Network-Based Applications of Multimedia Big Data Computing in IoT Environment

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Abstract In the modern business world, business management techniques are continuously increased and governed by smart devices and innovative technologies. These devices are associated with internet can be called as a device of Internet of Things (IoT). Wi-Fi, Bluetooth, Infrared and Hotspot technologies are the connecting medium for these devices. Somehow, these devices are connected to the servers for processing the user request. These sensing devices are producing enormous amount of data in structured or semi-structured or unstructured form otherwise known as big data. The data are stored, manipulated and analyzed with the help of big data techniques for taking well-defined decisions. Thus, the top management people of the business world are able to drive their business in real time. The uses of smart devices are rapidly increased in different application categories of IoT known as Personal, Group, Community and Industrial. Due to easy access to internet, independent power source and sensing without human intervention makes smart devices as an important component of IoT. This chapter first gives a brief introduction on IoT with its structure. Then different technologies are discussed in the field of IoT. The different application areas of IoT are also presented. Finally, Big Data and the importance of IoT based sensor devises in Big Data is presented.

Keywords Big data · IoT · RFID · Bluetooth · Wireless sensor network

1 Introduction

Internet of Things (IoT), the most remarkable network of intelligent electronic devices stands for "Connect with everyone, everything, always, everywhere for each service and each network" [1]. This development brings an immense revolution in

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the field business world. Catching information with the help of smart devices, store it and take decision for business world with the help of emerging technologies is the way Big Data is handled. These smart devices are connected through internet and send contextual information such as location, temperature, auto generated machine reports, etc. at any time or any moment from one location to other location [1]. The devices are executed with the help of sensors and processors. Due to lower price of sensors, processors and spreading of internet connection, the usages of these devices are increased strongly. Hence in real business world these devices are used as human necessity rather than "good to have."

As per the Gartner expectation the number of users who uses the smart devices will be rise to 20 billion by 2020 while the other scientist estimate that it should be 50 billion [2]. But in order for this to happen, only holding smart devices is not the solution. The requirement is, design a device with its own internet, independent power source and a way of sensing the physical environment [2]. Somehow, to happen these things a number of technologies are very much available with us. These are RFID, Bluetooth, 3G, 4G, 5G, wireless sensor networks, solar chargeable batteries, and portable devices. These technologies are operated with the help of sensor devices. These devices are not only very much capable to collect, analyze, transmit a large set of structured, unstructured or semi-structured data in real time but also monitored and control the complex industrial processes. For that reason, without data, the IoT devices do not have features and capabilities that have been backed by worldwide attitudes. These large set of data are otherwise known as Big Data.

IoT is an excellent driven approach to implement in today's business world [3, 4]. But the biggest problem for enterprises is how to generate the huge amount of data, collect those data, store them in an efficient manner for processing them to achieve their business objective. For generating such amount data is only possible with the help of the things and technologies used in IoT. Hence the researchers as well as the engineers are relaxed by using these devices. But still they are facing challenges in some research related work and real time scenario. i.e. how to manage these massive and heterogeneous data in highly distributed environment [3, 4]. This is possible only with the help of wear Operating System by Google such as Android Wear known as 'brain' of human Body area Network (BAN) [5] which gives the storage and communication capabilities of smart devices. Last but not least with technologies such as Near Field Communications (NFC) [6]. The smart sensor devices are also used as actuators and the actions with trigger control the devises like televisions, moor car, etc.

This chapter presents an overview on Internet of Things (IoT) like Bluetooth, Wi-Fi, Optical tags and quick response codes, Bluetooth, Body area Network (BAN), Near Field Communications (NFC), etc. A number of applications with the help of smart devices interconnected to other devices are discussed. Big Data and the role of IoT in big data are also discussed. The processing of IoT based big data is discussed through which how the business world will be benefited are also discussed. At the end of this chapter the future opportunities of IoT and it's use in big data analysis for business development is discussed.

