Studies in Big Data

Volume 63

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The series “Studies in Big Data” (SBD) publishes new developments and advances in the various areas of Big Data- quickly and with a high quality. The intent is to cover the theory, research, development, and applications of Big Data, as embedded in the fields of engineering, computer science, physics, economics and life sciences. The books of the series refer to the analysis and understanding of large, complex, and/or distributed data sets generated from recent digital sources coming from sensors or other physical instruments as well as simulations, crowd sourcing, social networks or other internet transactions, such as emails or video click streams and other. The series contains monographs, lecture notes and edited volumes in Big Data spanning the areas of computational intelligence including neural networks, evolutionary computation, soft computing, fuzzy systems, as well as artificial intelligence, data mining, modern statistics and Operations research, as well as self-organizing systems. Of particular value to both the contributors and the readership are the short publication timeframe and the world-wide distribution, which enable both wide and rapid dissemination of research output.

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IoT and Analytics for Agriculture

Springer

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Preface

This edited book aims to bring together leading academic scientists, researchers, and research scholars to exchange and share their experiences and research results on all aspects of wireless IoT and analytics for agriculture. It also provides a premier interdisciplinary platform for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of IoT and analytics for agriculture. The book is organized into 12 chapters.

Chapter "Integrating Big Data Practices in Agriculture", focuses on the integration of Big Data practices in agronomical practices, supply chain operation, and consumers' feedback, by using different Big Data approaches. This chapter would help in understanding the multifaceted concept of Big Data in various agricultural practices.

Chapter "Solar-Powered Automated IoT-Based Drip Irrigation System", presents wireless sensors that were used to analyze the moisture level of the field and to automate the irrigation process. An automated irrigation system refers to the operation of the system with a minimum of manual intervention besides the surveillance. All types of irrigation process like drip, sprinkler, or surface can be automated with the help of timers, sensors, or computers or mechanical appliances. In this automated system, some standard data regarding the moisture level of a field is predefined for a specific crop. The sensor first transmits the data through a microcontroller to the server after a specific time interval. If the moisture level of the field is below the standard value of the database, the microcontroller will trigger the pump for watering the plants till the predefined moisture level. If the moisture level of the field reaches the threshold limit, then the pump will automatically stop watering through microcontroller.

Chapter "IoT Foundations and Its Application", deals with the concept of Internet of things (IoT), the applications of IoT, the technologies of IoT, and the need of IoT.

Chapter "e-Device for the Protection of Agricultural Land from Elephant Attacks in Odisha: A Review", presents an approach to reduce crop damage by the elephants on agricultural lands. This proposed work is comprised of Internet of things and cloud-based technology with high-resolution camera to capture the images and process it and compare it with already stored images on cloud with the help of image processing algorithm, and after detection, it intimates the corresponding authority. This approach system would be fully automatic, and it is a low-cost device and affordable for large area coverage and ultimately this will decrease the loss of lives.

Chapter "The Impact of Irrigation on Agricultural Productivity in the Bolpur Sub Division, West Bengal", explores the fact that ever-increasing population leads to more intensive agriculture which needs more irrigation facilities, along with other inputs. Agricultural productivity of any region is closely associated with a number of physical (like relief, climate, soil, water, etc.), socioeconomic, political, institutional, and organizational factors of that region. Higher-level application of chemical fertilizers and pesticide, timely and adequate supply of irrigation, and higher-level supervision help to have an upper-level productivity of crops in the study area.

Chapter "Big Data, Climate Smart Agriculture, and India–Africa Relations: A Social Science Perspective", analyzes the possibilities of collaboration across agriculture and allied activities that can benefit both Indian and African economies by integrating Big Data into climate smart agriculture, which thereby increases agricultural productivity as well as efficiency in the utilization of resources. It takes an exploratory and descriptive research, with the intention of filling the void of lack of literature in social sciences.

