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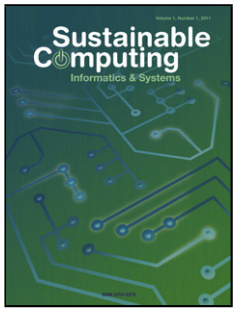

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PII: S2210-5379(18)30029-5
DOI: https://doi.org/10.1016/j.suscom.2018.05.005
Reference: SUSCOM 245

To appear in:

Received date: 29-1-2018
Revised date: 12-3-2018
Accepted date: 15-5-2018

Please cite this article as: Abbas H, Shaheen S, Elhoseny M, Singh AK, Alkhambashi M, Systems thinking for developing sustainable complex smart cities based on self-regulated agent systems and fog computing, *Sustainable Computing: Informatics and Systems* (2018), https://doi.org/10.1016/j.suscom.2018.05.005

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ACCEPTED MANUSCRIPT

Systems Thinking for Developing Sustainable Complex Smart Cities Based on Self-Regulated Agent Systems and Fog Computing

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Highlights:

- This paper provides a framework for developing the future complex sustainable smart cities based on the emerging systems thinking approach.
- We first study future smart cities from a systems thinking perspective and highlight the urgent requirement to envision them as systems-of-systems and complex adaptive systems.
- The proposed framework is suggested to be implemented based on self-regulating agent systems and fog computing as promising solution to complexity and high distribution.
- The implementation and deployment aspects of the proposed framework are also discussed. A preliminary simulated performance results are provided and discussed using multiple JADE agent platforms.
- A complete realization architecture for the proposed framework is currently under preparation.

Abstract: As the gap between digital and physical worlds getting dwindled as a result of the dramatic advance getting achieved in information and communication technology (ICT), feasible, efficient, reliable, and secure smart cities are becoming a reality. Future smart cities will be characterized by their high distribution, openness, heterogeneity, complexity, unpredictable/uncertain/dynamic work environments, and their large-scale nature. These challenging characteristics require a transition from the traditional parts thinking paradigm which studies systems by breaking them down into their separate elements to the emerging systems thinking paradigm which represents a holistic approach focuses on the way that a system's constituent parts interrelate and how systems work over time and within the context of larger systems. In this article, we first study smart cities from systems thinking perspective and then introduce self-regulating agent systems and fog computing as promising technological paradigms for developing future large-scale complex smart cities applications. Preliminary simulation results to test the performance of the proposed framework are provided. The results show that self-regulated agent systems can give high performance if an appropriate self-regulation model is used. A complete architecture for building future complex smart cities based on the systems thinking paradigm and using self-regulating MAS integrated with fog computing for implementation is currently under preparation.

Keywords: smart cities, systems thinking, future smart applications, macro-micro management, self-regulating multi-agent systems, fog computing.

1. Introduction

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