2 Internet of Things (IoT)

IoT is an wide and expanded networks of intelligent devices that are auto organized among them and share their data, information and resources over internet for changing the environments in a smart way [7]. The advanced IoT aims to enhance the lifestyle of peoples by using "smart" devices in the environment, which is fully integrated with Internet [4]. This will convert the people-to-people communication lifestyle to device-to-device communication lifestyle. It is also expected that the model of IoT includes a huge numbers of smart devices that are actuating, sensing and processing for establishing connection with Internet [8]. As the time passes away, the numbers of smart devices otherwise known as "things" which are connected to the internet are increased and finally these things are the major producers as well as the consumers of the data or resources. These things are obtain their data or resources from the physical world in real time over Internet by using wireless technology or through gateway [8]. These things are also able to connect other things and obtain the information by sensing and make independent decision [9–11].

In today's world, IoT is a primary need for the business world. This world depends on other enterprises to fulfill their requirements time to time. These needs of their requirements are maintained very easily with the help of smart devices or things. The ability of tracking their requirements make entrepreneur more efficient by speed up their process, reducing error and prevent theft through IOT [8]. Providing an authenticated and satisfactory connection to those smart devices of their companies is a big challenge. In this direction, the things of IoT can play bigger role as it was always connected with Internet through several communication interfaces, availability of many useful features, significant storage capacity and ability for taking decision by computing [12]. The term IoT has attracted the attention of today's IT world with a vision by projecting the global infrastructure of physical objects connected in a common network, enabling anytime, anywhere for everybody [13]. The IoT is also trying to create a global network, that communicates between people-to-people (P2P), people-to-things (P2T), things-to-things (T2T) (i.e. anything-to-anything) by providing a unique identity [14].

3 Structure of IoT

IoT is a large network of sensor devices, like RFID, barcodes, wired and wireless access, as well as the subnets of intelligence devices (i.e. computers) connected through a range of intermediary technologies that can act as a means of connectivity possible. International telecommunication Union (ITU) provide the structure of IoT and classified into four dimensions as given in Fig. 1 [15, 16].

For tagging things, RFID plays a vital role by automatically identifying a thing in real time for complete the identification process [17]. For Feeling thing, sensors are collecting the data from the environment by establishing the communication between

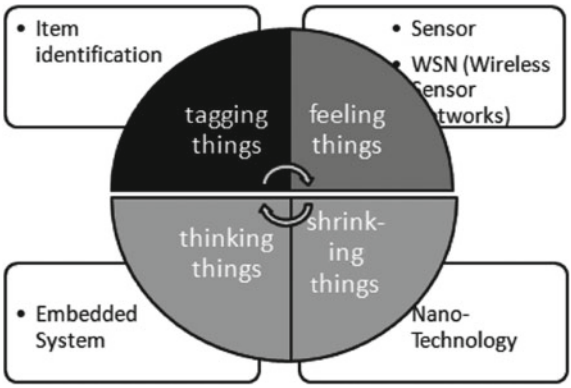

Fig. 1 Structure of internet of things [59]

physical and information world: for example measure the temperature and pressure [18]. In case of shrinking things, nanotechnology has been applied for connecting within small things: for example "for monitoring the quality of water in reasonable cost by using nano-sensors [18] in the field of healthcare the use of nano-sensors is utilized for diagnosis and treatment of diseases like HIV and AIDS [19]. In case of thinking, the embedded intelligence thing has established the network connection to the Internet with the help of sensors: for example maintaining the freshness of perishable items inside the refrigerators.

4 Technologies Used in IoT

IoT is a system, where the interrelated computing sensor devices or things are connected among themselves with the help of a number of technologies. Some of the technologies are discussed below.

4.1 Radio Frequency Identification (RFID)

RFID is a well known automated wireless identification mechanism [7]. It consists of three components named as scanning antenna, transceiver and RFID tags. This tag consists of a microchips, memory and antenna. It works on radio frequency waves for transmitting the signals. The tags are first activated with the help of this signal. After that the activated tag send a wave back to antenna, then it translated into data. RFID tags are basically two types named as active tag and passive tag. Active tag has work with its own energy source, i.e. a battery. On the other hand, passive tag draws energy from the reading antenna, whose electromagnetic wave activates the energy in the RFID tag's antenna. These tags are classified into two categories on the basis

of their memory types. These are read-only and write only. The RFID technology is divided into four types on the basis of low, high, ultra-high and microwave frequency [7, 20].

