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EMINENCE OF BIGDATA ANALYTICS IN IOT

Swapna Arroju[1], Shweta Kulkarni[2]

[1] *Assistant Professor, Department of Computer Science, Avanthi Degree College, India*

[2] *Assistant Professor, Department of Computer Science, Avanthi Degree College, India*

ABSTRACT:

The widespread adoption of sensors in various fields is leading to a significant surge in data due to the Internet of Things (IoT). The deployment of IoT devices across industries such as manufacturing, healthcare, transportation, agriculture, smart cities, and more has resulted in an exponential increase in data generation. Managing, processing, and analyzing such vast amounts of data can be complex and resource-intensive. This paper discusses about the challenges of IoT with Big Data Analytics in Descriptive, Diagnostic, Predictive, and Prescriptive way. Possible architecture of the IoT Big data analytics, different big data tools and techniques that can be used for IoT frameworks. It also presented a way how Big Data can be used to analyze IoT data sets intelligently. Different platforms of Big-data Analytics are explained in detail, and light is given on which of them is best for IoT data.

Keywords: *Big data, Frameworks, Internet of Things (IoT), Architecture, Big Data Analytics (BDA)*

1. INTRODUCTION

IoT is transforming organisations in every sector of the global economy and our way of life, improving both the quality of life and the way we live. Everything is being automated and networked as we advance towards the future. Every 'thing' in our lives now has the potential to be connected to the internet thanks to the growth of smart, embedded, connected systems, and technologies. The trip has been extremely futuristic, from smartphone to self-driving automobile.

To improve the convenience and effectiveness of our lives, this technology is an essential component of the development of smart cities. The system is capable of self-configuring because to its dynamic global network infrastructure. It connects the digital world of information technology (IT) with applications to the physical world of operations technology (OT) with equipment. Data produced by IoT devices play an essential role in the conversion of raw data to knowledge.

IoT devices save their data in an unstructured format, therefore big data analyses this data in real time and stores it utilizing a variety of storage systems. The demand for large data in IoT is therefore urgent. The future of IoT and big data is intertwined. It is clear that the two sectors will produce innovative ideas and chances with a lasting effect.

2. Overview of IoT.

The network of physical objects—"things"—that are integrated with sensors, software, and other technologies for the purpose of communicating and sharing data with other devices and systems over the internet is referred to as the Internet of Things (IoT). These gadgets include anything from common domestic items to high-tech industrial gear. Experts predict that by 2025, there will be 22 billion connected IoT devices, up from the current 7 billion. [2]

2.1 Components used in IoT:

- Low-power embedded systems
- Sensors
- Control Units
- Cloud computing
- Availability of big data
- Networking connection

IoT is a system of interrelated things or machines (computing, mechanical or digital devices) which can connect these machines or things without any interruption of human. It is a Machine to Machine (M2M) communication process.

IoT will expand in reach and become more complex in the not too distant future. The world will be altered in terms of "In a connected world, everything is possible at any time"

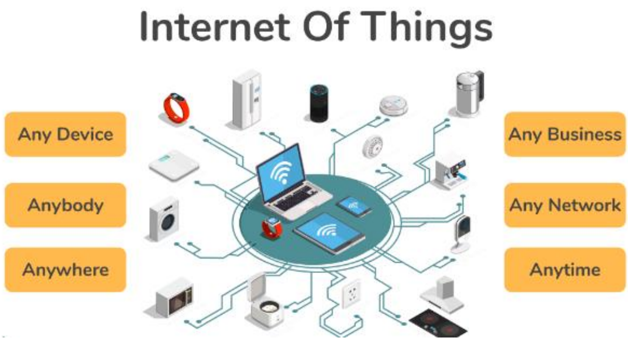

Fig1.Data source for IoT

2.2 IOT Architecture

- **PerceptionLayer:**

The foundation of IoT architecture is this layer. Numerous sensors and actuators are utilised at the perception layer to collect important data such as temperature, moisture content, intruder detection, sounds, etc. The primary purpose of this layer is to gather data from the environment and transmit it to another layer so that actions can be taken depending on that data.[5]

- **NetworkLayer:**

It serves as the connecting layer between the perceptual and middleware layers, as its name implies. Using networking technologies like 3G, 4G, UTMS, WiFi, infrared, etc., it receives data from the perception layer and sends it to the middleware layer. Because it facilitates communication between the middleware and perception layers, this layer is also known as the communication layer. Data is transferred securely at all times, maintaining the privacy of the collected information.

