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Abdul Salam

Internet of Things for Sustainable Community Development

Wireless Communications, Sensing,
and Systems

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*This book is dedicated to Umbreen, Alizay,
Anzalna, and Naba.*

Preface

Fires in Amazon rainforest, Hurricane Dorian in Bahamas, and wildfires in California are among some of the recent events related to the climate change. The rising sea levels, higher temperatures, and extreme precipitation are some of the causation of climate change. The communities around the world are coping with these changes now. In this regard, an untypical effort from all sectors of community is needed to address critical problems of adapting to climate change and feeding 7.7 billion people.

The *Internet of Things for Sustainable Community Development* addresses the key inter-related environmental, climate change, energy, water, health, mining, agro-economic, and cybersecurity challenges that limit the development of sustainable and resilient society. The aim of this book is to present an integrated depiction of how the Internet of Things “IoT” can stimulate the sustainable community development. The expertise across multiple domains including engineering and technology, ecosystems and natural resource management, environmental toxicology, human health, agriculture, mining, and urban underground infrastructure monitoring is introduced to examine important environmental challenges that can be solved with applications of recent advancements in Internet of Things.

In these domains, the sensing data is generated by a wide range of sensors, from point-based direct in situ measurements to airborne and remote sensing for global coverage through satellites. In each domain, the sensing requirements change considerably, stretching from plant level water status to field level soil moisture, and regional level cloud hydrometer to global scale climate crises and greenhouse gases. The integration of huge volumes of data being generated across these spatial–temporal scales is a major challenge. Moreover, the transmission and processing of this data in decision support systems to address sustainability challenges requires cross-disciplinary endeavors with expertise in sensing, wireless communications, systems science, and modeling, in addition to the specific domain knowledge. The Internet of Things has strong potential to foster the creation of these cross-disciplinary next-generation sensing and communication systems using IoT. These IoT systems for data gathering, wireless communications, processing, and presentation of sensing data are vital to get insights into the biological, physical, and

chemical processes in the environment, and forecasting the prospective advancement of ecosystems sustainability. Such forecasts are also required to support policy and regulation decisions.

The *Internet of Things for Sustainable Community Development* presents a portfolio of cutting-edge, interdisciplinary research developments and challenges in IoT sensing, communications, and systems. It provides a well-founded coverage of these technologies with rigorous focus on scientific concepts, evolution, and applications to sustainability. The comprehensive contents are arranged systemically to provide the scientific foundations of Internet of Things for sustainable community development. The book covers research and innovation ecosystem of the Internet of Things for sustainability in the following major areas that are explored in this book. These areas highlight converging activities that enable the main cohesive objective of sustainable community development.

- Climate Change
- Sustainable Energy Systems
- Sustainable Water
- Human Health
- Sustainable Mining
- Decision Agriculture
- Storm and Wastewater
- Sustainable Forestry

Each of these areas emphasizes core IoT research challenges and solutions while leveraging their shared traits, interdependencies, and expertise to converge on applications of IoT to sustainability challenges. These sections of our community do not exist in segregation. The energy and water are fully intertwined because the water is used to produce energy, and the energy is needed to drain, remedy, and transport water, which underscores the connection between the water-dependent crop growers and city dwellers. Moreover, the human health is impacted by water availability and quality, energy availability, cultivation, mining, and waste management, inter alia, impacting patients, diseases spread, and outbreak. Furthermore, forestry and watershed are impacted by water availability, energy supply, climate crisis, and biodiversity.

In that regard, the book emphasizes IoT paradigm's sensing, wireless communications, monitoring, actuation, and real-time decision capabilities for sustainability "things". Thus, proper focus is also given to systems, standards, and tools that have tremendous potential to achieve United Nations Sustainable Development Goals. It provides a comprehensive reference to all these aspects in an easy language that is understandable by a wide audience. It also includes advanced treatment of sustainability IoT technology applications and provides in-depth coverage of research developments and open research challenges.

While intended primarily for sustainable engineering and technology professionals, researchers, and students, this book is also beneficial to policy makers, city planners and managers, technicians, and industry professionals. The research in Internet of Things for sustainability has a vital role to play in shaping the future of

our community as they must create a research and education ecosystem promoting impactful solutions-oriented science to help citizenry, government, industry, and other stakeholders work collaboratively to make informed, socially responsible, science-based decisions. The socio-technical analysis presented in this monograph together with application of the latest innovations in IoT sensing, systems, and wireless communications technologies allows for a deeper understanding and management of these complex interconnected human-socio-environmental challenges.

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Abdul Salam

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