

Internet of Things-based Smart City Environment using Big Data Analytics

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ABSTRACT

The all-embracing intensification of the Internet of Things (IoT) is offering the trends towards the smart cities. Smart cities are favored because it develops the standard of living of the society and gives better services with regard to quality. These services may include but not limited to parking, water, health, transport, environment, power, and so forth. The varied atmosphere of smart city and IoT is challenged by the processing of gigantic data, and real time decision management. In this article, we explore the use of Big Data analytics in IoT based smart cities development and designing. This paper gives a conceptual apprehension of the use of Big Data analytics in the IoT based smart city environments.

Keywords : Smart City, IoT, Big Data Analytics.

I. INTRODUCTION

British technology pioneer Kevin Ashton was used terminology “Internet of Things” (IoT) in 1999 it defines internet of things in a system that different devices, actuator and sensor [1] are connected by our physical world. Internet is a bridge between real world and different devices for communication Ashton coined also describe the power of associating Radio-Frequency Identification (RFID) labels utilized as a Collaboration to the internet to keep track of any object and collect the information without human involvement [2]. Internet of things is open new door for the researcher it has computing ability and internet connect various everyday things, objects, sensor and devices. The wide application of IoT changes our life perspective. IoT used in industrial, water management, smart traffic, and noise sensing from our environment. From the customer point of view, new IoT trend offer different services for the home appliances, automate home object by remotely, management of energy system lead to the smart home, which is offered secure and efficient system. On the

other side, IoT provide help in personal use of wearable product; keep monitor health by using different function installed in mobile application. Internet of things promise to the people provides independent and quality of life in cost effective manner. Large number of organization and company offered application of IoT in different domain for the next ten year. For instance CISCO stated that in 2019 almost 24 billion objects are connecting via internet. Morgan Stanley, project 75 billion different network devices are connect till 2020 [3]. From the Huawei perspective in 2025 100 million different devices are connecting [4]. McKinsey Global forecast that gain revenue \$3.9 to \$11.1 trillion by 2025 by utilization of internet of things equipment.

However, Internet of things refers as nearly new trend, the idea is behind that it comprises different device or computer and network to monitor and control for many year ago. For example in 1970 era commercially used through telephone line monitoring meters on electrical grid by remotely. In the 1990 proposed industrial solution for Machine to

Machine connectivity wireless take place for monitoring and operation for variety of devices. M2M solution provides IP based connectivity of the different equipment [5]. Internet of things is new filed for research into smart object networking. From an immense viewpoint, the conjunction of some innovation and latest fashion is making it possible to interconnect increasingly and littler devices inexpensively and effectively “Smart Object. Networking” defined by The Internet Architecture Board (IAB) [6], “The terminology “Internet of things” (IoT) defines as large of embedded devices are connected via internet protocol which are communicate each other and offered services. Mostly some of these devices called “smart objects” there is no need of human intervention. But it extracts the information from the environment such as building, vehicles etc.”

Internet Engineering Task Force (IETF), defined smart object as it is used context of IoT. Smart objects have different non-functional requirement such as limited power, memory, and processing resources, or bandwidth. Main requirement of the different devices is interoperability between different devices. Internet of things there are four basic communication models that is used for small device design strategic which are permit to communicate each other. Device to device communication: Device to cloud communications, Device-to-Gateway Model, Back-End Data-Sharing Model. Different major issues are associated with IoT like security, privacy, interoperability, standard, economic and development, legal regularity and right.

A. IoT Applications

IoT application market is defined which can deployed in smart city. Smart home, Wearable's, Smart City, Smart grids, Industrial internet, Connected car, Smart farming, Smart Traffic, IoT Health Applications, Retail, security, energy, field of agriculture, Water management, waste management, Noise management, pollution management, smart home management.

B. Importance of Internet of Things

IoT generally refers high level of knowledge about world and continuously monitor the change of

environment and give information about it. With the change of global world IoT provide new service for the society, to manage every field with less effort and time saving. Internet of things is newly industrial revolution in the life of common people. Internet of things changes our life which is not imagining before. With the internet invention change the communication between people and devices but the revolution of IoT improved our living standard and become our life easy.

C. Challenges of Internet of Thing

There are five big challenge of internet of things such as:

Big Data expansion: IoT devices gain different data from various sources. It is become a large volume of data it is big challenge in IoT to deal big data expansion.

Power efficiency: IoT devices like sensor, switch connected through power so it is big challenge to supplies power all connected devices over internet.

Security: While use any internet service security concern is not ignore. People are most worry about their information. IOT has also associated security issue. When user use any new product, the company have responsibility to satisfy about the information vulnerability particularly when product is related our daily use. IOT make sure that his devices are secure from cyber-attack and data being protected from any unauthorized person.

Privacy: Internet of things is smart choice of every one it change the way of life. Data is collected by different sources like sensor, actuators many other devices, privacy is big challenge in this context. Personal information to make sure that it will save and no information will leakage. For example IOT introduce different smart city such as health, waste management, energy management, and so on.

