

Detailed Table of Contents

Preface..... xiv

Section 1 **Computing and Software Engineering**

Chapter 1

Internet of Things: A Broader View of Architecture, Key Technologies, and Research Opportunities 1

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The Internet of Things (IoT) is an emerging computing paradigm that supports the interconnection of objects. With the rapid growth in smart technologies, IoT is gaining popularity from industry and academia focusing on communication and networking of smart objects. It is assumed that in a typical IoT application, the smart sensors are capable of directly delivering a service with no or minimal human involvement. There are many new technologies that are driving the development of IoT, which include cloud computing, wireless sensor networks, and 5G, etc. On the other hand, there are many research challenges that need to be addressed such as identity management of billions of devices connected to the internet, standardization, privacy, energy management, security of the information, space to store and process the information, etc. In this regard, the main focus of this chapter is to present IoT in a broader perspective and its associated technologies and applications along with a review of the work published in these areas.

Chapter 2

AssessLIFE Software for Automation of Asset Degradation to Estimate Asset Life and Degradation Drivers30

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The AssessLIFE software is a solution platform that analyzes and reveals if industrial physical assets made of metals, alloys, and welds can survive their exposure or

ambient conditions. The software also reveals when time-dependent premature failure is likely to occur. The software can generate great financial and safety benefits for all stakeholders. Furthermore, the AssessLIFE software aims to provide asset information for better financial and technical decision-making by managers, engineers, legal teams, insurance teams, fabricators, and inspectors.

Chapter 3

A Network Data Analytic Technique in a 5G-IoT-Based Smart Healthcare System Using Machine Learning81

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Healthcare is an important part of every individual’s life. Unfortunately, the rising prevalence of chronic diseases is putting a burden on the modern healthcare system. The internet of things (IoT) with 5G technology offers a number of advantages to the healthcare system, including remote monitoring, remote robotic surgery, and ambulances operating on dedicated network slices, all of which relieve pressure on the traditional healthcare system. 5G-IoT enables billions of healthcare equipment to communicate with one another. These devices will produce a huge amount of data that can be evaluated. In the healthcare industry, data analytics has a huge potential. In this chapter, the authors examine a brief history of machine learning as well as some fundamental knowledge of the methodologies. In addition, the author has provided a brief overview of several machine learning algorithms utilized in healthcare in the context of 5G-IoT. The future aspect of machine learning in a 5G-IoT smart healthcare system was also highlighted.

Chapter 4

Protection of Critical Infrastructure Using an Integrated Cybersecurity Risk Management (i-CSR) Framework94

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Risk management plays a vital role in tackling cyber threats within the cyber-physical system (CPS) for overall system resilience. It enables identifying critical assets, vulnerabilities, and threats and determining suitable proactive control measures to tackle the risks. However, due to the increased complexity of the CPS, cyber-attacks nowadays are more sophisticated and less predictable, which makes risk management task more challenging. This chapter proposes an integrated cyber security risk management (i-CSR) framework for systematically identifying critical assets through the use of a decision support mechanism built on fuzzy set theory, predicting risk types through machine learning techniques, and assessing

the effectiveness of existing controls through the use of comprehensive assessment model (CAM) parameters.

Chapter 5

PAPR Reduction in OFDM Systems Using Compressive Sensing for Energy-Efficient 5G Networks.....134

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Orthogonal frequency division multiplexing (OFDM) is a multi-carrier transmission technique used to accomplish high data rate transmission in wireless communications. OFDM is one of the major players of multi-carrier communication systems in 5G networks due to its high spectral efficiency and is immune to multipath fading. However, the OFDM signal suffers from significant amplitude fluctuations resulting in a large peak-to-average power ratio (PAPR), which is one of the main downsides of OFDM systems. Therefore, limiting the PAPR in OFDM systems is a key issue, as decreasing PAPR results in lower power consumption and hence an extended battery life. Reducing PAPR without degrading power usage efficiency and bit error rate (BER) is a challenging issue in improving communication performance. This chapter discusses the use of compressive sensing for PAPR reduction in OFDM systems to deploy in energy-efficient 5G networks.

