

EDITORIAL

Special issue on real-time behavioral monitoring in IoT applications using big data analytics

1 | INTRODUCTION

Real-time social multimedia level threat monitoring is becoming harder, due to higher and rapidly increasing data induction. Data induction through electric smart devices is greater compared to information processing capacity. Nowadays, data becomes humongous even coming from the single source. Therefore, when data emanates from all heterogeneous sources distributed over the globe makes data magnitude harder to process up to a needed scale. Big data and Deep learning have become standard in providing well-known solutions built-up using algorithms and techniques in resolving data matching issues. Now, with the involvement of sensors and automation in generating data obscures everything, predicting results to overcome a current era of ever enhancing demands and getting real-time visualization brings the need of feature like human behavior mode extraction to overcome any future threats. Big data analytics can bring the opportunity of predicting any misfortune even before they happen. Map reduce feature of big data supports massive data oriented process execution using distributed processing. Real-time human feature identification and detection can occur through sensors and internet sources. A behavioral prediction can further classify the information collected for introducing enhanced security extents. Real-time sensor devices are producing 24/7-hour data for further processing recording each event. IoT-based sensors can support in behavioral analysis model of a human. Real-time human behavioral monitoring based on image processing and IoT using big data analytics.

2 | THEMES OF THIS SPECIAL ISSUE

Starting from the aforementioned considerations, this special issue aims to bring together researchers coming from both academia and industry, asking them to contribute to refining technologies and services aimed at personalization, monitoring, and recommendation in multimedia applications in using image processing techniques for human behavioral based feature extraction. This issue is intended to provide a highly recognized international forum to present recent advances in *Concurrency and Computation: Practice and Experience*. We welcomed both theoretical contributions as well as papers describing interesting applications. Papers were invited for this special issue considering aspects of this problem, including

- IoT-based frame by frame human feature extraction and behavior recognition;
- IoT-based real-time communication system using image processing techniques;
- Interlinked resource measurement expert system
- Architecture, models, and design for Human Behavioral Monitoring in IoT Big Data;
- Human behavioral monitoring in big data and IoT applications;
- Image processing techniques in big data analysis
- Image-based big data sensing and adaptive collection for IoT;
- Real-time human behavioral measurement, modeling, evaluation, reputation generation, and tools for IoT Big Data;
- Real-time human behavioral monitoring big data processing and analytics for IoT;
- Real-time behavior assessment in big data transmission with efficiency for IoT;
- Image-based big data storage management for IoT applications;
- IoT network security measurement based on big data;
- Administration and interpretation of multimedia big data;
- Image-based content and structure-based analytics;
- Behavioral feature based learning from big data to facilitate monitoring;
- Extraction of threat prediction on association rules using big data technologies;
- Multimedia technology for smart surveillance system with IoT environment;
- Scalable and semantics-driven indexing of ever growing multimedia data;

- Human behavioral features extraction techniques for image data analysis in electrical social environment; and
- Image data collection, mining, and prediction methods based on big data.

After review, a total of 18 papers out of 58 submissions have been accepted for publication in this issue.

2.1 | Models

The mining of human mobility can be exploited to support the design of traffic planning, route recommendations, urban planning, emergency management, and land use. Currently, various methods such as the machine learning algorithms, statistical methods, and semantic analysis are widely applied to identify and extract human mobility patterns. The contribution by Wang et al, "A Generic Paradigm for Mining Human Mobility Patterns Based on the GPS Trajectory Data using Complex Network Analysis," proposes a simple and generic paradigm for mining human mobility patterns based on the GPS trajectory data using complex network analysis.¹ The essential ideas behind the proposed paradigm mainly include (1) creating weighted complex networks of GPS trajectories and (2) extracting the human mobility patterns by analyzing the structures and metrics of the created complex networks of GPS trajectories. To evaluate the performance of the proposed paradigm, authors design five groups of experiments and identify the mobility patterns of the selected five persons based on the selected five network analysis metrics.

Voice over Internet Protocol (VoIP) carries and transforms voice over the IP networks. The principles of VoIP calls are similar to traditional telephony that involves signaling, channel-setup, digitization, and encoding of speech signal, but it transmits data over a packet-switched network instead of circuit-switched network. Factors which determine VoIP Quality of Service (QoS) include the choice of codec, packet loss, delay, jitter, and optimal hardware selection to handle different services. The contribution by Gupta et al, "Predictive Model for Hardware Calibration to Transmit Real-time Applications in VoIP Networks," proposes a predictive model that selects the best suitable hardware to handle particular offered load, which can support desired numbers of concurrent calls from wide array of processors available in the market today.² This model would help the VoIP service providers in providing efficient services with QoS for different VoIP services like voice, data, video, chat, etc. This paper attempts to train and evaluate a model using various system parameters and system benchmark is predicted on an absolute scale.

