PREDICTIVE METHODS *in* NEXT-GENERATION COMPUTING

An Approach Toward Sustainability

Edited By
R. Sathiyaraj, Rajesh Kumar Dhanaraj, K. Arun Kumar, Rutvij H. Jhaveri, and A. Mohamed Abbas

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Next-Generation Computing and Communication Engineering

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Scope: The rapid growth of technology and new smart city development initiatives has made computing and communication an inevitable platform for all engineering domains. The need for a sophisticated ambient environment has resulted in the exponential growth of automation, robustness and artificial intelligence. Therefore, it is very important to address computing and communication issues in such environments in order to achieve better performance.

Edge computing has become an active research field supporting low processing power, real-time response time, and more resource capacity than IoT and mobile devices. It has also been considered to effectively mitigate loads on data centers, to assist artificial intelligence (AI) services, and to increase 5G services. Edge computing applications along with the IoT field are essential technical directions in order to open the door to new opportunities enabling smart homes, smart hospitals, smart cities, smart vehicles, smart wearables, smart supply chain, e-health, automation, and a variety of other smart environments.

However, any developments are made more challenging because the involvement of multi-domain technology creates new problems for researchers. Therefore, in order to help meet the challenge, this book series concentrates on next generation computing and communication methodologies involving smart and ambient environment

design. It is an effective publishing platform for monographs, handbooks, and edited volumes on Industry 4.0, agriculture, smart city development, new computing and communication paradigms. Although the series mainly focuses on design, it also addresses analytics and investigation of industry-related real-time problems.

The main focus of the series includes but is not limited to the following research areas: Industry 4.0, Artificial Intelligence, Machine and Deep learning, Data science, Cognitive Engineering, Cognitive Analytics, CUDA system design, Cyber-physical systems, Quantum Machine Learning, Smart cities, Smart factory, Smart machining, Smart cutting tools, Sensors and Actuators, 5G and wireless technologies for industrial applications, prognostics and alert system. Additional areas of interest include Intelligent manufacturing, Smart healthcare and Transportation systems, Digital Twins, Rapid Prototyping and Manufacturing system, Low Energy Embedded system, Edge and Fog computing, Algorithm design, the Internet of Things and Cyber forensics, Cryptocurrency, Bitcoin and Blockchain Technology, Communication Protocol Design, Intelligent System design and Crowd Sensing, Smart Grid, Soft computing solutions, Microwave Antennas, Atmospheric & Ionospheric research, UAV and ROV monitoring, Signal Processing, System-on-chip and Embedded Design concepts.

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Preface

The ever-evolving landscape of computing has witnessed a paradigm shift toward the adoption of predictive methods, intelligent algorithms, and sustainable technologies. As we step further into the era of next-generation computing, the confluence of Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), Blockchain, and sustainable system design is transforming how societies function and innovate. The edited volume titled *Predictive Methods in Next-Generation Computing* is a timely and comprehensive compilation of research that brings together diverse perspectives on the application of intelligent computational techniques for shaping a smarter and more sustainable future.

This book aims to explore how predictive analytics, driven by AI and allied technologies, can address real-world challenges across various domains such as healthcare, transportation, energy systems, smart cities, and secure digital ecosystems. Each chapter contributes a unique insight into how predictive methodologies are being used to build efficient, intelligent, and future-ready applications.

Beginning with an overview of intelligent computational techniques and their relevance in smart applications, the book transitions into sustainable design strategies and global development paradigms powered by predictive models. The role of intelligent systems in managing urban transport, traffic, and infrastructure is examined through dedicated chapters, highlighting the importance of data-driven planning for urban sustainability. Further, the application of IoT in secure and smart development, especially in the context of smart cities and traffic systems, is discussed with practical frameworks and models.

Healthcare and biomedical informatics are addressed through predictive diagnostics, exemplified by the use of Autoencoders and Principal Components in heart disease classification. The integration of Blockchain in managing medical data and decentralized financial systems illustrates the emergence of secure and transparent computing ecosystems. Moreover, this volume also delves into the energy domain, focusing on renewable energy integration, data center optimization, and analytics for resource sustainability — critical aspects for the green transformation of digital infrastructure. This also addresses the security and privacy issues with the importance of safeguarding data in predictive environments, a growing concern in the age of ubiquitous computing.

This book is intended for researchers, academicians, industry professionals, and students who are eager to understand the cutting-edge advancements and applications of predictive methods in next-generation computing. It serves both as a reference for ongoing research and as a source of inspiration for developing innovative solutions to contemporary challenges. Additionally, the book provides the consideration and impact of technologies on lives of all stakeholders including industrialists and academicians, customers, government and policy makers. May this book serve as a catalyst for thought, innovation, and forward-looking collaboration in the next era of computational discovery.