Chapter 6

Prediction of Ethereum Blockchain ERC-20 Token Standard Smart Contract Vulnerabilities Using Source Code Metrics: An Ensemble Learning Approach155

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In this study, firstly, a dataset of 10,476 annotated vulnerable ERC-20 standard token smart contracts (belonging to a set of 33 common smart contract vulnerabilities) has been collected from a publicly available repository. Secondly, using the SolMet smart contract metrics measurement tool, the object-oriented software attributes (i.e., metrics) from each smart contract's source code has been extracted. Lastly, using the source code metrics and the vulnerability annotations (i.e., labels) as the input in supervised machine learning (classification) algorithms, the accuracy of each individual algorithm is evaluated against the accuracy of an ensemble classifier (namely voting). The model accuracies demonstrate the feasibility of identifying and prioritising smart contracts for further inspection prior to deployment to the blockchain network. The ensemble classifier performed better (accuracy = 0.79) compared to each classifier when used individually.

Chapter 7

An Application-Oriented Survey on the Adaptability of Artificial Intelligence for Natural Language Processing: A Survey 172

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The application domains for artificial intelligence and machine learning are expanding exponentially in recent times. The domains such as automation in software and business processes, healthcare, agriculture, robotics, and mostly natural language processing have seen the most adaptations. The domain of natural language processing seeks the maximum adaptation due to various sub domain applications such as textual classification, detection of emotions, design and delivery of virtual assistant tools, extraction of knowledge, content summarization, content recommendations, user profiling for content consumption habits, grammar and dialect verification, and text summation. These subdomains cater to a wide range of purposes such as user profiling or emotion extraction for surveying or feedback analysis for data-driven applications.

Section 2

Electronic Science and Engineering

Chapter 8

RF/Microwave Instruments Evolution: From Professional Hardware Into Amateur Kit and Software-Defined Radio 183

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This chapter describes the evolution of RF/microwave instruments within two decades. The described RF/microwave instruments focus more on low-cost amateur RF signal sources, power detectors, spectrum analyzers (SA), vector network analyzers (VNA), and software-defined radios (SDR). Each instrument is introduced, and its uses are compared. This chapter reviews in detail the development history and development factors of amateur RF/microwave instruments in the past 20 years. Through this chapter, fresh RF/microwave amateurs and hobbyists will better understand the development of low-cost instruments in the present and also in the future, as well as provide guidelines for RF/microwave amateurs and hobbyists in the selection and purchase of such instruments. In fact, some amateur instruments are also used in 5G researches and IoT applications when considering their instrument size, research budget, and the need to use a large number of instruments in the application.

Chapter 9

Tunable Attenuator Based on Hybrid Metal-Graphene Structure on Spoof Surface Plasmon Polaritons Waveguide.....232

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A novel type of tunable attenuator on spoof surface plasmon polaritons (SSPP) waveguide based on hybrid metal-graphene structure for terahertz applications is proposed in this chapter. Two structures are analyzed and designed, where the first is composed of a graphene sheet at only one cell of the SSPP waveguide and the second at all cells. By varying the graphene chemical potential via a biased voltage, the surface conductivity of graphene can be adjusted. Therefore, the attenuation can also be adjusted. Moreover, an equivalent circuit model is proposed to facilitate the designs of the proposed attenuator and offer a general understanding of the attenuation mechanism. Numerical simulation results with the CST simulator and WCIP method have a good agreement with the theoretical results. The simulated results show that the attenuator can obtain an adjustment range from 6.02 to 14.32 dB for the first structure and from 1.58 to 30.93 dB for the second, as the chemical potential rises from 0 to 0.5 eV.

Chapter 10

Opportunity and Challenges for VLSI in IoT Application.....245

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Internet-of-things (IoT) systems combine sensing, computation, storage, and communication to sense physical systems and respond accordingly. However, larger size chips are not suitable for fog and edge devices. Therefore, a new mindset is required for VLSI design to implement the IoT application. This chapter describes the first conventional technology used in VLSI design. Afterward, the characteristics of IoT systems relevant to VLSI design identify essential factors and challenges at different levels. Finally, the fifth-generation network (5G) is also studied to expand IoT applications.

Compilation of References 272

About the Contributors 302

Index..... 306