4.2 Barcode

Barcode is an optical of machine-readable form of a product to which it's stick. It is a way to code the numbers as well as letters with a formulation which includes space and different size of bars. It looks just like numbers of black lines with different width are placed in the form of square or rectangle with gaps [7]. These images are read by a laser scanner known as Barcode reader. These images are also read by using cameras [7]. The reader read these line thickness and space by the help of laser beam [7]. Then the reader transforms the reflected light into digital form for immediate intervention or storage. These barcode are basically three types named as Numeric, Alpha Numeric and Two dimensional [7].

4.3 Electronic Product Code (EPC)

Electronic Product Code (EPC) is used for single identification. In general EPC is an advanced form of barcode. EPC has its own numerical formulation system with greater capabilities for recognizing the products. In EPC the contained numbers are associated with specific information. These are the information of manufacture, starting point and end point of a shipment [7]. EPC consists of four parts, namely ONS (Object Naming Service), EPCDS (EPC Discovery Services), EPCIS (EPC Information Services) and EPCSS (EPC Security Services) [21]. EPC is designed in such a way so that it placed on a RFID tag and transmits data and activated when a signal is released from a reader. In today's fast moving environment the industry-driven standard of EPC was maintained by EPCglobal, a neutral and non-profit organization [22].

4.4 Internet Protocol (IP)

IP or Internet Protocol is a technique or protocol through which data or information is transmitted from one intelligence device to another over internet. The objective is to assign at least one IP in the form of binary to each intelligence device for achieving the uniqueness [7]. In the current scenario two version of IP are exist. They are IPv4 (IP version 4) consists of 32 bits and IPv6 (IP version 6) consists of 64 bits [7]. IPv6 and IPv4 are two completely separate protocols and not compatible with each other.

So these protocols cannot interact with each other directly but with the help of "dual stack" system exchanging data between IPv4 and IPv6 is possible [21].

4.5 Wireless Fidelity (Wi-Fi)

Wi-Fi is a network connectivity technology used for transferring high-speed data over short distance by using radio wave based devices (router, laptop, smartphones, etc.). These devises are bases on IEEE 802.11 standards in 1997 [3]. Different types of Wi-Fi standards are used by the wave-based devices. These standards are 802.11a, 802.11b, 80.2.11 g, and 802.11n [7, 23]. Now a day this wireless connectivity is an established part of everyday life. All smart devices like smartphones, laptops, tablets, cameras and very much other devices are used Wi-Fi connectivity. Due to the high-speed data transfer nature, Wi-Fi technology is highly accepted by hotels, homes, airports, and cafes in the society by using wireless access points [23].

4.6 Bluetooth

Bluetooth is a short-range low-cost wireless communication technology. With the help of this technology smart devices like smartphones, laptop, printer, cameras, tablet, PDAs, and other peripherals are transmitted data or voice wirelessly in short distances. The main purpose of Bluetooth technology is to replace the cables that normally connect with devices and keep a secured communication between the devices [24]. This technology was developed in the year 1994. It uses almost same frequency as other wireless technologies like cordless phones and Wi-Fi routers are used. It generates a 10 m radius wireless communication network known as personal area network (PAN), which can establish the communication between two to eight smart intelligence devices. This low cost and short-range wireless network allows us to send data like images, videos, voice and commonly text between the devices. The most important part of the Bluetooth technology is, it uses less power than the Wi-Fi technology. Its low power makes it less far from any of the other wireless devices in the 2.4 GHz radio band. Bluetooth v3.0 with high-speed technology incorporated devices can transfer up to 24 Mbps of data, which is faster than the 802.11b Wi-Fi standard, but slower than 802.11a and 802.11 g Wi-Fi standards. It was expected that as the technology has evolved, Bluetooth speeds have increased.

