][11]**.**

***Banking*:** The privacy issue arises when we use of customer data invariably. Big data analytics is used to prevent and eliminate internal and external fraud, determine the data transaction risks, resolve the problems of customers quickly and it provides a way to understand the customer's needs.

Agriculture: Big data revolution has made its way into the farming industry and modernized it at a pace. They use the

sensor data to optimize crop efficiency, reduction in fertilizer, cost savings, and more.

Healthcare: Big data analytics have enhanced healthcare by providing personalized medicine and prescribe analytics. It's possible to predict disease that will escalate in specific area, by mapping healthcare data with geographical data sets. According to these predictions, it's easier to direct diagnostics and plan for stocking serums and vaccines.
Marketing: By migrating big data with marketing strategy, marketing organizations can make a substantial impact in customer engagement, retention and loyalty, Marketing optimization.

Manufacturing: Primary goal of using Big Data applications in manufacturing industry are quality of product and defects tracking, planning, Manufacturing process, Predetermining Output , Increasing efficiency, Testing and simulation of new manufacturing processes and Support for mass-customization of manufacturing.

IOT: Data obtained from ***IOT*** devices provides a mapping of device inter-connectivity. Such mappings have been used by various companies and governments to increase efficiency. IoT is also gradually adopted as a means of gathering sensory data, and this sensory data is used in medical and manufacturing contexts.

Education: Big data in the education sector offers unprecedented opportunities for educators to reach out and instruct students in new ways. It will give them a deeper understanding of students' education experience, and thereby help them to evaluate the state of the education system. The overall idea of leveraging big data with the education system is to improve the student results, create customized programs for each student and reduces the dropout rates.

VI. TECHNICAL ELEMENTS OF BIGDATA

The enormous amount of data collected can be classified into useful trends and patterns. Thus it must be preserved, studied and processed. Following are some of the majorly used Big Data taming tools [12]:

1. **Hadoop: A**n open-source software skeleton for storing data and running applications on bunch of commodity hardware. It provides immense storage for any kind of data, vast processing power and the skill to handle virtually limitless synchronized tasks or jobs.
2. **HPCC: D**eveloped by LexisNexis Risk Solution. It works on a single platform, distinct architecture and a unique programming language for data processing.
3. **Storm:** It offers distributed real-time, fault-tolerant processing system, with real-time environment, as well as free and open source big data computation system.
4. **Qubole:** It grants self-managed platform, self-optimizing tool which allows the data team to focus on delivering finest business products.
5. **Apache Cassandra**: It provides an elevated performance, tremendously scalable, error free, distributed post-relational database result. Cassandra fuses all the advantages of Google Bigtable and Amazon Dynamo to deals with the types of database management requires that traditional RDBMS retailer cannot sustain.
6. **Statwing:** It is an easy-to-use statistical tool. It was constructed by and for big data analysts. Its recent interface chooses statistical tests automatically.
7. **CouchDB:** Stores data in JSON documents that can be processed web or query using JavaScript. It presents distributed scaling with fault-tolerant storage. It helps to access data by defining the Couch Replication Protocol.
8. **Pentaho:** Tools to mine, practice and merge data. It proposes visualizations and analytics that change the way to run any business.
9. **Flink:** It is distributed, high-performing, always-available, and précised data streaming applications.
10. **Cloudera:** The fastest, easiest and highly secure modern big data platform. It allows anyone to get any data across any networks within single, scalable platform.
11. **Openrefine:** It provides an environment with cluttered data, cleaning it and transforming it from one into another, also allows extending it with web services and external data. It is a very powerful big data tool.
12. **Rapidminer:** It is used for machine learning and model deployment. It offers a suite of products to build new data mining processes and setup predictive analysis.
13. **DataCleaner** Data quality analysis application and a solution platform. It has strong data profiling engine. It is extensible and thereby adds data cleansing, transformations, matching, and merging.
14. **Kaggle:**. It helps organizations and researchers to post their data & statistics. It is the best place to analyze data seamlessly.
15. **Hive:** It allows programmers analyze large data sets on Hadoop. It helps with querying and managing large datasets.