Chapter "IoT-Enabled Agricultural System Applications, Challenges and Security Issues", aims at agricultural applications where it utilizes modern technologies that benefit the farmers with decision tools and reduce manual laboring cost. The seamless integration of products, knowledge, and services through IoT maximizes the volume of productivity, product quality, and profit of business. Even though current surveys on the IoT in agriculture focuses on the challenges, constraints, benefits, and pitfalls for large scale in the agricultural food sector, all are presented in isolation to each other. So, keeping all in these in mind, a brief discussion on challenges, benefits, constraints, future trends, and security issues is presented in this chapter.

Chapter "Land Suitability Analysis for Peri-urban Agriculture Using Multi-criteria Decision Analysis Model and Crop Condition Monitoring Methods: A Case Study of Kolkata Metropolitan Area", discusses multi-criteria decision analysis model and applies crop condition monitoring method to find out the suitable zones of peri-urban agriculture around Kolkata city. This model was tested on the Kolkata Metropolitan Area (KMA) using various criteria like land use, digital elevation model (DEM), water facility, road and market facility, etc. For analyzing the land

use of KMA, supervised classification methods has been used, and to find out the agricultural area, crop condition monitoring method (e.g., NDVI, i.e., Normalized Difference Vegetation Index) has been used by using remote sensing images. For the analysis of water, road, and market facilities in various areas of KMA, census data has been used. Multi-criteria decision analysis model revealed that northwest, central-east, southeast, and northern zones of KMA are the most suitable for peri-urban agriculture. Finally, it can be said that this model is able to allocate the suitable land for the peri-urban agriculture very precisely. This model will help the urban, peri-urban planners, policy-makers, and decision-makers for taking action on various decisions at different levels.

Chapter "Security and Privacy Issues in Wireless Sensor Networks", discusses sensor node which is used to collect the information from the environment and transmit the data to the control unit. Due to a large number of collection and transmission, should need to protect from hacker. WSNs need to provide security in all aspects of their architecture reference model. In this chapter main contribution includes architecture, attacks, and countermeasures.

Chapter "A Design of IoT-Based Agricultural System for Optimal Management", designed IoT-based agricultural system using data mining and communication protocol/network for optimal management of agriculture. IoT-based technology makes nonstop message between object and things or between things/object and humans. Data mining and communication protocol will be used as prediction/inference of the knowledge from the hidden data and make the optimal travel of the data with security and recovery, respectively. Therefore, in this chapter, an effort has been made to design an IoT-based agricultural system and discuss the problem and implication of the implementation of these techniques.

Chapter "Smart and Sustainable Agriculture Through IoT Interventions: Improvisation, Innovation, and Implementation—An Exploratory Study", exemplifies by the glimpse of application like farming based on weather projection, real-life count of agriculture produces, real-life estimation for loss due to ability or expiry, irrigation issues, controlling of infrastructure support for farming activities from a distant location, census of cattle, etc. In fact, the concept of IoT is still in nascent stage in India. There are vast opportunities of IoT application in the country since India is primarily an agrarian society and around 60% population are engaged in this profession which contributes around 17% of share in GDP and feeding the elephantine population of the country. This paper would study various sparks of IoT system, its versatile application worldwide, and possible intervention in India, particularly in agricultural activities. The paper would explore innovative modeling for IoT integration in agriculture system and its ease of implementation globally with emphasis on Indian subcontinent.

We are sincerely thankful to Almighty for supporting and standing at all times with us, whether it is good or tough times and given ways to concede us. Starting from the call for chapters till the finalization of chapters, all the editors have given their contributions amicably, which is a positive sign of significant teamwork. The editors are sincerely thankful to all the members of Springer, especially

Mr. Aninda Bose and Ms. Shilpa, for providing the constructive inputs and allowing an opportunity to edit this important book. We are equally thankful to reviewers who hail from different places in and around the globe and shared their support and stand firm toward quality chapter submission.