Interoperability / Standards: Interoperability is not possible in every environment so user cannot adopt IOT services with confidence they hesitant to buy IOT service or product because of high cost, inflexibility , high ownership complexity etc. In this

regard different standard model and strategy has been proposed and used.

Legal, Regulatory and Rights: Internet of things is an emergent field, whenever we used new technology it always introduce new issues regarding law and regularity rights it also arose internet related administrative rule. Various problems are arise when different devices are interoperate with each other, transfer and received data over internet. Information over internet is important factor from user perspective it must be secured from hacker and abuser. So we cannot ignore security and, legal rights when adopt IOT services.

Emerging Economy and Development Issues: The Internet of Things encompasses all area of life and makes promise to give secure social and economy life everybody in future. Till 2050 different smart cities are established for provide better life. Smart city increases security within effective time and cost. IoT refer as a connected smart object of the real world. Different smart city is transport management, water management, green city, healthcare, mobility, smart parking so on.

II. Smart City

The smart city is an urban, a small area and city to incorporate multiple information technology in modern way to manage smart city it work on different domain schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement, and other community services. The purpose of the smart city is to enhance the living standard by using information technology and to offer better services within smart city. The purpose of the information communication technology to monitor and sense any event that is occurs within smart city. Sensors are deployed in smart city and get information from the environment in this way improve the residential life quality and save time and money of people.

The deployment of the IoT in urban area in the specific domain which is followed by various national governments rules and utilize ICT solution that manage residential community problems that is called smart city [7]. The criteria for the selection of a smart city in very initial stage government of India start smart city project. Starting it adopt selection criteria within budget.

A. Why Cities Need to Become Smart

Adequate fresh water; general access to cleaner vitality; the capacity to travel effectively starting with one point then onto the next; a feeling of wellbeing and security: these are the sorts of guarantees present day urban communities must satisfy on the off chance that they are to remain aggressive and give a not too bad personal satisfaction to their nationals [8]. It is expect till 2050, 66% of the world's population will shifted in city. Then problem is arising of standard and comfort life. It will be mandatory to manage such a increasing pupation and give all facility of life. It that purpose different smart cities will established in future.

B. Smart Traffic : Smart City Application

The example of Amsterdam specifically Europe encourage many countries to adopt smart cities application for this purpose Europe commission allocated 365 million Euros to member nation. In Paris already gain benefit by establish electric car smart city called as Autoli. Almost 3000 vehicle is connecting by via GPS for the reserve parking driver follow dashed board. London also started smart city many year ago for quickly access parking for car. UK also deployed smart electric car and bike sharing program. Copenhagen, New York establish smart city for traffic management.

C. Healthcare : Smart City Application

The most important and attractive area is medical and healthcare in Internet of things. IoT play important role in medical field in different context. Application of IoT in medical remotely gets information of

different diseases and recommends different medication by online. For this purpose different medical diagnostic equipment are deployed in smart devices to continue monitoring of the patient. IoT paradigm improves patient health, quality of life and cut down cost. All the patient data is stored in central repository or cloud server. Whenever required any data related health to doctor or patient it can access from the repository. April 20, 2015 Healthcare idea is describe by various way but the core idea is that to collect the scattered and disparate data from different sources and apply useful strategy for examining and change raw data into useful dataset [10].

Application of big data in healthcare is not an easy task its need expert team member, competent vendor, and useful technique. But different challenges are occur daily with the expanding of Internet of things. Different devices and connected that gives patient information in different format so overcome this issue expert team member. Overcome Fraud, Waste, and Abuse In the industry of healthcare fraud, waste and abuse play important role that increase the cost of United State economy. But big data analytic restrict the healthcare fraud by using different predict techniques.

III. Big Data Analytics

Big data analytic refer as analyze very large, massive and huge volume of data set. Data is in various form such as structure/unstructured, batch/streaming, and different size zettabytes and terabytes. Big data is taken in count where traditional system has not ability to process and manage the data.

A. Importance Big Data

Understanding customer needs, reduce cost, detect risk and check fraud, make process more efficient, faster and better decision making, new product and services. When big data is necessary information is successfully and proficiently caught, prepared, and obtain full understanding of business, customers,

products, competitors that can cause efficient utilization, lower cost, high performance, increase business sales. Analyzing large set of data permit the business user, analyst and researcher take such faster decision on data that is not possible in traditional system.

B. Characteristic of Big Data

Big data is popular trend due to its characteristic such as high volume, high velocity, and high variety data are manage in efficient manner. Data are coming from different sources so that it is necessary to organize the raw data into meaningful form. Various analytic techniques are used for this purpose such as machine learning, predictive analytic, data mining, statistics so forth [10]. The Vs are further explained below.

The Volume: In Big data a huge amount of information is involved. Data grows day by day which contains all its types e.g. kilobyte, megabyte, petabyte, terabyte etc. of information.

The Velocity: Data originates at very high speed so big data is time sensitive.

The Variety: The data is kept in different files format and type, which contains extreme heterogeneity. It may include structured or unstructured data like audio, log file or any video file etc.