VII. BIGDATA ISSUES AND CHALLENGES

ISSUES IN BIGDATA

Now a day, Big Data grants us extraordinary insights and openings across all industries from healthcare to

manufacturing and more. But, it also increases some issues that must be noticed. We suggest three issues that should keep people up at right: Storage and Transport Issue, Management Issue and Processing Issue.

A. Storage and Transport Issue

New storage medium are invented due to quantity of data being exploded every time. Now a day's data is being produced by each one and all from mobile devices to computers, not just by devices, by scientists, the media, reporters etc [13]. Modern disk technology confines are about 4terabytes per disk. So, 1 Exabyte of data would require 25,000 disks. It is unable to directly attach the required number of disk on a single computer system, although the processed data may be of Exabyte. Process to that data would beat current communication networks. Let as assume that 1 Giga byte per second network has an efficient transfer rate of 80%, the sustainable bandwidth is about 100 megabytes. Transmitting an Exabyte would get long period to pass on the data from a collection or storage point to a processing point than it would to really practice it. To overcome this transferring problem two methods have been proposed [14]. First, just process the data at the similar location where it is stored and only transfer the essential information. Particularly, fetch the processing code to the stored data instead of transferring the stored data to the processing code, known as map reduce algorithm. Second, transfer only the part of data which seems more critical for analysis [15].In either case, integrity and provenance metadata should be transmitted along with the actual data.

B. Management Issue

It will be the most tedious problem to deal with big data. Big data is formed by multiple heterogeneous sources with different formats, representations etc [15]. Many systems contribute data in the form of documents, videos, audios, drawings without the sufficient information about the metadata from where, how, why, when and how it was gathered [13]. So handling the big data needs high performance and multi dimensional organization tools, otherwise we are likely to get undesirable outcomes. For better marketing policies, business experts often need significant, cleaned, précised and managed data to perform analysis. Organizing of data includes methods like cleaning, transforming, elucidation, dimension reduction, justification etc. Firms can make the use of business intelligence to manage the large amount of data for example quantum computing and in-memory database management systems allow economically valuable and quick management of vast datasets[15]. But the existing businesses are already reputed on traditional platforms, moving the whole business to the new platform can be cost and time consuming. As the big data is in the unmanaged form, it becomes very hard for business organizations to analyze and extract consequential information from it. In simple way there is no ideal data management result. This crack must be filled with new research techniques.

C. Processing Issue

Nowadays, the prompt results actually matters a lot especially for business organizations. If the results are not produced precisely and well-timed, they will be of least use [16]. In the modern state most of the organizations have relocate their type of business from 'brick and mortar' type to online mode in order to snatch the customers and enhance the sales worldwide which results in storm of data. Our obtainable infrastructure, equipment and procedure are not able to process such ample amount of data in real time which leaves the business organizations handicapped. Although some advanced indexing schemes (CAI based method) and processing methods like map reduce [17], are available to boost the processing speed but processing of Zettabytes and even Exabyte of data is still a ridiculous task. Thus, efficient processing of exabyte of data should need extensive parallel processing and new analytics algorithms in order to grant timely and actionable information.

CHALLENGES IN BIGDATA

Now a day, Big Data grants us extraordinary insights and openings across all industries from healthcare to manufacturing and more. But, it also increases some issues that must be noticed. We suggest three issues that should keep people up at right: Storage and Transport Issue, Management Issue and Processing Issue.

D. Privacy and security

It is the essential challenge with big data which is sensitive and includes some abstract and technical significance. Information security is becoming a big data analytics issue where enormous amount of data will be interrelated, evaluated and extracted for important model [19]. Big data security controls must meet the following prerequisites:

- It should not agree with the basic methodologies of the cluster.
- It must range in the same manner as the cluster.
- It should not deal with essential big data characteristics.
- It should tackle a security risk to big data environments or data stored within the cluster.

