Towards enhancement of communication systems, networks and applications for smart environment

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1 Introduction

A great deal of research in communication systems, networks and applications (CSNA) has been geared towards creating a smarter environment with the objectives of improving quality of life and building sustainable societies. CSNA has been intended to enhance the underlying communication systems and networks (e.g., vehicular networks, wireless sensor networks, and cellular Internet protocol networks), and integrate applications and services (e.g., smart grid, fire detection, and pollution detection) into daily life. Artificial intelligence based approaches, such as reinforcement learning and genetic algorithm, have been proposed as the enabling techniques for various aspects of CSNA. The goal of this Special Issue is to present CSNA solutions, including the use of artificial intelligence based approaches, to provide smart environment, which has been characterized as dynamic, heterogeneous and complex.

We received 41 high-quality papers submission. After a rigorous review process, 19 papers were selected to be included in this Special Issue. The accepted papers are

broadly divided into the enhancement of communication systems and networks, and applications.

2 Enhancement of communication systems and networks

This Special Issue covers various enhancement for communication systems and networking, including routing, clustering, anycast communication, sensor placement, resource allocation, and peer selection for supporting and deploying smart applications in different kinds of networks, such as wireless sensor, mobile ad hoc, opportunistic, vehicular, and cellular Internet protocol networks, and peer-to-peer applications.

In “An Efficient Multi-hops Clustering and Data Routing for WSNs based on Khalimsky Shortest Paths”, Mahmoud Mezghani selects gateways, which are located at the border of a cluster, based on triangulation theory, and establishes optimal intra-cluster and inter-cluster routes to reduce the number of clusters and energy consumption in wireless sensor networks.

In “kROp: k-means Clustering based Routing Protocol for Opportunistic Networks”, Sharma et al. use a lightweight k-means clustering algorithm to form clusters, and establish routes based on network features (e.g., the possibility of encountering a destination) to increase packet delivery probability, and reduce overhead and hopcount, in opportunistic networks.

In “Supernode Routing: a Grid-based Message Passing Scheme for Sparse Opportunistic Networks”, Sharma et al. identify supernodes, which are located in a grid, that relay packets towards the direction of a destination node in order to increase packet delivery rate, and reduce end-to-end delay, overhead, and energy consumption in opportunistic networks.

In “Ticket-based QoS Routing Optimization using Genetic Algorithm for WSN Applications in Smart Grid”,

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Baroudi et al. use a genetic algorithm to reduce the number of tickets exchanged to collect information compared to traditional ticket-based approaches in order to reduce end-to-end delay and hopcount in wireless sensor networks applied to the smart grid.

In “New NSGA-II-based OLSR Self-organized Routing Protocol for Mobile Ad Hoc Networks”, Harrag uses a genetic algorithm to select routing protocol parameters, particularly the exchange intervals of Hello, topology control, and multiple interface declaration messages, in order to reduce end-to-end delay and packet loss in mobile networks with high mobility.

In “Fuzzy based Novel Clustering Technique by Exploiting Spatial Correlation in Wireless Sensor Network”, Singh and Soni use a fuzzy-based approach to form clusters based on the correlation of residual energy and energy consumption in a three-dimensional correlation model in order to reduce energy consumption and the number of clusters in wireless sensor networks.

In “Learning for Adaptive Anycast in Vehicular Delay Tolerant Networks”, Wu et al. use reinforcement learning to estimate the possibility of encountering a multi-hop destination in anycast communication from vehicles to cloud where multiple gateways (or road side units) exist in order to increase packet delivery rate, and reduce end-to-end delay in vehicular networks.

In “A New Strategy to Optimize the Sensors Placement in Wireless Sensor Networks”, Musa et al. use sensor distribution and density information to deploy a limited number of sensors in a field for short-term and long-term monitoring applications in order to reduce energy consumption while preserving network connectivity in wireless sensor networks.

In “Optimum Bandwidth Allocation in Wireless Networks using Differential Evolution”, Afzal et al. use differential evolution algorithm to distribute bandwidth resources, which are from a cell and its neighboring cells, among different users while ensuring acceptable quality of service in order to reduce connection drop probability in cellular Internet protocol networks.

In “Efficient Neighbor Selection through Connection Switching for P2P Live Streaming”, Kim et al. enable a peer to communicate with a peer that maximizes data duplication, rather than the most recently joined peer, in order to reduce the playback lag and initial response delay without considerable reduction in playback continuity in peer-to-peer live streaming.

Lastly, Kumar and Kumar change the transmission range of sensor nodes dynamically to adjust traffic load of sensors in “Improved Network Lifetime and Avoidance of Uneven Energy Consumption using Load Factor”, and change the locations and trajectories of mobile sink nodes dynamically to collect and forward packets in “Improving Reporting Delay and Lifetime of a WSN using Controlled Mobile

Sinks”, in order to reduce energy consumption in wireless sensor networks.

3 Enhancement of applications

This Special Issue covers various enhancement of applications and tools, including data collection and fusion, relationship management, pattern matching, cloud service composition, path planning, and security monitoring, for supporting and deploying smart applications, such as fire detection, and pollution detection.

In “Fire Detection by Fusing Correlated Measurements”, Javadi and Mohammadi have used copula theory to resolve correlations among temperature and humidity measurements, producing a multivariate distribution in data fusion in order to detect a fire occurrence. The authors performed an extensive Monte Carlo simulation to show an improvement in the detection probability.

In “Crowdsensing Sub-populations in a Region”, Steele and Jaimes have presented a mechanism to collect data from different sub-populations of devices and sensors in a region in order to provide better coverage in crowdsensing to support smart applications, such as pollution and traffic monitoring. The proposed scheme is a pioneer work of this topic in crowdsensing, and it has shown to increase the number of active population of participants and coverage.

In “The Interaction Type Approach to Relationships Management”, Nota and Aiello have proposed a metamodel based on a novel concept of interaction type for relationship management in smart decision making. The authors have adopted the metamodel in case studies, including an intelligent logistic service for urban ports. Interestingly, this work has warranted further investigation on software development based on the metamodel.

In “A Novel JSON based Regular Expression Language for Pattern Matching in the Internet of Things”, Rasool et al. have optimized a processing engine to filter and compile huge volumes of data produced by Internet of things. JavaScript object notation is used to define regular expressions (or textual patterns). The authors have conducted an extensive evaluation to show a reduction in the number of cache misses, and hence the programme execution time.

In “iPOJO flow: a declarative service workflow architecture for ubiquitous cloud applications”, Zhang et al. have proposed a workflow-based service composition to compose services together in order to form realistic, complicated ubiquitous cloud applications. Interestingly, the authors have presented a proof-of-concept prototype based on smart home, and it has shown to reduce memory usage and composition time required to execute a workflow.

In “Comparison of Eulerian and Hamiltonian Circuits for Evolutionary-based Path Planning of an Autonomous

Surface Vehicle for Monitoring Ypacarai Lake”, Arzamendia et al. have proposed an evolutionary-based path planning scheme used by autonomous vehicles to collect samples from a large area of water in order to detect pollution. Of particular interest is its investigation on Ypacarai Lake. The proposed scheme has shown to improve coverage.

Lastly, in “Near-miss Situation based Visual Analysis of SIEM Rules for Real Time Network Security Monitoring”, Majeed et al. have presented a visual tool that provides a complete overview of security information and event management (SIEM) rules execution to detect malicious activities in near-miss situation in a real-time manner. Interestingly, the proposed tool performs exploration on security issues using questions.

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