- **MiddlewareLayer:**

Advanced functions including storage, computing, processing, and the ability to take action are available in the middleware layer. It maintains all data sets and sends the necessary data to each device depending on its address and name. Additionally, it is capable of making decisions based on calculations made from sensor data sets.

- **Application Layer:**

Based on information collected from the middleware layer, the application layer controls every aspect of the application process. Sending emails, turning on alarms, security systems, turning devices on or off, smart watches, smart agriculture, and other functions are all included in this program.

- **Business Layer:**

Any device's success depends not just on the technologies it uses, but also on how it is distributed to its users. For the device, the business layer does these responsibilities. It entails creating graphs, flowcharts, outcomes analysis, and how the device can be improved, among other things.

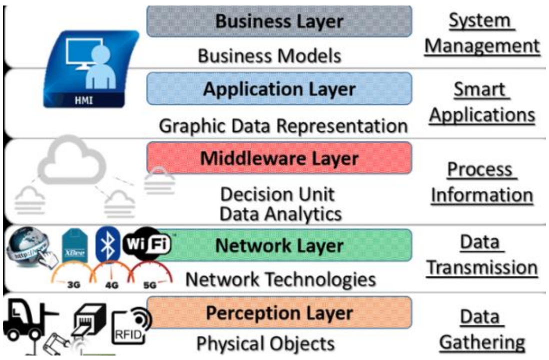

Fig2. Five layered IOT architecture

2.3 Application Domains: IOT is currently found in four different popular domains:

1) Manufacturing/Industrial business

2) Healthcare

3) Security

4) Retail

3. Overview of Big data

The Big Data terminology refers to large, diverse sets of information with dimensions that go beyond the capabilities of widely used database management systems (DBMS) or standard data processing software tools to manage within a given limit

Big data pertaining to businesses using internet services is now widely available. For instance, Google manages hundreds of Petabytes (PB) of data, and Facebook logs about 10 PB of data each month.

The Internet of Things (IOT) paradigm relies on sensors to gather and send data globally. These sensors produce a growing amount of data, which tends to aggregate into a sizable heterogeneous dataset. This data must be processed and stored in a way that preserves its quality. Existing IT businesses must upgrade their designs and infrastructures in order to retain the volume and relationships of such enormous data.

There are many tools that are used by data analysts to produce useful information from unorganized data.

Big Data and IOT are mutually dependent and have significant mutual effects. Big data capabilities are becoming more and more in demand as IOT expands. An organization's big data storage infrastructure must be updated as a result of the daily increase in data volume, which necessitates more sophisticated and creative storage solutions.

3.1 Traditional four Vs of Big Data

Big Data refers to data which is also too vast or complex to process using usual methods, including what's known as the four V's:

Fig3. Four V's of Big Data

1. Volume:

The volume of information gathered from many sources.

2. Velocity:

A measure of how quickly data is processed.

3. Variety:

The different types of formats of data that are transferring across systems.

4. Veracity:

The ability of your Big Data tools and analysis to separate poor quality and high quality data.

3.2 10V's model

To disclose the inherent qualities of this heterogeneous data and enhance decision-making, new mining, analysing, modelling, visualising, and forecasting tools are required. Moreover, with further advancements, scientists have reached to 10V's of Big Data. In 10V's model, we have the following

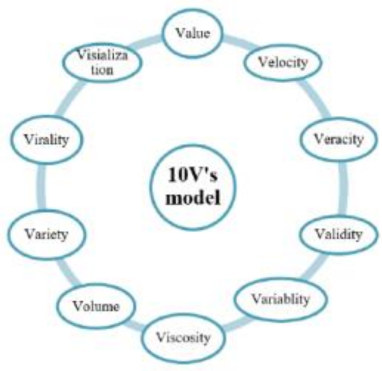

Fig 4. 10 V's of Big Data

1. Volume: It is the most crucial V in v's model. It describes big data. With the rise in data generation devices, broad, diverse data is being generated
2. Velocity: Velocity represents the rate of big incoming data from various devices.
3. Variety: As the definition of Big data says, it is a large amount of heterogeneous data. So, variety is indeed the essential property of big data
4. Value: Continuous amount of data generation tends to create Big Data. This data is of no use until or unless it seems to have some value. Thus the value of data indeed is an essential factor of big data
5. Validity: For future use of data, it must be precise and accurate. Any organization should validate the data if it wants to make correct decisions for the future based on the data collected by the devices. So, Validity is considered an essential factor for big data.
6. Variability: Variability includes data consistency and value of data.
7. Viscosity: Viscosity is considered as a part of velocity. It is used to describe the delay or lag-time which occurs between the sender and receiver during data transmission
8. Virality: It describes the data speed. This property has checks on the data speed with which sender and receiver access data from different devices.
9. Visualization: This property represents big data symbolically. Visualization helps to find out the hidden patterns. These hidden patterns help in decision making for any query of big data. Visualization helps Big data to play an essential part in decision- making.

