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Big Data Analysis: Enables Internet of Things

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Abstract- The Big Data and Internet of Things (IoT) are two most emerging techniques in latest years. Data is created constantly & ever increasing rate. Different areas like mobile phones, social media, various medical imaging technologies & more creation of new data. This must be stored somewhere for some purpose.
Big data is data whose scale, distribution, diversity, timeliness require the use of new technical architectures & analytics to enable insights that unlock new sources of business value.
Internet Of Things is new revolution in abilities of the end point that are connected to the Internet. IoT is about devices, data and connectivity. The real value of Internet of Things is about creating smarter products, delivering intelligent insights and providing new business outcomes .This paper shows factors and relation between Big Data and Internet of Things.
Huge data generated by different IoT devices must be analyzed by different Big Data Analytic tools.

Keywords: Big Data, Internet Of Things, Data Analytics

I. INTRODUCTION

The data generated by social media, genetic sequencing, health care applications, temperature sensors, and different other software applications and digital devices that continuously generate large amounts of structured, unstructured, or semi-structured data is strongly increasing. This massive data generation results in "big data" .Big data is characterized by three attributes that are (3V):

1. **Volume:** As there is no fixed threshold for volume of data to be considered as Big Data. Big Data is used for massive scale data, which is difficult to store, manage & process by using traditional databases.

3. **Variety:** Big Data reflects variety of new data sources, formats & structures such as structured or unstructured data including text, audio, video, image & sensor data.

4. **Velocity:** Big Data describes high velocity of data which means how fast the data is generated & how frequently it varies. A successful Internet of Things (IoT) environment requires standardization that contains interoperability, compatibility, reliability, and effectiveness of the operations on a global scale. The rapid growth of the IoT causes a sharp growth of data. Enormous amounts of networking sensors are continuously collecting and transmitting data to be stored and processed in the cloud. Such data can be environmental data, geographical data, astronomical data, logistic data, and so on. Mobile devices, transportation facilities, public facilities, and home appliances are the primary data acquisition equipment in IoT[1].

Table 1.

Category	Big Data	Small Data
Data Sources	Data generated outside the enterprise from nontraditional data sources, includes: 1. Social Media 2. Sensor Data 3. Device Data 4. Video, Images etc.	Traditional enterprise data sources, includes: 1. Enterprise resource 2. Planning data 3. Financial data 4. Customer Relationship data
Volume	Terabytes Terabytes Exabyte Zettabytes	Gigabytes Terabytes
Velocity	Often real time Requires immediate response	Batch processing.doesnot requires immediate response.
Variety	Structured, semistructured, quasi-structured & non structured.	structured

II. Related Work: How Big Data relates with IoT?

Big data analytics in IoT requires processing a large amount of data and storing the data in various storage technologies. Figure 1 shows that how big data works and analytics with IoT data where, unstructured data are gathered directly from web-enabled "things," big data implementations large queries to allow organizations to get rapid insights, make quick decisions, and interact with people and other devices [2]. The interconnection of sensing and connected devices provides the capability to share information across platforms through a architecture and develop a common operating picture for enabling innovative applications.

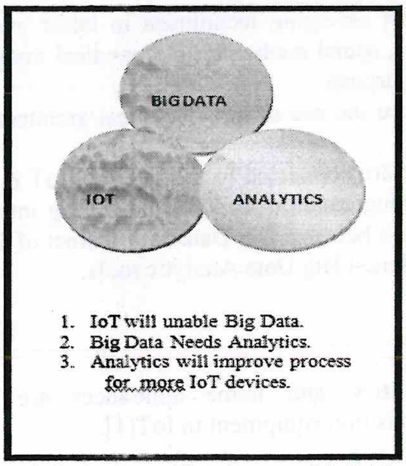

Figure 1: Relation of Big Data with IoT

For example, the interaction of devices such as CCTV cameras, smart traffic lights, and smart home devices, generates large amounts of data sources with different formats. The data collected by IoT is processed as follows:

1. This IoT generated big data largely depends on their 3V factors that are volume, velocity, and variety.
2. In the big data system which is basically a shared distributed database, the huge amount of data is stored in big data files.
3. Analyzing the stored IoT big data using analytic tools like Hadoop, Map-Reduce or Spark.
4. Generating the reports of analyzed data[3].

III. BIG DATA ANALYSIS & IoT DATA

The data generated by IoT devices is in a scalable manner. Users must be able to handle this data and make it actionable. The actions performed on these high volumes of stream data may include analytics, statistics operation, metric calculation, or event correlation. The actions may vary depending on the big data scenario, and the data may not always be stream data. Therefore IoT data requires proper analysis in increased form, with right size infrastructure & performance focused [7].

Big data analytics require technologies and tools that can transform a large amount of structured, unstructured, and semi-structured data into a more understandable data and metadata format for analytical processes. The analytical tools must discover patterns, trends, and correlations over a variety of time horizons in the data. After analyzing the data, these tools visualize the findings in tables, graphs, and spatial charts, reports for efficient decision making.

IV. SOME RELATED CASES

Following are cases for big IoT data analytics, as well as relevant to IoT applications. Most of the IoT applications use analytic tools to analyze IoT data.

