Chapter 64
Bootstrapping Urban Planning:
Addressing Big Data Issues in Smart Cities

Ankur Lohachab
https://orcid.org/0000-0002-5291-7860
Kurukshetra University, India

ABSTRACT

Rapid growth of embedded devices and population density in IoT-based smart cities provides great potential for business and opportunities in urban planning. For addressing the current and future needs of living, smart cities have to revitalize the potential of big data analytics. However, a colossal amount of sensitive information invites various computational challenges. Moreover, big data generated by the IoT paradigm acquires different characteristics as compared to traditional big data because it contains heterogeneous unstructured data. Despite various challenges in big data, enterprises are trying to utilize its true potential for providing proactive applications to the citizens. In this chapter, the author finds the possibilities of the role of big data in the efficient management of smart cities. Representative applications of big data, along with advantages and disadvantages, are also discussed. By delving into the ongoing research approaches in securing and providing privacy to big data, this chapter is concluded by highlighting the open research issues in the domain.

INTRODUCTION

IoT envisages enormous number of smart devices and embedded systems which empowers physical objects with pervasive sensing, seeing, hearing, and communication with each other. As a result, IoT can be considered as a big outlook for future Internet which provides a new scope of opportunities. The promise of Smart Cities ensures the transformation in various areas of human life including transportation, education, health, and energy. Smart Cities led to the concept of smart communities in which distinct electronic devices are inter-connected with each other and generally produce high-quality two-way interactive multimedia content. This multimedia content along with colossal amount of incommensurable types of datasets generated by heterogeneous IoT devices are collectively termed as Big

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Data. As compared with traditional data, Big Data contains more unstructured data that also require real-time analysis. Mainly, three aspects are used for characterizing Big Data: (a) it cannot be classified into regular relational database, (b) it is in enormous amount, and (c) it is captured, processed, and generated expeditiously. An observation from McKinsey & Company suggests that Big Data create productive, competitive, and economic value in the five core sectors. Record creation of data due to its deep detailing is eliciting attention of everyone.

Along with IoT, Cloud Computing is a major breakthrough technology which is used as an alternative for providing dedicated storage space, software, and even expensive hardware to the users according to their uses and needs. The reason for adoption of Cloud Computing among common users is that it minimizes infrastructure cost by providing virtual resources and parallel processing with anytime, anywhere user access, and efficient management (Bhushan & Gupta, 2018; Chen, Mao, & Liu, 2014; Bhushan & Gupta, 2017). The said advantages motivate organizations for using the virtualized environment in the Smart Cities scenario. The increasing popularity of IoT devices and personal digital assistants has taken the Cloud Computing concept to prominence peak due to their limited storage capacity, processing capability, and constrained energy resources. The concepts of Cloud Computing, IoT, and Big Data are coalescing as IoT provides users the convenience to interact with their physical objects, Cloud Computing provides the fundamental engine through the use of virtualization, and Big Data provides users the capability of using commodity computing for processing their queries in a timely and efficient manner.

Despite the fact that these smart connected objects are used for reducing traffic congestion, fighting crime, making local decisions more open, and foster economic development, they are creating the Big Data that require excessive amount of energy which is also responsible for increasing greenhouse gases. Researchers and industrialists see Big Data as an opportunity for developing new solutions and analyzing new problems. Big Data can be seen as one of the driving technology for drastic increase in development of machine learning algorithms (Labrinidis & Jagadish, 2012). For enhancement of Smart City services, Big Data is mined, processed, and stored efficiently in order to help managers for taking right decisions in real-time according to the provided information (Caragliu, Bo, & Nijkamp, 2011). Although analyzing datasets of network flows, logs, and system events is always considered as a problem, nevertheless this Big Data driven information security is utilized for forensics and intrusion detection.

The field of security and privacy has many standards and regulations, but the unprecedented value of Big Data exposes it to various security and privacy risks. In various authentication protocols, anonymized information is primarily used for hiding critical information, but recent studies show that this anonymized information can be easily breached by attackers in terms of privacy (Lohachab & Karambir, 2019). Usually in the process of data anonymization, removal of obvious identifiers is done, but attackers easily re-identify the information using spatial-temporal points in the processed datasets. Although cryptography is a powerful technique for privacy protection, various attacks motivate us to rethink the exact meaning of identification (Gupta & Quamara, 2018). Accordingly, communication privacy should also be explored in terms of Big Data. Privacy protection mechanisms can be classified into two major categories: content and interaction privacy.

Along with security and privacy issues, various issues regarding to Big Data including scalability, availability, transformation, data quality, heterogeneity, regulatory, governance, and data integrity should be addressed. Computational intelligence algorithms and Quality of Service (QoS) for maintaining the scalable, reliable, fault tolerant, and flexible Big Data are still facing many challenges. According to the growing demands of Big Data analysis for the development of new Smart City, services should be managed well for addressing the technological adoption of applications among common users. Figure