With the rapid growth in wireless data networks and increasing demand for multimedia applications, the next generation of wireless networks should be able to provide services for heterogeneous traffic with diverse quality of service requirements. Multiuser diversity refers to a type of diversity present across different users in a fading environment. This diversity can be exploited by scheduling transmissions so that users transmit when their channel conditions are favorable. Hence, scheduling algorithms that support QoS and maintain a required throughput to ensure users' satisfaction are crucial to the development of these wireless networks. In the contribution by Chehri and Jeon, "Real-Time Multi-User Scheduling based on End-User Requirement Using Big Data Analytics," the authors evaluated different scheduling techniques using OFDM with different scenarios.³ The goal is to analyze the properties of networks such as throughput, fairness, and delay.

In the contribution by Reena et al, "Chaotic Sequence based MC-CDMA for 5G," the authors studied a unique chaotic spreading sequence-based MC-CDMA.⁴ By employing this spreading sequence, interference effect that is inherent in a multi-user environment can be lessened by deciding on the spreading series with suitable cross-correlation properties. The simulation study exhibits that chaotic sequence-based MC-CDMA acts well in a multiuser setting, resulting in better attainable error rates. Moreover, results confirm that chaotic sequence-based MC-CDMA beats the Walsh Hadamard code spreading-based MC CDMA system.

The aim of an ideal distributed Mobile Cloud environment, the surrogate object, is an agent for a particular Mobile Host in the wired or wireless network with specific data structures and methods. The Surrogate object is a software entity that is hosted on mobile support station and acts on behalf of a mobile host during the disconnection operation. The mobile hosts are registered with their own unique identifier in their cloud environment with their mobile support system. In the contribution by Jeevan and Mohamed, "SOGC: Implementing Surrogate Object Model Garbage Collector Management for a Mobile Cloud Environment," the authors proposed the Surrogate Object Garbage Collector (SOGC) model with new middleware consists in detecting the unused surrogate object by Mark-Compact Garbage Collection technique to recycle their object resources.⁵ SOGC periodically recycles the idle object and automatically reuses it; whenever it is needed to manage cloud environment, it results in quality-of-execution, low latency, and cost optimization in data management.

Most of the data concerning business-oriented systems are still based on either NoSQL or the relational data model. On the other hand, Semantic Web data model Resource Description Framework (RDF) has become the new standard for data modeling and analysis. Due to this situation integration of NoSQL, Relational Database (RDB) and RDF data models are becoming a required feature of the systems. Many solutions like tools and languages are provided in the shape of the transformation of data from RDB to RDF. The contribution by Ramay et al, "Hybrid Approach for Big Data Localization and Semantic Annotation," is aimed to compare and map data models used for transformation between NoSQL, RDB, and Semantic Web.⁶ This study will help in achieving much better and enhanced technology-based systems for retrieval and storage of data among Big-data annotation using Semantic Web. It is aimed to reduce the response time of queries and offer compatibility with the web and semantically enriched data format.

2.2 | Performance improvements

In the contribution by Guan et al, "Performance analysis of polling based MAC protocol with retrial for internet of thing," the authors considered and analyzed a single-server multi-queue polling model with inner arrivals.⁷ Customers arriving at the station before polling instants could

receive service; furthermore, each one could be retried a given times with the specified probability. Such polling model can be used to study the performance of certain scheduling data transmission in internet of things and the relationship between data retransmission and delay. When the data arrived with Poisson distribution, served with the gated mechanism, and retried in a certain probability, the authors obtained the closed-form expression for the generating function for the number of customers presented at polling instants. Then, it is used to derive the precise closed form formula of mean queue length and mean waiting time in symmetric system.

The Software plagiarism, which arises the problem of software piracy, is a growing major concern nowadays. It is a serious risk to the software industry that gives huge economic damages every year. The customers may develop a modified version of the original software in other types of programming languages. Furthermore, the plagiarism detection in different types of source codes is a challenging task because each source code may have specific syntax rules. In the contribution by Ullah et al, "Software Plagiarism Detection in Multiprogramming Languages using Machine Learning Approach," the authors proposed a methodology for software plagiarism detection in multiprogramming languages based on machine learning approaches.⁸ The Principal Component Analysis (PCA) is applied for features extraction from source codes without losing the actual information. It extracts features by factor analysis and converts the dataset into normalized linear principal components, which are further useful for predictions analysis.