1
Introduction to Intelligent Computational Technologies

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Abstract

Indeed, the convergence of smart technologies and sustainability imperatives is one of vital spectrum and focus in application development within the contemporary technological context. This chapter investigates the overlap in these domains by putting forward a framework for designing smart and sustainable applications *via* computational techniques. Building on cutting-edge Artificial Intelligence, Machine Learning, and Data Analytics technologies, it tackles challenging problems as efficiently as possible by maximizing resource utilization without compromising the environmental impact. The paper highlights some key concerns associated with the design, such as data acquisition, modeling, optimization, and deployment policy. Moreover, it discusses case studies and applications in different domains to clarify the effectiveness of intelligent computational techniques and their potential for enabling smart, sustainable development. By doing so, developers and stakeholders can work towards building novel pathways that lead to a more efficient, resilient, and environmentally conscious future. This chapter is all about gathering the right sets of elements/attributes or factors to utilize for different E-Governance services. As per this research, weak adoption factors of E-Governance have been identified and ranked using the fuzzy conjoint technique. These factors are ranked based on satisfaction levels, from highest to lowest: very satisfied, satisfied, neither/nor (ambiguous), dissatisfied, and very dissatisfied. The ranking of the above factors with satisfaction levels also defines whether the government needs to focus on or not to increase adoption.

***Keywords*:** Smart technologies, sustainability, application development, intelligent computational techniques, artificial intelligence, machine learning

1.1 Introduction

Implementing e-services, or electronic services, will have a deeply rooted impact on every citizen of the nation. If the citizens are unwilling to consume these services, it virtually defeats the purpose of provisioning and consuming e-services as they are the primary consumers. This pressure therefore blasts the

call to sieve out what factors can ascertain the suitability of such services. So, the suitable factors have already been identified by the researchers. These factors are addressed as infrastructure, cost, trust, time, accessibility literacy, language, willingness, age, gender, and people awareness [1]. The success of e-services depends on how satisfied people are with their usage. There aren't many private players in the community to meet this expectation, so we need support from the government as well. Internet connectivity, including its speed and bandwidth, is a crucial factor when implementing e-services across the country. Another thing to consider is that there are new technologies out. In the case of a multilingual country, these e-services should also be multilingual. Given the variations in demand preferences for end-users across the country, it is essential to understand what specific factors play a critical role in ensuring that consumers adopt e-services. Hence, this chapter will rank acceptance factors through fuzzy joint model statistics to address the sluggish access to e-governance services. The Fuzzy Conjoint Model was proposed by Turksen and Wilson [2] in 1994. This order of factors was also validated with other ranking approaches such as those proposed by Biswas [3] and Wang [4].

1.2 Literature Survey

Most theories are based on the Davis Technology Acceptance Model (1989) [5], the Unified Theory of Acceptance and Use of Technology, the Theory of Reasoned Action (TRA) [6], the Diffusion of Innovation, etc. Tashfeen Miral Screwvala extended the work of Carter and Belanger (2005) [7] by identifying the 'purpose of use' factor. When deploying technology-based electronic services, the security of existing information is a highly important factor. E-services [8] introduced by the government offer numerous benefits, including increased reusability of information and citizens' satisfaction by sharing it with general public. The author tested an e-governance service introduced by the city council of New Delhi, India [9]. The central idea is that, based on literature research, it can be assumed that the adoption of these services depends on how citizens perceive government electronic services. Table 1.1 lists some of the theories discussed by researchers [10] that the study or research found. Table 1.2 presents the key attributes affecting e-governance adoption.

Table 1.1 Some empirical theories about adoption models.

Model/theory	Factors/items	Definitions	Authors
A Unified Model of E-Governance Adoption (UMEGA)	Perceived service quality and recommendation	Recognizing the quality and trust of service to the government, as well as the intent to use and recommend e-government services.	Mensah *et al.*, 2020 [11]
TAM2 (Extended Technology Acceptance Model)	Thought/Image	An image of a person after using an innovative service.	Venkatesh, 2000 [15]
	Voluntariness	Personal evaluation of the voluntary use of innovative services.	Moore and Benbasat, 1991 [16]
	Job relevance	Identify the system that applies to his or her work.	
	Quality of output	Comparison with the previous version.	
DOI (Diffusion of Innovation)	Benefits	How is the E-Governance service advantageous over its predecessor?	Rogers and Shoemaker, 1971 [17]
	Complexity	The system is relatively difficult to use and understand.	
	Observability	Determine the output of innovation.	

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