The Value: It addresses the requirement for evaluation of data. It holds great importance for IT infrastructure system and other businesses to store various amount of values in database.

The Veracity: The increase in the choices of values representing a large data set. There exists an unnecessary or obsolete data which is not correct for further analysis.

C. Big Data Life Cycle

In this section the steps involved in the life cycle of Big Data analytics are highlighted which are different from the set of activities involved in tradition life cycle model due to high volume, velocity and variety of dataset. It is advance technique that is utilized to bring the large data in meaningful and compact form.

Life cycle of Big Data comprised of nine phases which are given below:

1. Business Case Evaluation
2. Data Identification
3. Data Acquisition & Filtering
4. Data Extraction
5. Data Validation & Cleansing
6. Data Aggregation & Representation
7. Data Analysis
8. Data Visualization
9. Utilization of Analysis Results

D. Future Opportunities of Big Data

Big data can uncover individuals' concealed behavioral examples and even shed light on their plans. More specifically, it can cross over any barrier between what individuals need to do and what they really do and in addition how they connect with others and their condition. This data is helpful to government offices and also privately owned businesses to help basic leadership in territories running from law implementation to social administrations to country security. Big Data will change how we live in both little and substantial ways [5].

E. Challenges of Big Data Analytics

The following are the major challenges faced in Big Data

Big Data Format Conversion: As we know that there is a diversity of data sources in big data, so heterogeneity is the aspect here which limits the effectiveness of data format conversion. The applications used can create more values if such format conversions be made much effective.

Big data allocation: Big data allocation includes data generation, acquisition, transmission, storage, and other data transformations in that specific domain [5]. Improving the transfer productivity of big data is a main factor to increase big data computing.

Big data privacy: Personal and private data may get leaked through storing, broadcast, and practice phenomena, even if bothered with the permission of workers.

F. Relationship between IoT and Big Data

In the IoT paradigm, a large number of network sensors are embedded in different types of devices and machines. After that, these sensors get deploy in numerous fields which further gather data of various categories, e.g. environmental data, geographical data and logistic data. There is a dire need of big data adoption for different IoT applications, whereas the development of big data is already legged behind [7]. We can say that these two technologies are inter-dependent and should be associated together. The extensive deployment of IoT drives and evolution of data both in size and type can provide the opportunity for the application and improvement of big data. Apart from that, the application of big data technology to IoT also speeds up the research improvements and business representations of IoT.

I. Technique

Big Data needs exceptional strategies to effectively handle huge volume of information inside constrained run times. Big Data techniques involve a number of disciplines, including: Statistics, Data mining, Machine learning, Neural networks, Social network analysis Signal processing, Pattern recognition Optimization methods and visualization approaches. Some of the most widely used approaches for Big Data analytics include Yarn, Map Reduce, Spark, HBase, Hive, Kafka, and Pig.

IV. Role of IoT and Big Data in Smart Cities

This is a fact that there is only one way for any city to become truly a smart city and that is possible only through data and analytics. The growth of big data and the advancement of Internet of Things (IoT) technologies have played a vital role in the feasibility of smart city initiatives[5]. Big data offer

the potential for urban areas to get significant bits of knowledge from a lot of information gathered through different sources, and the IoT allows the incorporation of different sensors for different devices using networked services. Companies are providing Internet of Things (IoT) and big data solutions for everyday running in order to bring the city into the era of “fourth business Revolution”.

The IoT is the fundamental in building a city as smart city. For a city to be entirely as „smart“, the devices connected must have to communicate with one another. so here, IoT takes its part by providing a perfect template for communication of devices, hence providing smart solutions for different problems. According to Schuller, Everything really becomes an opportunity from a smart city perspective [8-32]. With more than 50% of people now living in urban areas, it's crucial for cities to think about how they can mitigate problems that arise from urbanization. Big Data analytics plays a very important role in the smart cities planning [19]. When the Internet of Things technology will come together with big data, it will make way for cities to be recognized as upcoming smart cities. These smart cities basically change our professional as well as personal living at many levels such as low pollution, waste management, improved parking facility and more energy savings. With the existing belief of converting the entire world into several different smart cities, big data and the Internet of Things technology are the only ideologies that have the power to drive this implementation. One of the biggest perks of creating smart cities is that it will reduce the wastage of resources to a very large extent. Lesser wastage of water, lesser congested streets, lesser energy/ power consumption, lesser pollution and fewer problems will certainly be a boon for the commoners living across these smart cities. In fact, there are several smart cities around the world which have successfully tackled problems like sewage treatment, water theft, pollution and traffic

congestion over time. This means that the Internet of Things technology when combined with big data can help in achieving the impossible.

V. Conclusion

The understanding of the smart city is still very novel due to the revolution of the conventional city functions. The smart city notion brings the researchers and industries to the point to have well-organized and generic architecture. In this research article, use of Big Data analytics in IoT based smart cities development and designing is explored. A conceptual apprehension of the use of Big Data analytics in the IoT based smart city environments is given in this article.

VI. References

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