For companies the privacy issue is more related to the sensitive data that they employ with. Whether is financial data, clients list, perspective projects, all signifies precious data that may or may not be disclose. Companies have multiple options regarding where to store their information. They can also store it on cloud systems "in-house" systems or hybrid systems. By storing data on cloud systems is more suitable for companies in terms of cost [20]. Also, a cloud system is not only characterized by storage space, but as well for the speed of processing requested procedure. The data security still remains an arguable issue in this case. To solve

that, some companies choose to construct their own infrastructure for storing and operate the data that they have. For smaller companies this can be a solution, but, in most cases, to apply such a system the costs are high. Also, to retain this type of system it need skilled personnel and the more the company grows, the more it will be needed an add-on to the infrastructure. After all, this solution will prove redundant. The only gain of this solution is privacy. Alternate solution for this matter, besides keeping all the data stored on an "in-house" Big Data system, is to encrypt it using some extraordinary encryption software. To attain performance from this method there has to be an OLAP system that is capable of doing encryption at the same time with interpreting data. By doing this the process will be much faster and data can be handled roughly in real-time.

E. Data Access and Sharing of Information

The data in the company information is used to make business assessment. It is essential that data should be obtainable in perfect manner, on time and complete. Sharing the information confirms to be one of the most valuable characteristics of development. Information about almost anything can be found by simply doing a ―Google search. Every person and company has at their disposal vast amount of information that can use it to serve their intention. Everything is available only if everyone shares it. Regarding persons, there is a difference between what is personal and what can be made public. Depending on the usage services can be classified into private and public.

F. Analytical Challenges

Big Data are distinguished by high dimensionality and great sample size. These kinds of aspects elevate three challenges: (i) high dimensionality fetches noise growth, spurious associated and incidental homogeneity; (ii) high dimensionality combined with large sample size creates issues such as heavy computational cost and algorithmic wavering; (iii) the enormous samples in Big Data are typically cumulated from multiple sources at different time points using unusual technologies. This creates issues of heterogeneity, experimental variations and statistical biases, and needs us to enlarge more adaptive and vigorous events.

G. Heterogenous data

The solidity of big data analysis receives from its huge scale as well as the existence of mixed data based on different patterns or rules (heterogeneous mixture data) in the collected and stored data. In the case of intricate heterogeneous mixture data, the data has numerous patterns and rules and the properties of the patterns differ significantly. Data can be structured, unstructured and semi structured. 80% of the data generated by organizations are unstructured. Unstructured data which is about each kind of data being produced like social media sites, recorded meetings, fax report, PDF documents and many more. Functioning with unstructured data is valuable. Converting unstructured data into structured data is not feasible. Structured data is always organized into highly mechanized way and controllable technique [17].

H. Scalability

Organizing wide range and promptly growing level of data is a challenging issue. Scalability issue of big data has lead towards cloud computing, which now aggregates multiple contrasting workloads with varying performance goals into very huge clusters [18] .Traditional software tools are not enough for handling the growing level of data. Data analysis, organization, retrieval and modelling are also challenges due to scalability and complexity of data that demands to be analyzed.

VIII. CONCLUSION

Many people view "big data" as a promoting buzzword. It is, however, a valuable term because it highlights new data management and data analysis technologies that enable organizations to analyze certain types of data and handle certain types of workload that were not formerly achievable. It will also depend on the capabilities provided by vendors for managing, administering, and governing the improved environment. These capabilities are important selection criteria for product assessment. In this paper, We have tried to determine the issues and challenges that Big Data is facing from data storage and analytics perception. Some of the challenges that we have mentioned can easily be conquer. These practical challenges are common across a large multiplicity of application zone, and consequently not cost-effective to address in the context of one domain alone. Therefore, there is need to sustain and strengthen essential research towards tackle these technical challenges if we are to build the certain benefits of Big Data.

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Authors Profile

Mrs.P. Muthulakshmi, pursued Bachelor of Science from Madhurai Kamaraj University and Master of Computer Applications from Alagappa University, Karaikudi, in year 2008. She is currently working as Assistant Professor in Department of Computer Science, Cauvery College for Women, Trichy-18, since 2009. Her area of interest focuses on Cloud Security and Privacy, Big Data Analytics, Data Mining, and IoT.

Mrs.S. Udhayapriya, pursued Bachelor of Science and Master of Science from Bharathidasan University, Trichy-24 in year 2003. She is currently working as Assistant Professor in Department of Computer Science, Cauvery College for Women, Trichy-18, since 2009. Her area of interest focuses on Cloud computing, Big Data Analytics, Data Mining, and IoT.

