Artificial Intelligence and Soft Computing for Industrial Transformation

HUMAN COMMUNICATION TECHNOLOGY

Internet of Robotic Things and Ubiquitous Computing

EDITED BY

R. Anandan, G. Suseendran

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Artificial Intelligence and Soft Computing for Industrial Transformation

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Preface

It is with great pleasure that we introduce this book on “Human Communication Technology: Internet of Robotic Thing and Ubiquitous Computing”. Our objective in writing it was to adopt advancements in the field and help disseminate results that cover a broad cross section of technical disciplines concerning recent applications and case studies in the areas of human communication technology, robotic intelligent systems, and ubiquitous computing among working professionals, academics and researchers. The book is also designed to provide students with a platform for exploring knowledge relating to human communication technology that will enable them to produce serviceable innocuous and purposeful systems using cutting-edge technology to yield computer systems with decent usability. In order to achieve these goals, developers must first attempt to understand the factors that determine how people use technology.

These new architectures, networking paradigms, trustworthy structures, and platforms for the integration of applications across various business and industrial domains are needed for the emergence of’ intelligent things (static or mobile) in collaborative autonomous fleets. These new apps speed up the progress of paradigms of autonomous system design and the proliferation of the Internet of Robotic Things (IoRT). Collaborative robotic things can communicate with other things in the IoRT, learn independently, interact securely with the world, people and other things, and acquire characteristics that make them self-maintaining, self-aware, self-healing and fail-operational. Due to the ubiquitous nature of collaborative robotic things, the IoRT, which binds together the sensors

and the objects of robotic things, is gaining popularity. Therefore, the information contained in the sixteen chapters of this book, as briefly described below, was chosen to provide readers with a better understanding of this interdisciplinary field.

– Chapter 1 describes how robots share information and operate in a common environment.

– Chapter 2 defines the BCI-based headsets developed with the architecture of the IoRT to analyze incoming EEG signals for the corresponding actions of human beings.

– Chapter 3 explains why automated verification and validation of IoRT systems warrant the functional safety and reliability characteristics of soft-ware using appropriate program verification techniques. These include automated model checking and theorem proving in combination with automated test frameworks for establishing independent testing in ubiquitous software environments using reduced manual resources and timelines to verify and validate systems with a higher degree of operational efficacy.

– Chapter 4 explains the sequential pattern mining process and fuzzy time interval sequential pattern mining using genetic algorithm (GA), pattern matching using similarity computation index (SCI), classification based on SCI value, and significant pattern evaluation process. The second part of the chapter shows how patients are assessed using a belief network automated via the IoRT.

– Chapter 5 describes the various Li-Fi technology applications used for man-to-machine and machine-to-machine communication. Li-Fi will be the future technology for short-range wireless communication.

– Chapter 6 highlights the computation process for monitoring human activity using human-centered computing. It focuses on the design, implementation, and evaluation of interactive information gathered from the technological system in relation to usable and accessible information gathering. The multimodal human communication interaction system is premeditated to receive communication from humans to provide improved results and an operative communication process.

– Chapter 7 showcases the automatic robotic systems designed and developed with a combination of computing, intelligence and the internet of things (IoT).

– Chapter 8 outlines the general layered architecture of an IoRT system with an emphasis on the various communication protocol choices available for each layer. The initial subsections summarize the latest developments in communication standards and data exchange protocols that tie robotics and the IoT together. There is a discussion of some of the prominent communication challenges in realizing an IoRT system along with the latest research solutions. A later subsection provides details about the open platforms available for developing IoRT solutions and also highlights the developments in the industrial sector that could bring such solutions to everyday life.

– Chapter 9 describes a real-time hazardous gas classification and management system using neural networks. The chapter begins by giving a detailed view of the preparation of an input dataset from a sensor for an artificial neural network model that helps to classify and measure the concentration of gases and ends with network training using the dataset.

– Chapter 10 focuses on medical imaging research that uses a noninvasive diagnostic technique and many effective algorithms, such as gravitational search algorithms (GSAs), for optimization of modular neural networks (MNNs) in pattern recognition. In this chapter, a novel method known as the hierarchical elitism gene gravitational search algorithm is proposed.

– Chapter 11 proposes a machine learning algorithm that combines the IoT application areas. A basic aim of this chapter is to also analyze the different uses of machine learning in the IoT for healthcare, logistics, transportation and agriculture among others.

– Chapter 12 describes the time-variant adaptive techniques for feedback cancellation in hearing aids. The IoT-based bias analysis provides a statistical evaluation of the steady-state performance of an acoustic system and offers significant and robust feedback cancellation in the presence of varying environmental conditions.

– Chapter 13 applies the concepts of Industry 4.0 and Smart Cities Mission to pave the way to the concepts of Agriculture 4.0 and Smart Farming through the use of the IoT. With the evolution of the IoT, we have the ability to totally change the different phases of agriculture.

– Chapter 14 mainly focuses on the green computing practices used in combating COVID-19 in a study by the Institute of Health Sciences in Gaborone. This study investigated different literature reviews concerning green computing practices assisted by several theoretical models, such as the technology acceptance model, utilized to present an economical explanation of the components that define the adaptations, which are

generally applicable to many utilization behaviors from different computing innovations.

– Chapter 15 lists the available technology of sensor, pervasive computing, and intelligent information processing widely used in body sensor networks (BSNs), which are a branch of wireless sensor networks (WSNs). These BSNs play an increasingly important role in the fields of medical treatment, social welfare and sports, and are changing the way humans use computers.

– Chapter 16 explains how the IoT, assisted by advanced electronic tools, offers the best ways of experiencing and responding to the outside world. However, at the same time, with the help of sensor information, new problems and obstacles will emerge as new application scenarios are envisaged. Therefore, this chapter investigates further developments, such as the interoperability between heterogeneous devices and confidence in smart devices, to meet business and technical requirements such as validity, safety, and trust.

To conclude, we would like to extend our appreciation to our many colleagues. We also extend our sincere thanks to all the experts for providing preparatory comments on the book that will surely motivate the reader to read the topic. We also wish to thank the reviewers who took time to review this book, and are also very grateful to our family members for their patience, encouragement and understanding. Special thanks are also due to many individuals at Scrivener Publishing, whose talents and efforts made the publication of this book possible. Finally, any suggestions or feedback from readers to improve the text will be highly appreciated.

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Internet of Robotic Things: A New Architecture and Platform

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Abstract

IoT is an interconnection of internet-enhancing devices that increases the usage of internet. It provides a stable base for users to form communication with other devices. The linked devices will share data among themselves through network protocols. Internet of Things is a technological change among the Blockchain, AI, Cloud Computing, Machine Learning technologies with increasing speed to solve the problems.

The area of Cloud robotics includes cloud computing, Internet technologies and cloud storage. It enables robots to benefit from quick increases in online data transfer rates and reduces the maintenance, updates. By using cloud robotics, operation durations can be reduced and costs increased. Cloud robotics is used in a variety of areas, for example cloud computing, big data, distributed computing-Human and robotic constraints, such as service quality (QoS), physical infrastructure, privacy, jitter, multi-robotic management, etc.

In order to avoid limitations in cloud robotics we combine the Internet of Things with Cloud Robotics to provide smart, high performance, reliability, stability, cost-effectiveness and collaborative multi-robot networks. This paper describes how robots will share the information and operating in common environment. IoRT can make a solid base for implementing robotics in diverse applications. This work discusses about the architecture and platform of IoRT.

Keywords*:* Amazon web services, real-time processing, robot operating system, cloud services, internet of robotic things, robotics

1.1 Introduction