4.7 ZigBee

ZigBee is a wireless technology used for transmits data from one intelligent device to another in low cost and low power [25]. Specifically it was designed to control the

sensor network on IEEE 802.15.4 standard used for WPANs. This device is designed by ZigBee alliance and operates at 868 MHz, 902–928 MHz and 2.4 GHz frequencies only [25]. This is a very simple and less expensive communication system used widely for short-range wireless networks like Wi-Fi and Bluetooth. The communication network of ZigBee is also utilized for wide area network with the help of routers and allow other intelligent devices to join in his network. The ZigBee communication system consists of at least one coordinator, router and an end device for its operation in an efficient manner [25]. The coordinator behaves like a root and creates a bridge between the networks. The responsibility of ZigBee coordinator is to keep track of data when the transmission is performed and also store the data. It works like an intermediary router which gives permission to route the data through him from one device to another. The ZigBee devices connect themselves through the parent node of end device and maintain the life of the energy unit (i.e. battery) for long time. The router, coordinator and end device numbers are calculated on the type of network (i.e. star, mesh, tree, etc.) for which it works.

4.8 Near Field Communication (NFC)

NFC is a wireless communication technique on wave for intelligent compatible devices [7]. The benefit is, a user can transmit the data or information without needing to touch both the devices together. This technology is designed and developed by jointly "Philips and Sony" in the year 2004. This technology is very popular in Europe and Asia. It was also migrated to United State because of its popularity. This technology comes under the category of short-range wireless connectivity standard (i.e. ISO/IEC 14443). It creates a magnetic field for enabling the communication [26]. NFC technology started becoming widely available to consumers in the field of mobile payment like Google Wallet and mobile ticketing like Oyster Card [26].

4.9 Wireless Sensor Networks (WSNs)

WSN is a wireless sensor based network, specifically designed for the sensor devices which are available at distributed autonomous location. These devices are monitored the environmental conditions like pressure, location, temperature, heat, light etc [7, 27]. A WSN system built a wireless gateway among the distributed sensor devices. This sensor device consists of several technical components. These components are radio, power bank, microcontroller, analog circuit, and sensor interface. The radio technology of WSN system is consuming more battery power. So today's WSN systems are based on ZigBee due to its low consumption power. Depending on the environment, different types of WSN networks are selected and can be deployed underwater, underground, on land, and so on. These types of WSNs are used in different application areas like agriculture monitoring, Home Control, Build-

ing Automation, Industrial Automation, Medical Applications, military applications, highway monitoring, civil and environmental engineering applications, etc [27].

4.10 Actuators

Actuators are a electro-mechanical intelligence devices which is responsible for moving and controlling a system [7, 28]. It was operated by electrically, manually or various type of fluids (i.e. air, hydraulic, etc.) energy and convert to some kind of motion [7]. One common type of actuator named as pneumatic cylinder is powered by air and known as airtight cylinder. This is made from metal and used for storing energy of compressed air. These compressed airs move a piston when the air is released. It works much like a human finger. In the field of IoT, The actuators are utilized whenever there is a need to operate another device by applying a force.

4.11 Artificial Intelligence (AI)

Artificial intelligence (AI) is an area where the intelligent machines are simulated from the experience in such a way, so that it performs a task as human performs. These machines are connected with network to perform their daily activities and made human life easy [7]. These machines are also very sensitive and responsive to human's presence and activities [7]. The process for simulation of human intelligence and machine are including learning, reasoning and training. The intelligent machines are characterized as Embedded, Context Aware, Personalized, Adaptive and Anticipatory. The different application of AI are expert systems, speech recognition and machine vision [7].

5 Architecture of IoT

In today's world, the technological field of IoT extends into a very wide range. Billions to trillion of heterogeneous object or things are trying to connect themselves over the internet. So there is a need for a perfect reference model. The growing numbers of architectures of IoT are not able to give a perfect reference model [29]. The basic model provided a 3-layer architecture [26, 30], which have Application layer, Network layer, and Perception layer. Some other reference models of IoT architecture are also proposed and discussed in the literatures [31–33] with more abstraction. A very common and interesting view of a reference model named as 5-layer architectural model is briefly described below with the help of Fig. 2.