Bhubaneswar, India — Prasant Kumar Pattnaik
Jabalpur, India — Raghvendra Kumar
Nadia, India — Souvik Pal
Chandigarh, India — S. N. Panda

About This Book

A major challenge in agriculture is to cultivate produce in the farm and deliver it to the end consumers with the best possible price and best possible quality. Currently, all over the world, it is found that around 50% for the farm produce never reach the end consumer due to wastage and suboptimal prices. The audience will get the solution to reduce the transport cost, predictability of prices on the past data analytics, and the current market conditions, reduce number of middle hops and agents between the farmer and the end consumer using IoT-based solution. Again, the demand by consumption of agricultural products could be predicted quantitatively; however, the variation of harvest and production by the change of farm's cultivated area, weather change, disease, insect damage, etc. could be difficult to be predicted, so that the supply and demand of agricultural products have not been controlled properly. To overcome it, this edited book designed the IoT-based monitoring system to analyze crop environment and the method to improve the efficiency of decision making by analyzing harvest statistics. The book also intended to attract the audience who work in climate changes. Climate change and rainfall have been erratic over the past decade. Due to this in the recent era, climate-smart methods called as smart agriculture is adopted by many Indian farmers. Smart agriculture is an automated and directed information technology with the IoT.

Key Features

1. Addresses the complete functional framework workflow in IoT-enabled agrosystem.
2. Explores basic and high-level concepts, thus serving as a manual for those in the industry while also helping beginners to understand both basic and advanced aspects in IoT-based agriculture-related issues.
3. Based on the latest technologies and covering the major challenges, issues, and advances in IoT agrosystem.
4. Exploring intelligent field monitoring and automated system through IoT ecosystem and its implications to the real world.
5. Explains the concepts of smart monitoring and irrigation in IoT-based agricultural system for the betterment of the smarter humanity.
6. Intelligent data processing and sensor technologies in IoT-enabled agriculture system.
7. Exploring the predictive analysis system, crop monitoring, and weather data-enabled analysis in IoT agrosystem.
8. Exploring data acquisition and case studies related to data-intensive technologies in farming-based Internet of things.

Contents

About the Editors

Prasant Kumar Pattnaik Ph.D (Computer Science), Fellow IETE, Senior Member IEEE is a Professor at the School of Computer Engineering, KIIT Deemed University, Bhubaneswar. He has more than a decade of teaching and research experience. Dr. Pattnaik has published numbers of Research Papers in peer-reviewed International Journals and Conferences. He also published many edited book volumes in Springer and IGI Global Publication. His areas of interest include Mobile Computing, Cloud Computing, Cyber Security, Intelligent Systems and Brain Computer Interface. He is one of the Associate Editor of Journal of Intelligent & Fuzzy Systems, IOS Press and Intelligent Systems Book Series Editor of CRC Press, Taylor Francis Group.

Raghvendra Kumar is working as Associate Professor in Computer Science and Engineering Department at L.N.C.T Group of College Jabalpur, M.P. India, and Serving as Director of IT and Data Science Department, Vietnam Center of Research in Economics, Management, Environment (VCREME) - Branch VCREME One Member Company Limited, Vietnam. He received B. Tech. in Computer Science and Engineering from SRM University Chennai (Tamil Nadu), India, M. Tech. in Computer Science and Engineering from KIIT University, Bhubaneswar, (Odisha) India and Ph.D. in Computer Science and Engineering from Jodhpur National University, Jodhpur (Rajasthan), India. He serves as Series Editor Internet of Everything (IOE): Security and Privacy Paradigm publishes by CRC press, Taylor & Francis Group, USA and Bio-Medical Engineering: Techniques and Applications, Publishes by Apple Academic Press, CRC Press, Taylor & Francis Group, USA. He has published number of research papers in international journal (SCI/SCIE/ESCI/Scopus) and conferences including IEEE and Springer as well as serve as organizing chair (RICE-2019), volume Editor (RICE-2018), Keynote speaker, session chair, Co-chair, publicity chair, publication chair (NGCT-2017), advisory board, Technical program Committee members in many international and national conferences and serve as guest editors in many special issues from reputed journals (Indexed By: Scopus, ESCI). He also published 11 chapters in edited book published by IGI Global, Springer and Elsevier. He also

