International Journal of Advance Engineering and Research Development
Scientific Journal of Impact Factor (SJIF): 4.72
Special Issue SIEICON-2017,April -2017
e-ISSN : 2348-4470 p-ISSN : 2348-6406

Role of Big Data and Cloud Computing in Smart Cities with Issues and Challenges

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Abstract *- The paper covers how Internet of Things, Machine to machine, Big Data and Smart Cities Linkages can help in doing predictive analytics which can be helpful to human wellbeing. This paper focused on two main areas – Smart Grid and Traffic Congestion Management where Big Data Analytics can be useful for decision makers and city planner. To this purpose, this paper browses the semantic annotation of the sensors in the cloud, and innovative services can be implemented and considered by bridging Clouds and IoT. Things-like semantic will be considered to perform the aggregation of heterogeneous resources by defining the Clouds of Things (CoT) paradigm.*

Keywords- *Big Data, IoT, Smart City, Smart Grid, Traffic Congestion, Cloud of Things, Smart Cities, Internet of Things*

I. INTRODUCTION

Smart City applications are developed with the goal of improving the management of urban flows and allowing for real time responses to challenges. As of 2007, 50% of the population of the world was living in cities. [8] The United Nations Population Fund forecasts that by 2030 approximately 60% of the world population will live in an urban environment. This paper portrays a field trial that leverages an internet of things (IoT) platform intended for bringing value to existing and future smart city infrastructures. The paper highlights how IoT creates the basis permitting integration of current vertical city services into an all-encompassing system, which opens new horizons for the progress of the effectiveness and sustainability of our cities.

Over the past few years, the definition of "Smart Cities" has evolved to mean many things to many people. Yet, one thing remains constant: part of being "smart" is utilizing information and communications technology (ICT) and the Internet to address urban challenges. People's in cities area facing a variety of problems like Job Market, Economic Growth, and Social Status etc. Where we are in the evolution of the Internet is critical to future city-planning processes. [10]

II. INTERNET OF THINGS AND SMART CITIES WITH BIG DATA AND CLOUD COMPUTING

The Term **Big Data** refers a huge volume of structure, unstructured and semi structured data that is too large and complex to analyze.

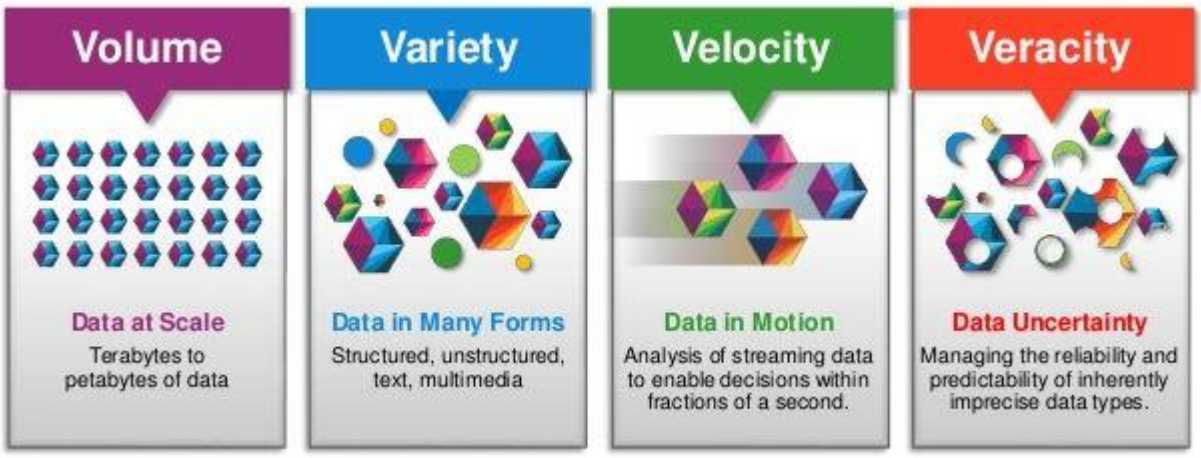

Figure 1 Big Data

Characteristics of Big Data:

1. **Volume**: Volume refers to amount of data.
2. **Variety**: Variety refers to the data from multiple sources in the form of both structured and unstructured format. Data source is diverse. Gartner mentioned it as dark data. Similar to dark matter in physics, dark data cannot be seen directly, yet it is the bulk of the organizational universe.
3. **Velocity**: Velocity deals with the rate at which data flows in from various sources. Big Data flow is massive and continuous.

4. **Veracity**: Veracity refers to uncertainty of data. It deals to quality, trustworthiness, accuracy of data.