Vitality reliant and mobility are the two factors that deplete some measure of energy during the radio communication often occur in Mobile Ad hoc Network (MANET) among and between the nodes. Since MANET is a decentralized system, it poses to the exploitation of energy during the reliable path selection during routing. Hence, selection of protocol plays a major aspect in MANET for combating against the energy depletion of nodes, Instable link, mobility character, and load balancing. In the contribution by Anbarasan et al, "Improving performance in Mobile Ad hoc Networks by reliable path selection routing using RPS- LEACH," the authors proposed the RPS-LEACH protocol for the efficient path selection by organizing the nodes into clusters.⁹ For each cluster, Cluster Head (CH) is elected based on its strong transmission power and battery life. The Cluster Members (CM) is organized, respectively, based on its ability to respond to its cluster head REqs. Mainly, RPS values are calculated by the two parameters such as (1) successful interactions and (2) unsuccessful interactions.

Mobile ad hoc network is a gathering of portable nodes that works without foundation or central administration. Because of the accessibility of little and cheap remote conveying nodes, MANETs can be utilized as a part of different applications, eg, front line correspondence and debacle alleviation applications. Energy consumption is an important issue in MANET because the mobile nodes are battery powered, hence diminishing system lifetime as batteries get depleted rapidly as nodes move and change their positions quickly crosswise over MANET. In the contribution by Anand et al, "Energy Efficient Channel Aware Multipath Routing Protocol for Mobile Ad-Hoc Network," the authors proposed an energy efficient channel aware routing algorithm for mobile ad hoc networks, called energy efficient channel aware ad hoc on-demand multipath distance vector routing (EECA-AOMDV).¹⁰ EECA-AOMDV addresses three vital prerequisites of mobile ad hoc networks, ie, energy effectiveness, unwavering quality, and dragging out system lifetime. The proposed energy efficient channel mindful AOMDV (EECA-AOMDV) utilizes the channel normal nonfading span and nodal residual energy as directing metric to choose the stable route for way revelation.

The throughput of a TCP flow depends on the average size of Congestion Window (cwnd) of a congestion control mechanism being used during the communication. The size of cwnd depends upon the usage of available link bandwidth during communication. The response function is a measure of average throughput of a single TCP flow of congestion control mechanism as the level of random packet loss is varied. Nowadays, many organizations are deploying IoT based applications for the analytics of their Big Data. TCP CUBIC and TCP Compound are the default congestion control mechanisms in Linux and Microsoft Windows Operating Systems, respectively. The aim of the contribution by Ahmad et al, "ARFC: Advance Response Function of TCP CUBIC for IoT-based Applications using Big Data," is to enhance the TCP friendliness behavior of TCP CUBIC congestion control mechanism for IoT-based applications using Big Data.¹¹ In this work, an Advance Response Function of TCP CUBIC (ARFC) is designed to share fairly available link bandwidth among flows of TCP CUBIC and TCP Reno.

Social networking websites such as Twitter provide a platform where users share their opinions about different news, events, and products. A recent research has identified that 81% of users search online first before purchasing products. Reviews are written in natural language and needs sentiment analysis for opinion extraction. Various approaches have been proposed to perform sentiment classification based on polarity bearing words in reviews such as noun, verb, adverb, and an adjective. Prior researchers have also identified the role of an adverb as a feature. However, impact analysis of adverb forms is not yet studied and remains an open research area. The contribution by Haider et al, "Impact Analysis of Adverbs for Sentiment Classification on Twitter Product Reviews," focuses on the following tasks¹²: (1) impact of different forms of adverbs that are not studied for sentiment classification and (2) analysis of possible combinations of eight forms that are 255. The different forms are Adverb (RA), Degree Adverbs (RG), Degree Comparative Adverbs (RGR), General Adverbs (RR), General Comparative Adverbs (RRR), Locative Adverbs (RL), Prep. Adverb (RP), and Adverbs of time (RT); (3) Lastly, its comparison with benchmark dataset. Dataset of 5513 tweets is used to evaluate the idea.

2.3 | Applications

Optimizing cell locations of cellular networks is one of the most fundamental problems of network design. However, in order to meet a growing appetite for mobile data services, a large number of base stations are being deployed, which leads to tremendous energy consumption in cellular networks. This augmentation increases not only the system's capital and operational expenditure (CAPEX/OPEX) for mobile operators but also CO2 emissions. Besides the issue of meeting overwhelming traffic demands, network operators around the world now realize the importance

of managing their cellular networks in an energy-efficient manner. In the contribution by Chehri and Jeon, "Optimal Matching Between Energy Saving and Traffic Load for Mobile Multimedia Communication," the authors developed a self-organizing framework for energy saving in orthogonal frequency-division multiple-access-based cellular access networks.¹³ The authors considered three different objectives, namely, coverage maximization, overlap minimization, and power consumption minimization, which is different from all existing works on energy saving in cellular networks.