4. Big Data Analytics

When data scientists, analysts, and statisticians employ strong tools and techniques to extract trends and patterns from sizable, unstructured, and diverse data sets and make these quickly and easily accessible to company executives, managers, and other important stakeholders, this is referred to as big data analytics. Business strategies and plans are developed using these findings. Data analysis comes in four different flavours [1].

1. **Descriptive analytics**: This type of analytics seeks to answer "what happened". This type of analytics reviews data and uses a lot of traditional research approaches.
2. **Diagnostic analytics**: Diagnostic seeks to answer "why did something happen".

3. **Predictive analytics**: Predictive model seeks to answer "what will happen in the future". This branch of analytics focused on predicting what you may do.
4. **Prescriptive analytics**: Prescriptive analytics seeks to determine "what should be done"

4.1 NECESSITY OF IOT AND BIG DATA IMPLEMENTATION

Big Data analytics is the process through which data scientists, analysts, and statisticians use potent tools and techniques to glean insights from sizable, unstructured, and diverse data sets and then rapidly and readily make these insights available to business decision-makers, managers, and other key stakeholders. The strategies and plans for businesses are developed and informed by these findings. Four different forms of data analysis exist.

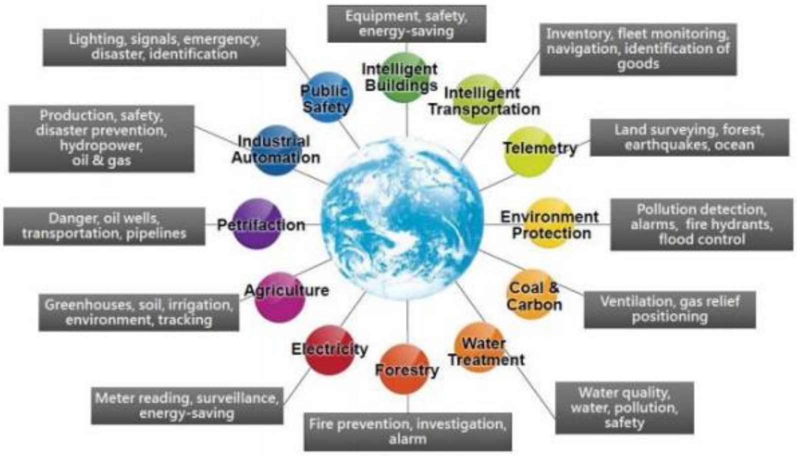

Fig5.big Data produced across various areas

5. CHALLENGES OF IoT WITH BIG DATA

5.1 Too much data

IoT is a network of connected gadgets that the internet monitors. Actuators, sensors, cameras, and other connected devices produce a large volume of data. **Petabytes** of data are produced by passing over **terabytes** of data due to the extensive development of IoT applications. The biggest contributors to the huge volumes of data produced on a Broadview are IoT applications like the smart city, smart industrial, home automation, intelligent transit systems, and monitoring sensors. IoT devices, however, are constantly producing a large volume of data. A lot of data is often managed by the data warehouse. The difficult task is to extract the relevant information from such a large amount of data. Big Data is the answer to this issue. Big data analytics has grown in popularity in recent years across a variety of industries, including online shopping, social computing (which includes recommender systems and prediction markets), retail, healthcare, and other interdisciplinary scientific studies.[3]

5.2 Misbehaving devices

Other difficulties include heterogeneous hardware, a sluggish CPU, little memory (of the order of 100KB), scarce energy resources, robustness and self-organization, and real-time demands like scheduling support. Big Data and IoT can be combined to address a variety of problems. By connecting with the cloud, big data can be useful, for example, in areas with limited energy supplies. The data may be transmitted to the cloud, and we can create as many virtual machines as needed using Amazon Web Services. This virtual computer resolves the IoT's heterogeneous hardware challenge.

5.3 Storage

Every day, Google processes almost 20,000TB of data. More than 6 billion people use mobile smartphones to text, call, browse, and tweet. Therefore, for the same, effective management methods and tools are needed. The efficient creation of services and products made possible by the new Big Data technology has boosted performance and aided in decision-making. By efficiently using the resources, big data attempts to minimise the hardware and lower the processing costs. Several technologies and strategies, including Not Only SQL (NoSQL), Google Big Table, Voldemort, and MemcacheDB, are used to handle data effectively. Hadoop, MapReduce, and BigTable are some of the data management tools and methods used for big data.

