

Big Data Analysis Using Multi-Layer Distributed Fog Computing for Smart City Applications

Tofiq Asbaghi ^{a,*}, Mohsen Bagheri Zefrei ^a, Mohsen Tarighi ^a

^a University of Amirkabir, Department of Computer Engineering, Tehran, Iran

* Corresponding author email address: tofiq@aut.ac.ir

Abstract

The concept of Big Data Analysis (BDA) due to the Internet of Things (IoT) applications in Smart Cities (SCs) has been changing meaningfully in these days. That is to say, the basic concept of Smart City, which was introduced and has been under investigation since several years ago, is not new. However, implementation of Smart City Network, due to the wide variety of sensors used in the network, and the analysis of the actual big-data gathered by these sensors, meets crucial challenges. Fog computing is a good candidate capable of handling the above-mentioned issues. In this paper, a novel multi-layered distributed-on-edges of the network computing model is proposed. The presented model, using a modular and hierarchical structure, can greatly alleviate and speed up the inherent complexity and drawbacks of BDA in smart cities.

Keywords: Smart City, Cloud Computing, Fog Computing, Edge Computing, Big Data Analysis

1. Introduction

During the last decade witnessed a dramatic growth in urbanization of the population. This can be a result of greater accessibility, better education facilities, and more job opportunities that are more available in cities rather than villages (Khaneghah, Nezhad, Mirtaheri, Sharifi, & Shirpour, 2011). Wherever the reason is, these huge growing cities introduce several challenges in the management of cities in different aspects. Smart City, as a solution that could address these challenges, has gained considerable attention from both academic scientists and practical engineers. Equipped with tools for gathering information in various parts of the city and real-time processing of this information, Smart City is an IT-based management system that can practically handle the modern city's problems like pollution, traffic congestion and non-uniform public resource allocation (Mirtaheri et al., 2013). However, the fast-increasing urban population make the existing problems worse faced by modern cities, such as traffic congestion, pollution, low-quality public services, insufficient public resources and budget for health and education. Smart cities are ambitious vision to tackle the above city problems by making more efficient use of city resource.

The enormous number of sensors which are used in SCs have led to modern paradigm of computing that shifts the cloud computing to the edge of network, making the Fog Computing as a reasonable solution. That is to say, the massive number of infrastructures, services and

components are widespread in SCs, specially, in future ones, which are supposed to be at edge of network technology (Baccarelli, Naranjo, Scarpiniti, Shojafar, & Abawajy, 2017).

2. Cloud Approach

Consider an arrangement of thickly dispersed remote things with low allowable regime, and suppose that all of them are capable of gathering and exchanging received or sent, or generally, the transferred data in real-time. Due to the current energy-computing-bandwidth impediments of the wireless domain, an appropriate framework of this complexity was impossible at all, or at least, was considerably vague and difficult to propose. Therefore, the Future Web model is tending to be classified into two modern ideal models. To be specific, the two categories that are being widespread are the Haze Computing (FC) and the Web of Everything (IoE). The advances proposed day by day, and required computational approaches provide the fundamental capabilities to make the sensors compatible with new data transfer structures, leading to modern actuators a city's physical environment to establish a smart city (Cheng et al., 2017).

Progresses in Cyber-Physical Frameworks (CPS), Internet of Things (IoT), Cloud Computing (CC), Haze Computing are the result of the existing focus on this objective. These modern techniques offer an uncommon opportunity to provide vast verity of applications that improve and shift the smart cities' administrations.