1. Smart Transportation

A smart transportation system is an IoT-based use case that aims to support the smart city concept. A smart transportation system intends to deploy powerful and advanced communication technologies for the management of smart cities. Traditional transportation systems, which are based on image processing, are affected by weather conditions, such as heavy rains and thick fog. The captured image may not be clearly visible. The design of an e-plate system using RFID technology provides a good solution for intelligent monitoring, tracking, and identification of vehicles [6]. Moreover, introducing IoT into vehicular technologies will enable traffic congestion management to exhibit significantly better performance than the existing infrastructure. This technology can improve existing traffic systems in which vehicles can effectively communicate with one another in a systematic manner without human intervention.

Satellite navigation systems and sensors can also be applied in trucks, ships, and airplanes in real time. The routing of these vehicles can be optimized by using the bulk of available public data, such as traffic jams, road conditions, delivery addresses, weather conditions, and locations of refilling stations. For example, in case of runtime address change the updated information (route, cost) can be optimized, recalculated, and passed on to drivers in real time. Sensors incorporated into these vehicles can also provide real-time information to measure engine health, determine whether equipment requires maintenance, and predict errors.

2. Smart Metering

Smart metering is one of the IoT application use cases that generates a large amount of data from different sources, such as smart grids, tank levels, and water flows, and silos stock calculation, in which processing takes a long time even on a dedicated and powerful machine. A smart meter is a device that electronically records consumption of electric energy data between the meter and the control system. Collecting and analyzing smart meter data in IoT environment assist the decision maker in predicting electricity consumption. Furthermore, the analytics of a smart meter can also be used to forecast demands to prevent crises and satisfy strategic objectives through specific pricing plans. Thus, utility companies must be capable of high-volume data management and advanced analytics designed to transform data into actionable insights [3].

3. Smart Supply Chains

Embedded sensor technologies can communicate bidirectional and provide remote accessibility to over 1 million elevators worldwide. The captured data are used by on-and off-site technicians to run diagnostics and repair options to make appropriate decisions, which result in increased machine uptime and enhanced customer service. Ultimately, big IoT data analytics allows a supply chain to execute decisions and control the external environment. IoT-enabled factory equipment will be able to communicate within data parameters (i.e., machine utilization, temperature) and optimize performance by changing equipment settings or process workflow. In-transit visibility is another use case that will play a vital role in future supplies chains in the presence of IoT infrastructure. Key technologies used by in-transit visibility are RFIDs and cloud-based Global Positioning System (GPS), which provide location, identity, and other tracking information. These data will be the backbone of supply chains supported by IoT technologies. The information gathered by equipment will provide detailed visibility of an item shipped from a manufacturer to a retailer. Data collected via RFID and GPS technologies will allow supply chain managers to enhance automated shipment and accurate delivery information by predicting time of arrival. Similarly, managers will be able to monitor other information, such as temperature control, which can affect the quality of in-transit products [4].

4. Smart Grid

The smart grid is a new generation of power grid in which managing and distributing electricity between suppliers and consumers is upgraded using two-way communication technologies and computing capabilities to improve reliability, safety, efficiency with real-time control, and monitoring .One of the major challenges in a power system is integrating renewable and decentralized energy. Electricity systems require a smart grid to manage the volatile behavior of distributed energy resources .However, most energy systems have to follow governmental laws and regulations, as well as consider business analysis and potential legal constraints. Grid sensors and devices continuously and rapidly generate data related to control loops and protection and require real-time processing and analytics along with machine-to-machine (M2M) or human-to-machine (HMI) interactions to issue control commands to the system [8].

5. Smart Agriculture

Smart agriculture is a beneficial use case in big IoT data analytics. Sensors are the actors in the smart agriculture use case. They are installed in fields to obtain data on moisture level of soil, trunk diameter of plants, microclimate condition, and humidity level, as well as to forecast weather. Sensors transmit obtained data using network and communication devices. These data pass through an IoT gateway and the Internet to reach the analytics layer. The analytics layer processes the data obtained from the sensor network to issue commands. Automatic climate control according to harvesting requirements, timely and controlled irrigation, and humidity control for fungus prevention are examples of actions performed based on big data analytics recommendations [5].

6. Smart Traffic Light System

The smart traffic light system consists of nodes that locally interact with IoT sensors and devices to detect the presence of vehicles, bikers, and pedestrians. These nodes communicate with neighboring traffic lights to measure the speed and distance of approaching transportation means and manage green traffic signals .IoT data gathered using the system require real-time analytics processing to perform necessary tasks, such as changing the timing cycles according to traffic conditions, sending informative signals to neighboring nodes, and detecting approaching vehicles that use IoT sensors and devices to prevent long queues or accidents. Moreover, smart traffic light systems can send their collected IoT data to cloud storage for further analytics[6].

V. CONCLUSION

This paper is concluded as the generation of Big Data by IoT, the traditional data processing capacity of IoT is becoming ineffective and it is imperative to incorporate Big Data technologies to promote the development of IoT. The interconnection of sensing and connected devices provide the capability to share information across platforms through a architecture and develop a common operating picture for enabling innovative applications It is important to understand that the success of IoT depends upon the effective use of Big Data analytics. This paper covers the major aspects of big data with IoT . There is hope that both the IoT and the big data are at emerging stage and there will be upgrade.

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