The state of art to integrate bio-signals with computer based diagnosis is taking dominance. The man-machine interface is useful for early and immediate clinical interpretation. The electrocardiogram (ECG) signal plays a vital role in revealing the possible data towards categorizing normal and abnormal cardiac functioning. The fatal conditions exhibited by ventricular arrhythmias (VA) pose a remarkable change in the feature set of the ECG signals. In the contribution by Karnan et al, "Human Machine Interfacing Technique for Diagnosis of Ventricular Arrhythmia using Supervisory Machine Learning Algorithms," the authors proposed a novel approach to segregate the superior feature toward the ventricular arrhythmias using feature ranking score algorithm.¹⁴ The performance estimates attained by the proposed algorithm shows the selection of optimal feature for the findings of VA through ECG. The man-machine interface aides in the early diagnosis of ventricular arrhythmias using non-invasive diagnosing tool, the ECG.

Human behavior would lead to a significant impact on the environment. By monitoring the environment, we can indirectly monitor human behavior. Remote sensing (RS) technology provides a large number of multispectral (MS) images. When combining the Internet of things technology, those images can be used for human behavioral monitoring. However, due to the limitation of the optical sensors embedded in satellites, the spatial resolution of MS image is relatively low, which poses a huge problem for further understanding these images. In the contribution by Li et al, "Pansharpening multispectral remote-sensing images with guided filter for monitoring impact of human behavior on environment," the authors proposed a novel pansharpening method.¹⁵ Different from those traditional IHS methods, the proposed method first decomposes MS and PAN into high-frequency-component (HFC) and low-frequency-component (LFC), respectively. Then, the guided filter (GF) is utilized to enhance the spectral information on the detail map. Furthermore, the detail map is refined according to the adaptive coefficients for each band of MS.

The advent of the Internet of things (IoT) has radically changed the way in which computations and communications are carried out. People are just becoming another component of IoT environments, and in turn, IoT environments are becoming a mixture of platforms, software, services, things, and people. The price one pays for such dynamic and powerful environment is an intrinsic uncertainty and low trustworthiness due to its opaque perimeter, the multitude of different data sources with unknown providers, and uncertain responsibilities. In the contribution by Anisetti et al, "A Trust Assurance Technique for IoT based on Human Behavior Compliance," the authors took a different approach and put forward the idea that, in many cases, the behavior of people owning smart devices can contribute to the evaluation of the trustworthiness of collected data and, in turn, of the whole decision process.¹⁶ The authors therefore defined an assurance methodology based on data analytics evaluating the compliance of people to behavioral policies.

The northwest region in China located at arid and semiarid areas, atmospheric precipitation converted by the cloud is an important part of water resources, and if we fully utilize cloud for cloud-water conversion to alleviate the scarcity of water, thereby it is particularly important to analyze the macroscopic characteristics and the changing trends of clouds in the northwest region. In the contribution by Zhao et al "Statistical Analysis of Cloud Characteristics in Northwest China Based on Fengyun Satellite Data," the authors calibrated, corrected, and processed the 2016 Level 1 data of Fengyun Satellite using the improved multi-spectral thresholding method to calculate cloud coverage and cloud classification data.¹⁷ The optical thickness inversion uses the SBDART (Santa Barbara DISORT Atmospheric Radiative Transfer) radiation transmission mode to establish a radiation look-up table with optical thickness as a function variable under different conditions of observation geometry, underlying surface type, and atmospheric environment.

In the contribution by Abdulkadir and Al-Turjman, "Smart-Grid and Solar Energy Harvesting in the IoT Era: An Overview," the authors summarized smart-grid and solar energy harvesting techniques.¹⁸ As the need of energy is increasing worldwide, the energy availability globally is quite less than the demands for it. Thus, the importance to consider other means of electricity generation is looked into for Sub-Saharan Africa, which is enormously rich in solar radiant. With just an average of 5.5 kWh/m², countries in the region can generate over 2000 TWh of electricity daily by just covering 1% of its total land area with solar panels. To meet up with the citizen's energy demands, steps have to be initiated to reduce the continuous dependence on fossil fuel. This can be done by integrating renewable energy sources into the grid. It of course requires urgent need to upgrade the existing grid systems into a Smart Grid. The advantages for this smart grid upgrade and the development in storage devices have been highlighted in this article, including its possible optimization and metering technologies.

3 | CONCLUSION

The articles presented in this special issue have provided insights in fields related to Real-time Behavioral Monitoring in IoT Applications using Big Data Analytics, including models, performance evaluation and improvements, and application developments. We wish the readers can benefit from insights of these papers, and contribute to these rapidly growing areas. We also hope that this special issue would shed light on major developments in the area of *Concurrency and Computation: Practice and Experience* and attract attention by the scientific community to pursue further investigations leading to the rapid implementation of these technologies.

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