Internet of Things (IoT) is an ecosystem of connected physical objects that are accessible through the internet. The 'thing' in IoT could be a person with a heart monitor or an automobile with built-in-sensors, i.e. objects that have been assigned an IP address and have the ability to collect and transfer data over a network without manual assistance or intervention. [6]

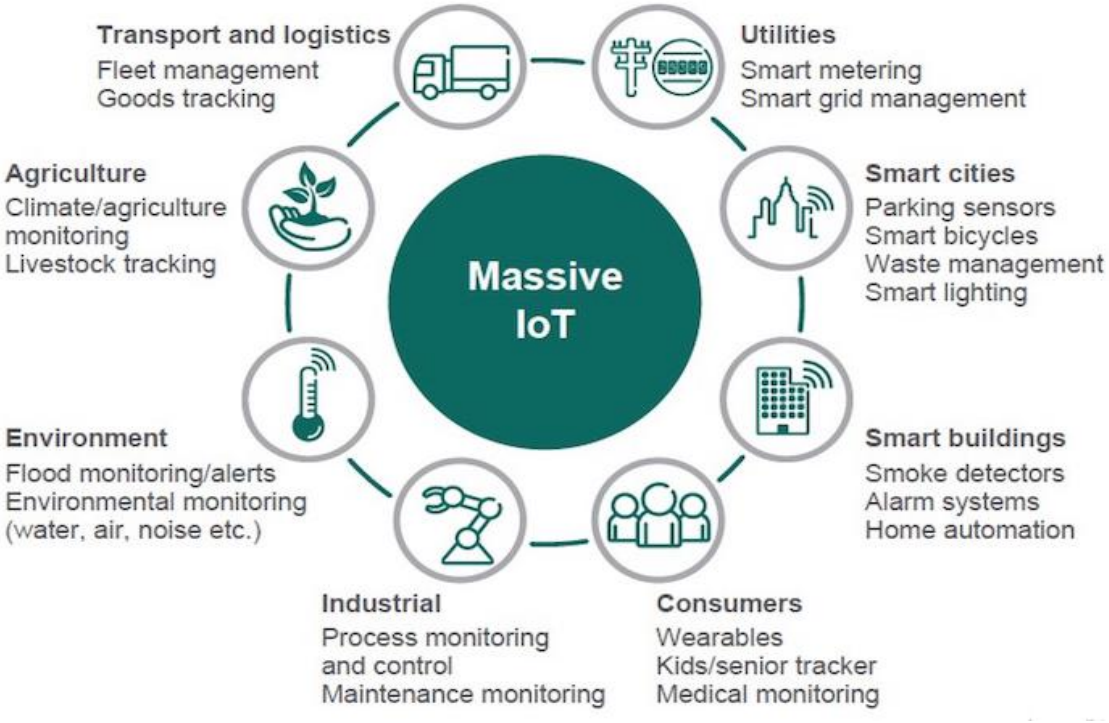

Figure 2 Internet of things in world

Smart city means different thing to different people. Its conceptualization varies from city to city, country to country depending on the level of development, willingness to change and reform, resources and aspirations of the city residents. A smart city would have a different connotation in India than, say, Europe. Even in India, there is no one way of defining a Smart city. Defining a Smart City as a city which functions in a sustainable and intelligent way, by integrating all its infrastructure and services into a cohesive whole and using intelligent devices for monitoring and control, to ensure sustainability and efficiency. [7]

Figure 3 Internet of things in Smart Cities

III. SMART CITY CONCEPT AND SERVICES

On the technical side, the most relevant issue consists in the no interoperability of the heterogeneous technologies currently used in city and urban development. In this respect, the IoT vision can become the building block to realize a unified urban scale ICT platform, thus unleashing the potential of the Smart City vision [1][2].

1. **Structural Health of Buildings:** Proper maintenance of the historical buildings of a city requires the continuous monitoring of the actual conditions of each building and identification of the areas that are most subject to the impact of external agents. such as vibration and deformation sensors to monitor the building stress, atmospheric

agent sensors in the surrounding areas to monitor pollution levels, and temperature and humidity sensors to have a complete characterization of the environmental conditions.

2. **Waste Management:** Waste management is a primary issue in many modern cities, due to both the cost of the service and the problem of the storage of garbage in landfills. A deeper penetration of ICT solutions in this domain, however, may result in significant savings and economical and ecological advantages. For instance, the use of intelligent waste containers, which detect the level of load and allow for an optimization of the collector trucks route, can reduce the cost of waste collection and improve the quality of recycling [4].

3. **Noise Monitoring:** Noise can be seen as a form of acoustic pollution as much as carbon oxide (CO) is for air. In that sense, the city authorities have already issued specific laws to reduce the amount of noise in the city Centre at specific hours. An urban IoT can offer a noise monitoring service to measure the amount of noise produced at any given hour in the places that adopt the service [6].