The First layer is known as object layer, otherwise known as perception layer. This layer is responsible for performing the functionalities like collecting informa-

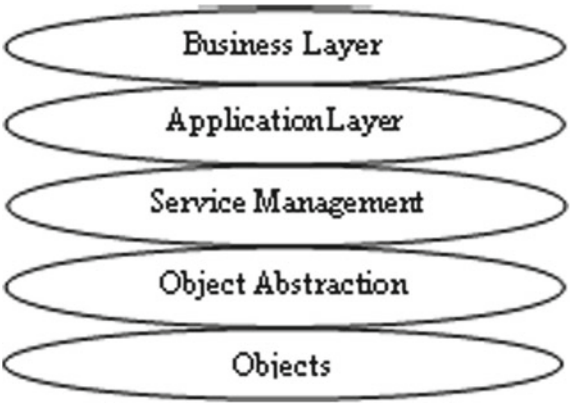

Fig. 2 5-layer architectural model of IoT

tion about location, weight, temperature, etc. by using standardized heterogeneous devices which have plug-and-play mechanism. This layer is also responsible for digitalizing the data and sends them through a secured channel to the next layer. The perception layer of IoT is the creator of Big data [29]. The second layer is Object Abstraction Layer and responsible for transferring the data which are collected in perception layer to the next layer. These data can be transferred through various devices having wireless technologies like RFID, 3G, GSM, Wi-Fi, Bluetooth with Low Energy, infrared, ZigBee, etc. [29]. This layer is also handling the data management process as well as cloud computing [31]. The third layer is known as Service Management layer Middleware layer. This layer is responsible for pairing a service with its requester based on addresses and names. This layer enables the IoT application programmers to work with heterogeneous devices or objects. This layer also processed the received data, take decision and provide the required services over the wireless network [32, 34]. The fourth layer is Application layer and responsible for providing the services requested by the customers. The ability of providing quality intelligent services to the customers need until their satisfaction is the main motto of this layer. The importance of this layer is to provide high-quality intelligent service as per the customer requirements. This layer is responsible to make smart and automated many business market domain such as home, building, transportation, industry, and healthcare [31, 33]. The fifth layer is Business Layer and maintains the overall activities and services of a system. This layer is responsible for building business models and makes it possible to take support decision by analyzing big data [29]. This layer is also responsible for monitoring and managing the above four layer of IoT architecture. Apart from this an architecture on e-health care is also proposed in [35]. FlexRFID, a middleware architecture of IoT was also implemented on different application domains like supply chain management, smart library management and healthcare sector [36–38].

6 Application Areas of IoT

In the professional life or day to day life humans are curious in nature. These curiosities provide a new begin where human start to make machines smart enough, so that it reduces the work load. The designed interconnected smart devices have captured the data and shared these data between machine to machine or machine to human or human to machine on a daily basis in different application areas of IoT. They are Logistic and supply chain management (SCM), transportation, healthcare, and environment and disaster monitoring, etc. [39].

6.1 Logistics and Supply Chain Management (SCM)

There are huge potential for applying IoT in many domain areas of Supply Chain Management. It helps the objects to communicate freely and enables better control on the logistics as discussed in [39–41]. It increases the efficiency of the process by scanning the data with the help of RFID tags, barcodes, NFC, and mobile phones and creates a smart ways of transmitting the things by using transmission protocols such as WSNs, GSM network, 3G, 4G, or even 5G networks, it brings in transparency in an organization [39]. It creates the real-time visibility of inventory system and brings transparency in an organization. A numerous examples on different application of IoT in the field of logistics and SCM are discussed in [39]. A supermarket chain management, where things (goods) are tracked and maintained the stock automatically by using WSNs, barcodes, and RFIDs is illustrated in [40]. The Use of Aspire RFID with session initiation protocol (SIP) to detect the location and mobility management of RFID tags is discussed in [39]. The design of Logistic Geographical Information Detecting Unified Information System Based on IoT is discussed in [42]. The concept of "circular economy," with the help of supply chain where tagging a product from manufacturing unit to the end of product life i.e recycling enables a new way of resource optimization is discussed in [43].