5.4 Complexity

Utilising the data while it is still in motion and gleaning the necessary information from it is a significant challenge. Due to the enormous amount of data produced and ingested by billions of concurrently occurring events that are geographically dispersed all over the world, the IoT infrastructure is exceedingly complicated. The complexity of IoT's infrastructure is increased by difficulties in describing, interpreting, processing, and predicting. Reliability, safety, fault tolerance, and security are considerations. All of these difficulties can be efficiently handled using Apache Strom.

6. COHERENCE OF IOT AND BIG DATA

The issue is how to convert the data that the Internet of Things (IoT) collects into useful knowledge. Big data analytics are useful in this situation. The main area of research focuses on is IoT and Big Data integration. Big Data can be used to transform the enormous volume of unstructured data produced by IoT devices into information that is usable. There is unstructured data all around us. Images, movies, sensor data, GPS, mobile devices, social networking platforms, etc. are some of them. When the sensor data does not appear to be originally event-driven, sparse data can result. Making the sensors only capture the data that is of interest is one method of managing the huge data generated by IoT. Making the data available on a cloud platform is another option. One of the most important technologies today is cloud computing. Instead of using a local equipment, such as a personal PC, tablet, or cell phone, cloud computing uses connected remote devices that are hosted online to gather, manage, and analyse data. The data can then be analysed utilising the Hadoop eco system from this data centre.

The HBase, Zookeeper, Hive, Mahout, and other components of the Hadoop ecosystem. The purpose of Apache Hadoop[18] was to process big clusters more efficiently and affordably. The high throughput of the Hadoop eco system, which can deal with issues linked to large-scale data processing and analysis, is one of its key features.

Spark and MapReduce are the two primary big data infrastructure technologies. IoT and big data can be thought of as two sides of the same coin. In terms of big data, it can be said that the data gathered from the linked items is vast in diversity, volume, and veracity. It is also high in quality, quantity, and sensitivity. Such data types are capable of being handled by Hadoop.

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The potential of big data analytics in the process of data-driven decision making is demonstrated by the rapid rise in data consumption and the sheer number of internet-connected equipment. Big data and the Internet of Things work together to advance the technical revolution that has come after.

The link between IoT and data analytics is depicted in Figure.

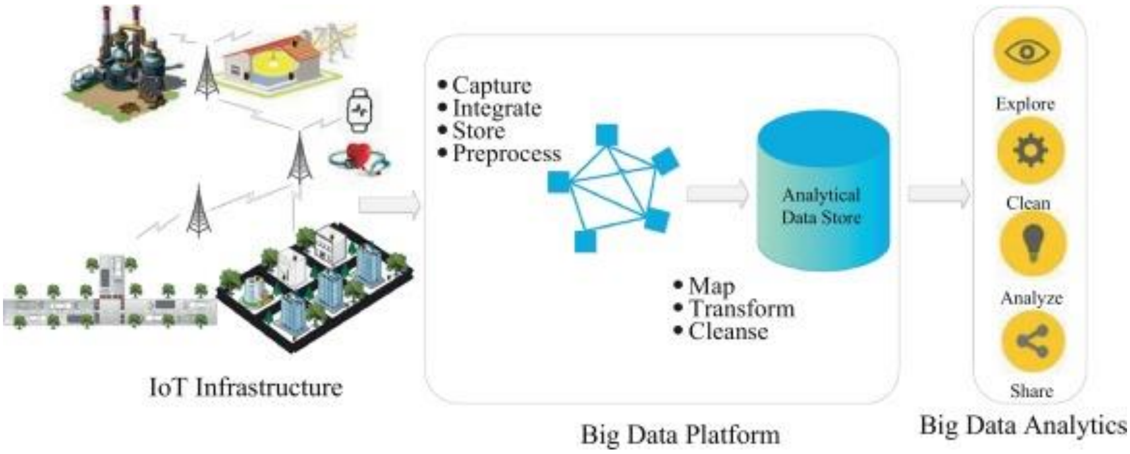

Fig 6:Bigdata Analytics and IoT

In short, it can be stated that Big Data is all about data and IoT is about data, devices/objects and connectivity

7. Big Data Tools and Techniques used for IoT Framework

To convert IoT structured, semi-structured, and unstructured data into metadata or comprehensive form for the subsequent analysis process, big data analytics needs specific tools and approaches. These technologies make use of algorithms to find trends, correlations, and patterns across different types of data.[4]

These tools are used to visualise the results of data analysis in the form of graphs, tables, pie charts, bar charts, etc. Various platforms that can analyse IoT data are described in this section. Platforms for big data analytics are detailed below.