4. **Traffic Congestion:** On the same line of air quality and noise monitoring, a possible Smart City service that can be enabled by urban IoT consists in monitoring the traffic congestion in the city. Even though camera-based traffic monitoring systems are already available and deployed in many cities, low-power widespread communication can provide a denser source of information. Traffic monitoring may be realized by using the sensing capabilities and GPS installed on modern vehicles, and also adopting a combination of air quality and acoustic sensors along a given road.[8]

5. **Smart Parking:** The smart parking service is based on road sensors and intelligent displays that direct motorists along the best path for parking in the city [16]. The benefits deriving from this service are manifold: faster time to locate parking slot means fewer CO emission from the car, lesser traffic congestion, and happier citizens. The smart parking service can be directly integrate d in the urban IoT infrastructure, be use many companies in Europe are providing market product s for this application. Furthermore, by using short -range communication technologies, such as Radio Frequency Identifiers (R FID) or Near Field Communication (NFC), it is possible to realize an electronic verification system of parking permitting slots reserved for residents or disabled, thus offering a better service to citizens that can legitimately use those slots and an efficient tool to quickly spot violations.[9]

6. **Smart Lighting:** In order to support the 20-20-20 directive, the optimization of the street lighting efficiency is an important feature. In particular, this service can optimize the street lamp intensity according to the time of the day, the weather condition, and the presence of people. [5]

IV. SOLVING IOT CHALLENGES FOR SMART CITIES

New Internet of Things (IoT) applications that leverage ubiquitous connectivity, big data and analytics are enabling Smart City initiatives all over the world. These new applications introduce tremendous new capabilities such as the ability to remotely monitor, manage and control devices, and to create new insights and actionable information from massive streams of real-time data.

As a result, IoT offerings are transforming cities by improving infrastructure, creating more efficient and cost effective municipal services, enhancing public transportation, reducing traffic congestion, and keeping citizens safe and more engaged in the community.

Forward-thinking cities, smart city solution providers and system integrators recognize that in order to realize the full value of IoT cities must not deliver disparate smart city point solutions, but rather enable a secure and scalable IoT infrastructure that integrates multiple systems.

Strategic IoT Solutions for Smart Cities

In the end, it's about making the right strategic choices, selecting the right partners, and leveraging best-of-breed technologies to quickly deliver the right smart city solutions that will result in immediate value and deliver a secure and scalable platform to unlock continuous new value.

ThingWorx provides the first purpose-built IoT platform designed to meet the unique needs of today's connected world. It has been proven in preeminent cities across the world, and at hundreds of market-leading companies, managing millions of connected devices, systems and people. With PTC ThingWorx you can deliver powerful, secure, new IoT solutions in a fraction of the time of other approaches.

Benefits of the IoT Platform for Smart Cities

ThingWorx works with multiple entities engaged with Smart Cities and can help meet your diverse needs:

1. Build a New Smart City Solution with the market leading IoT Platform that will reduce the time, cost, and risk required to create and evolve your innovative new Internet of Things (IoT) applications – and to connect multiple systems in a city.

2. Engage with ThingWorx Smart City application providers that have already built solutions on the platform which are ready to become part of your smart city initiatives.
3. Leverage the ThingWorx Marketplace and partner ecosystem to market and sell your IoT smart city solutions and services.
4. Identify a System Integrator/Network Provider Partner from the ThingWorx Ecosystem to discuss how they can help deliver a secure and scalable ThingWorx IoT solution to unlock continuous new value for your city.

V. CHALLENGES IN IMPLEMENTING BIG DATA

Smart cities are considered as dynamic and evolving environments. Following are the challenges organization, Smart City Solutions Using Big Data and Analytics.

Data sources and size
In Smart City Data will be generated from multiple sources and in multiple formats – Structured, Unstructured, and Semi Structured. Storing and processing such data is not possible using traditional software. Also future anticipation about the data formats and sources needs to be considered and factored into the solution while designing the smart city applications. Due to evolving environment it is difficult to predict the growth of data – 3Vs. [1]

Data sharing and information
The smart city vision holds out the promise of integrating data from multiple organizations, diverse environments, and a wide variety of intelligent devices. Data integration even within organizations is one of the hardest challenges in the IT world, Data integration from various department would be challenge. There are challenges in sharing of information and data across various departments. Every department has its own data warehouse which works in silos, sharing information is difficult. Also there are legal mandatory privacy and security requirement like DPA (Data Protection Act) to ensure citizen rights of privacy. Smart City solution should be design keeping in mind how to prevent the privacy of the citizen. [6]

Security of Data
Big Data breaches will be big with potential of more serious damages to reputation and legal repercussion. Movement of data across various sources in a secure manner is a biggest challenge in Smart city application implementation. Security here means right information to a right person at right time and at right place. While designing smart city, it is important to look at how data can be masked and secured so that it cannot be reached to unwanted persons. [5]

Technology Advancement
In Today's environment, keeping the pace with technology is very difficult and costly effort. The smart city solution should be design in a manner that with advancement of the technology, upgrades to the existing solution can be achieved easily or with less effort.

CONCLUSION AND FUTUREWORK

The role Big Data is fundamental in building smart cities. Reliable technology and infrastructure which can tackle machine to machine, machine to human, human to equipment is required for managing public amenities and services in such cities. Big Data Analytics will help in analyzing and predicting information generated by smart devices connected through various channel in Smart Cities. Since data will come from various heterogeneous sources, this is challenging, as big data analytics and applications are not developed enough for real time processing of large data sets. In future Smart Cities implement some security and Privacy in IOT Device with IOT platform and Data Store in Cloud Computing.

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