6.2 Transportation

IoT transforms the transport sector by optimizing the movement of human and things (goods), economy of the country and safety of the public. This smart transport system will automate the roads, railways, airways transform the experiences of passengers and give a new form to the way of goods tracked and delivered. The monitoring of road in real time and provide the status of road condition as alert system reported is discussed in [44]. Applications like license plate identification, parking place indexing and secure vehicle system are reported in [45]. A vehicle monitoring system based on WSN for measuring the performance of lithium-ion batteries used in electric

vehicles and enhance the uses of batteries by providing the route status to the driver is discussed in [46]. By using the IoT system the manufactures of electric vehicles provide a battery monitoring system and their charging schedule is presented in [43]. A fully autonomous vehicle integrated system, parking sensor system is also presented in [43]. How to improve customer experience and control the flow of passenger in London City Airport and provide them the "doorstep to destination" data time to time with the help of smartphone is discussed in [43].

6.3 Healthcare

The benefits of IoT technology have greatly reflected on healthcare. IoT intelligence devices are multiplied and used across the entire healthcare industry throughout the world. These devices are portable heart rate, check blood pressure and blood sugar, smart pill boxes, etc. A cooperative IoT based approach for better health monitoring and control of rural and poor human is proposed in [47]. How IoT is able to shift healthcare from cure to prevention, and give people a greater control over their decisions is discussed in [43]. The uses of smartphone for monitoring vital signs and transmit health data directly to the care centers are proposed in [48]. This system provides emergency help to patients, who suffer from critical illness. As most of the IoT devices are connected via the cloud, healthcare providers i.e hospital can constantly and consistently check-up their patients.

6.4 Environment and Disaster

Hurricanes, earthquakes and tsunamis that destroy everything. Due to lack of technical resources and physical obstacles execute the work of the emergency services is very difficult. Thanks to the devices of IoT, those are being seen as a solution for reducing the impact of these disasters [39]. These devices are made up of smart sensors and connect themselves with the help of Internet. They transmit information in real time and help the disaster recovery process. Sensors are also utilized to monitor physical or environmental conditions, such as temperature, pressure and sound etc. and pass their data through the network for taking right decision of facing a disaster [39]. A Long-Term Environmental Monitoring system with the help of WSN is discussed in [49].

6.5 Smart Home

A smart home, otherwise known as automated home where the available devices placed anywhere is controlled remotely from any place in the world. These devices

are interconnected through internet and accessible through one central point [50, 51]. This central point is a smart device like smartphone, tablet, laptop, game console, etc. Examples like Door locks, televisions, home monitors, cameras, lights and even appliances such as the refrigerator can be controlled through one home automation system. The whole system is installed on a smart network device for certain changes to take effect time to time. These devices come with self-learning skills. It learns the homeowner's schedules and adjusts as needed. A Bluetooth based home automation system is discussed in [52].

6.6 Smart Farming

In Smart farming, The IoT based intelligent devices are monitoring the crop and give information so that the farmer able to take decision instantly with the help of expert management system. This makes our system as an automated irrigation system discussed in [43, 50]. Sensors can also used for tracking animals, diseases, etc. The farmer can monitor the field condition from anywhere. The IoT based automated farming system is more efficient than the traditional farming system. The farm who uses smart farming can share their data with other firm, consumers and regulators [43]. The smart farming not only targets conventional large farming operations, but also provide new levers to uplift other growing trends in agricultural like organic farming, family farming and enhance highly transparent farming. From environmental point of view, smart farming can provide a lot of benefits like efficient water usage, optimize use of fertilizer and meditational treatments if required in the field. A special Android application for with user-friendly GUI for irrigation control by using smartphone is developed and presented in [53].

7 Big Data

Big Data is an important topic for today's business world where the data sets are so large and produced at astronomical rate [54]. These data cannot be managed and analyzed efficiently by traditional data mining and handling techniques. The types of data are unstructured or sensitive w.r.t time or very large in size and not able to process by the engine of relational database [55, 56]. Such type of data requires an efficient processing approach called as Big Data. To make sense of such huge amount of data, they are often categorized into five V's named as Velocity, Volume, Value, Variety, and Veracity as reported by Google (Fig. 3).

- Velocity refers to the speed at which the large amounts of data are being generated.
- Volume refers to the unbelievable amount of data generated per second.
- Value refers to worth of the data being extracted.

Fig. 3 5V's of big data

- Variety refers to the different types of data (i.e. Structured, Unstructured and Semi-structured)
- Veracity refers to the quality or trustworthiness of the data (Fig. 3).