received best paper award in IEEE Conference 2013 and Young Achiever Award-2016 by IEAE Association for his research work in the field of distributed database. His researches areas are Computer Networks, Data Mining, cloud computing and Secure Multiparty Computations, Theory of Computer Science and Design of Algorithms. He authored and Edited 17 computer science books in field of Internet of Things, Data Mining, Biomedical Engineering, Big Data, Robotics, Graph Theory, and Turing Machine by IGI Global Publication, USA, IOS Press Netherland, Springer, Elsevier, CRC Press, USA, S. Chand Publication and Laxmi Publication. He is Managing Editor in International Journal of Machine Learning and Networked Collaborative Engineering (IJMLNCE) ISSN 2581-3242.

Souvik Pal Ph.D., MCSI, MCSTA/ACM, USA; MIAENG, Hong Kong; MIRED, USA; MACEEE, New Delhi; MIACSIT, Singapore; MAASCIT, USA is working as Assistant Professor at the Department of Computer Science and Engineering in JIS College of Engineering, Kalyani, India. Dr. Pal has received his both Masters Degree and Doctorate Degree from KIIT University, Bhubaneswar, India. Dr. Pal has published several research papers in peer-reviewed International journals and conferences (SCOPUS, ESCI). He has authored a book on computer science in the field of Cloud Computing. He was appointed in many conferences as Session chair, reviewer, and track co-chair. Dr. Pal also serves as Editorial and International Advisory board member for many journals and conferences. His research area includes Cloud Computing, Big Data, Internet of Things, and Data Analytics.

S. N. Panda born in Jharsuguda, Odisha on 19th August 1969. He completed his B.Sc. (Hons) with First class Distinction from Laxmi Narayan College, Jharsuguda, then he pursued his M.Sc. from G.J.University, Hissar and Ph.D. (Computer Science) from Kurukshetra University, Haryana. He joined as Lecturer in S.A.Jain (PG) College, Ambala. In the year 2007 he joined as Professor and Principal Regional Institute of Management and Technology, Punjab and is presently working as Professor and Director Research, Chitkara University, Punjab. He has more 25 years of Teaching/ Administration and Research experience. Guided 7 Ph. D. Computer Science and 13 M.Phil Scholar. He is now working towards development of innovative technologies and product based on Internet of things and Cloud Computing. He is expertized in Cyber security, Networking, Advanced Computer Network, Machine Learning and Artificial Intelligence. He has filed 8 patents, 55 Intenational publications in the relevant area and involved in Internet of things healthcare devices like Portable Intensive Care Unit, Digital Laryngoscope etc. He has developed the prototype of Smart Portable Intensive Care Unit through which doctor can provide the immediate virtual medical assistance to emergency cases in ambulance and won prestigious Millennium Alliance Award from FICCI in 2017 and seed funding for his project. He is also working on a project "Cyber Technology Communication for Women Safety" which is funded by Ministry of Science and Technology, Govt. Of India and another project "Remote Vital Information and Surveillance System for Elderlyand Disabled Persons" which is again funded by Ministry of Science and Technology, Govt. Of India. He has been

bestowed with “Adroit Researcher Award” for the outstanding contribution in the field of Education and Research, during the “International Conference on Interdisciplinary Research for Sustainable Development (IRSD-2016)” in NITTTR Chandigarh and COSMIC Outstanding Researcher Award from COSMIC Journal, Thailand. He is also proud recipient of Teacher’s Excellence Award from Chitkara University, Punjab INDIA. He received Certificate of Appreciation as Productive Member of International Reviewer Board, Informing Science, Vilnius, Lithuania (Europe) 2014 and Appreciation Award by ISI Florida, USA for excellent work as Member of International Board of Reviewer 2015. He represented Chitkara University in TiECON 2017, in Silicon Valley, California, USA.