7.1 Apache Hadoop

A platform that is open-source is Apache Hadoop. It serves as a storage facility for a substantial amount of raw data. It is capable of Big Data Analytics. Apache Hive, the Hadoop kernel, Map-Reduce, and HDFS (Hadoop Distributed File System) make up this common framework. Libraries in Hadoop make advantage of a straightforward programming model. The data is stored in HDFS, and it is distributedly processed by Map-Reduce. Data can be distributed across N nodes and duplicated using the HDFS and MapReduce technology.

7.2 Apache Spark

Although it is just as open-source as Apache Hadoop, it is used to get around Map-Reduce's drawbacks, including as fault tolerance and linear scalability. It offers swiftness, usability, and comprehensive analytics.

7.3 Dryad

It functions as a data flow graph for distributed and parallel data sets. Even without knowledge of concurrent programming, a user can operate several machines simultaneously. It effectively manages cluster failures, generates graphs, allocates available free machines according to a schedule, displays jobs to available machines, etc.

7.4 Apache Drill

It is employed in a distributed system for the analysis of Big IoT data. It is compatible with a variety of query languages. It is capable of managing thousands of servers at once. Map-Reduce is used for analysis while HDFS is used for storage.

7.5Apache Storm:

An open-source and cost-free large data processing solution is called Apache Storm. With a real-time framework for data stream processing that supports any programming language, Apache Storm is another Apache offering. It provides distributed, fault-tolerant real-time processing. with the capacity for real-time calculation.It creates a data cluster resembling a Hadoop cluster. It can also function as a worker node and a master node

7.6 Splunk

Cloud computing and big data are combined in it. The user can browse, search, and monitor the data using a web interface. Indexing machine-generated organised and unstructured data is beneficial. It is hence beneficial for IoT Big data sets. It is a sophisticated tool for real-time and commercial data investigation..

7.7 Jaspersoft

It is a real-time data analysis tool that is open-source. It displays data from a variety of sources, including Redis, Cassandra, and Mongo DB. It can design robust HTML reports.

7.8 Talend

A large data tool called Talend makes big data integration simple and automatic. Native code is produced via its graphical wizard. Additionally, it enables the integration of big data, master data management, and data quality checks.

7.9 Splice Machine: It is a tool for large data analytics. They may use their architecture on any public cloud, including AWS, Azure, and Google.

7.10 Plotly:

Users can create charts and dashboards with Plotly's analytics tool and share them online

7.11 Azure HDInsight: It is a cloud-based Spark and Hadoop service. It offers big data cloud services in the Standard and Premium categories. It offers the organisation an enterprise-scale cluster on which to run its big data applications.

7.12 R: R is a free programming language and graphics and statistical computation software. For creating statistical software and conducting data analysis, statisticians and data miners frequently use the R programming language. There are several statistical tests available in the R language.

7.13 Lumify:

Lumify is regarded as a platform for large data fusion, analysis, and visualisation. Through a variety of analytical capabilities, it aids users in finding connections and exploring relationships in their data.

7.14 Qubole: Big data platform that maintains, learns, and optimises itself based on your usage is called Qubole Data Service. This allows the data team to focus on business results rather than platform management.

8. CONCLUSION

The role of big data in IoT is the primary emphasis of this research. IoT is one of the big data sources that will grow significantly in size over the coming years as more and more devices connect to the Internet at an ever-increasing rate. It is challenging task to process, manage and analyze large amount of data in scalable, cost-effective and distributed manner. So It is necessary to process this enormous volume of data effectively. When processing, transforming, and analysing vast amounts of data, big data tools and techniques are essential in the Internet of Things (IOT). Both the IoT and the big data are at an emerging stage and there will be upgrade.

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REFERENCE

[1]R. Ratra, and P. Gulia, "Big Data Tools and Techniques: A Roadmap for Predictive Analytics.", International Journal of Engineering and Advanced Technology (IJEAT), *Vol. 9, Issue-2*, pp. 4986-4992, 2019.

[2].M. Farooq, M. Waseem, S. Mazhar, A. Khairi, and T. Kamal, "A review on internet of things (IoT)," International Journal of Computer Applications, *vol. 113*, *no. 1*, *2015*

[3] https://www.upsolver.com/blog/IoT-analytics-challenges-applications-innovations

[4].https://www.edureka.co/blog/bigdata-analytics-tools-and-features

[5].https://dgtlinfra.com/internet-of-things-IoT-architecture/