In the recent trend the Big Data technology analyze the data at the time of generation without storing in database because collecting the huge data and then analyzing it is a big challenge from the point of view of organisation. The most important part of such data is to realize it's cost and benefit. The new and efficient big data technologies allow the structured, unstructured and semi-structured data for harvesting, storing, utilizing and the trustworthiness of the data is also maintained at the same time.

8 Role of IoT in Big Data

When business world wants to analyze the huge amount of data, IoT plays a vital role as a source of those data [54]. This is the point where the role of IoT in Big Data comes into the picture. To analyze the IoT sensor devices data, the big data analytics is emerging as a key. This helps the entrepreneurs of business world for making fruitful decisions to achieve their goal. The role of IoT is to generate huge amount of data in real time w.r.t the concept of 5Vs. These data are processed and stored in distributed locations. The IoT based big data are processed as follows:

1. Huge amounts of structured, unstructured and semi-structured data are generated by IoT based smart sensor devices. These data otherwise known as big data depend on Velocity, Volume, Value, Variety, and Veracity. i.e. 5Vs.
2. The huge amount of data generated in step 1 is stored in big data files, which is a shared distributed database.
3. These IoT based big data is now analyzing with the help of analytic tools like Hadoop MapReduce or Spark.
4. Finally the reports are generated by analyzing the data (Fig. 4).

There is a strong interdependent relation between big data and IoT, as they help each other for taking decision in real time for business world [57, 58]. As the business

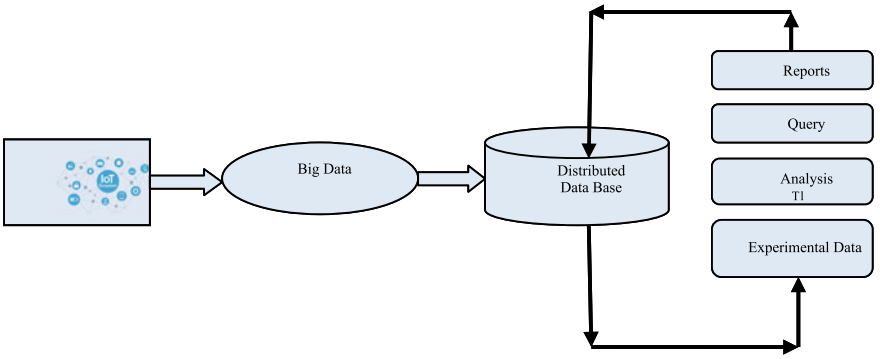

Fig. 4 IoT based big data processing

grows, IoT sensor devices also grow and it creates more demands on the capabilities of big data. Due to the huge amount of data generated by IoT based sensor devices, the traditional data storage technology unable to store the data. As a result, more advanced and innovative storage technology are designed and developed and update the big data infrastructure of the business organisation. Due to this updating the IoT based big data combined applications are expedite the scope of research in both the areas. Hence, from the perspective of IoT, it is the fuel that drive the big data technology.

9 Conclusion

IoT or Internet of Things is a system of interconnected intelligent devices with unique identifier and ability to transfer data or information over a wireless network automatically. This allows the development of intelligent devices and its applications in the field of energy, logistics, industrial control, retail, agriculture, etc. The word "things" in IoT refers to the devices which have unique identifiers and allow remote sensing, remote monitoring and actuating. This chapter tries to present a brief overview on the structure of IoT from point of view of International telecommunication Union (ITU). A numerous data transfer technologies are utilized by the sensors or devices of the IoT system. Some of the technologies named as RFID, Barcode, EPC, Internet protocol, Wi-Fi, Bluetooth, ZigBee, NFC, WSNs, Actuators and AI are explained briefly in this chapter. From the architectural point of view, A 5-layer architectural model of IoT is briefly described. As internet is hype of the IoT, it has many application areas. A few application areas such as Supply chain management, Transportation, Healthcare, Environment and disaster, Smart home and Smart Farming are briefly described in this chapter. Big data and the role of IoT in big data for business world

is also explored in this chapter. The IoT based big data processing is also described in this chapter. Through which the business organisations are able to analyze IoT based big data, manage them and able to take well-informed decision for their future goal.

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