PROSPECTS IN SMART TECHNOLOGIES

Emerging Technologies and the Application of WSN and IoT

Smart Surveillance, Public Security, and Safety Challenges

Edited by SHALLI RANI

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Emerging Technologies and the Application of WSN and IoT

The Internet of Things (IoT) has numerous applications, including smart cities, industries, cloud-based apps, smart homes, and surveillance.

The Internet of Things (IoT) enables smarter living by connecting devices, people, and objects. As networking became a crucial aspect of the Internet, rigorous design analysis led to the development of new research areas.

The Internet of Things has revolutionized daily living in countless ways. It enables communication between buildings, people, portable gadgets, and vehicles, facilitating mobility. Smart cities and cloud-based data have transformed corporate practices. With billions of connected gadgets, everything will soon be able to communicate remotely. IoT networks, whether public or private, rely significantly on machine learning and software-defined networking. Indian and other governments have approved various research projects on IoT-based networking technologies. This field of study will significantly impact society in the future.

Researchers are concerned about the many application areas and driving forces behind smart cities. The authors aim to provide insights into software-defined networking, artificial intelligence, and machine learning technologies used in IoT and networking. The framework focuses on practical applications and infrastructures. The books includes practical challenges, case studies, innovative concepts, and other factors that impact the development of realistic scenarios for smart surveillance. It also highlights innovative technology, designs, and algorithms that can accelerate the creation of smart city concepts.

This resource includes real-world applications and case studies for smart city technology, enormous data management, and machine learning prediction, all with confidentiality and safety problems.

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Preface

During the past decades, Internet of Things (IoT) offer a wide range of uses in many different industries and fields, including smart cities, smart industries, cloud-based applications, smart home scenarios, smart surveillance, and many more areas. Through connectivity between devices, people, and objects, the IoT has made it possible to live a smarter life. Furthermore, when networking became an essential component of the Internet, rigorous examination of the design issues in this field prompted the emergence of new research pathways.

The IoT has altered daily life in numerous ways. It has offered communication between numerous items, including buildings, people, portable devices, and vehicles for mobility. By transforming cities into smart ones where data is accessible on the cloud, it has altered how business is done. All things and objects will eventually be able to converse remotely thanks to billions of connected devices. Both public and private networks that support IoT heavily rely on machine and deep learning, software-defined networking. Governments in India and other nations have approved numerous research projects on IoT-based different technologies of networking. This area of study will have a significant influence on society in the future.

The concerns of researchers have risen as a result of the various application categories and forces that are driving the smart cities phenomena. It is anticipated that the collaborating authors would offer insights into the software-defined networking, artificial intelligence, or machine learning technologies employed in IoT and networking. Practical applications and infrastructures are at the center of the framework for smart cities, which is centered on the needs of the people. For observing, comprehending, and managing the better learning environment, it needs the deep association of cyber and physical aspects.

The editors of the book have conducted a top-down investigation into the aspects that are influencing the development of smart cities, taking into account key elements including "smart surveillance", "public security and strategic issues", and "science, engineering, and development". We examine key areas and problems with practical hurdles, use case illustrations, unique ideas and possibilities, and other elements influencing the creation of realistic situations for smart surveillance. This book also emphasized new technologies, designs, and algorithms that might hasten the development of smart city ideas. Additionally, it contains extensive information on the range of real-world applications and case studies pertaining to certain smart city technologies, massive data handling, and machine learning prediction approaches with confidentiality and safety challenges.

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Moreover, without the prayers and best wishes of my parents, my sister, and both of my sons, none of my achievements would have been possible. I am also thankful to the CRC Press/Taylor & Francis Group editorial team, who really helped me in every aspect in the preparation of this book. Their prompt response and care to the literature and contribution is remarkable. She is great and responsible researcher indeed.

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Last but not least, my gratitude is due to my inspiration **Dr. Archana Mantri**, Vice Chancellor, Chitkara University, Punjab, India for her trust in me and for making me confident that I can put efforts to be successful in each and every field.

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PhD research scholars are pursuing their PhD research work under her guidance. She has many professional affiliations to her credit. She has a rich experience in domain of university accreditations, event management, and other institutional workloads. She has hosted two TEDx conferences. She has published around 40 research publications, majority of which have been published in Scopus and SCI databases. Dr. Kamali has filed more than 25 patents, out of which five are published and one is granted. She has applied and presented one project in DST. Her research interests include cloud computing, security, IOT, computer architecture, and data structures.

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1 Transforming Urban Spaces and Industries

The Power of Machine Learning and Deep Learning in Smart Cities, Smart Industries, and Smart Homes

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INTRODUCTION

When authors in Ref. [1] handed Procter & Gamble a study on radio-frequency identification (RFID) in 1999, the phrase "Internet of Things" (IoT) was first used. The idea of autonomous data collecting via RFID and sensing technology, along with developments in machine-to-machine (M2M) topologies, wireless sensor networks (WSNs), artificial intelligence (AI), and semantic technologies, has encouraged the growth of the IoT. By 2030, according to Cisco's predictions, 80 billion connected devices are expected to be available, which is 6.58 times the estimated world population [2]. The researchers in Ref. [3] noted that the need for accessible enabling technologies was the main factor fuelling the IoT's explosive expansion. An intelligent computer server, commonly referred to as a smart machine, is able to create personalised content for a dynamic web page and send it to a particular user depending on their browsing history. Networked computers can now be included into a variety of items because of Moore's law and the ongoing miniaturisation of electrical components. As a result, things are getting more intelligent, computerised, and internet-connected. Wesier predicted the concept of ubiquitous computing more than two decades ago [4]: The idea that computers will be present everywhere, linked, and effortlessly incorporated into everyday life. Thing-to-thing or M2M interaction is the core technology behind the IoT, a concept that aims to interconnect physical things to the internet. These IoT devices have transformed the equation of human-computer interaction (HCI) and developed new strategies for incorporating technology into our daily lives. Today's HCI technology, in contrast to the past, lays more emphasis on being human-centric than computer-centric [2]. HCI has significantly advanced in the last ten years, leading to expanded applications and more efficient use of HCI [3].

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Using sophisticated data analytics to grasp, monitor, regulate, and manage the city is the underlying concept of smart cities, industries, and residences from a data-centric viewpoint [5]. It is well acknowledged that there are four layers to the data analysis process, as depicted in Figure 1.1, despite slight discrepancies [6–9]. These layers include data collection, data preparation, analysis of the data, and service supply. The data preliminary processing layer performs initial calculations (such as cleaning the information, making decisions, and interpolation) to acquire higher quality data

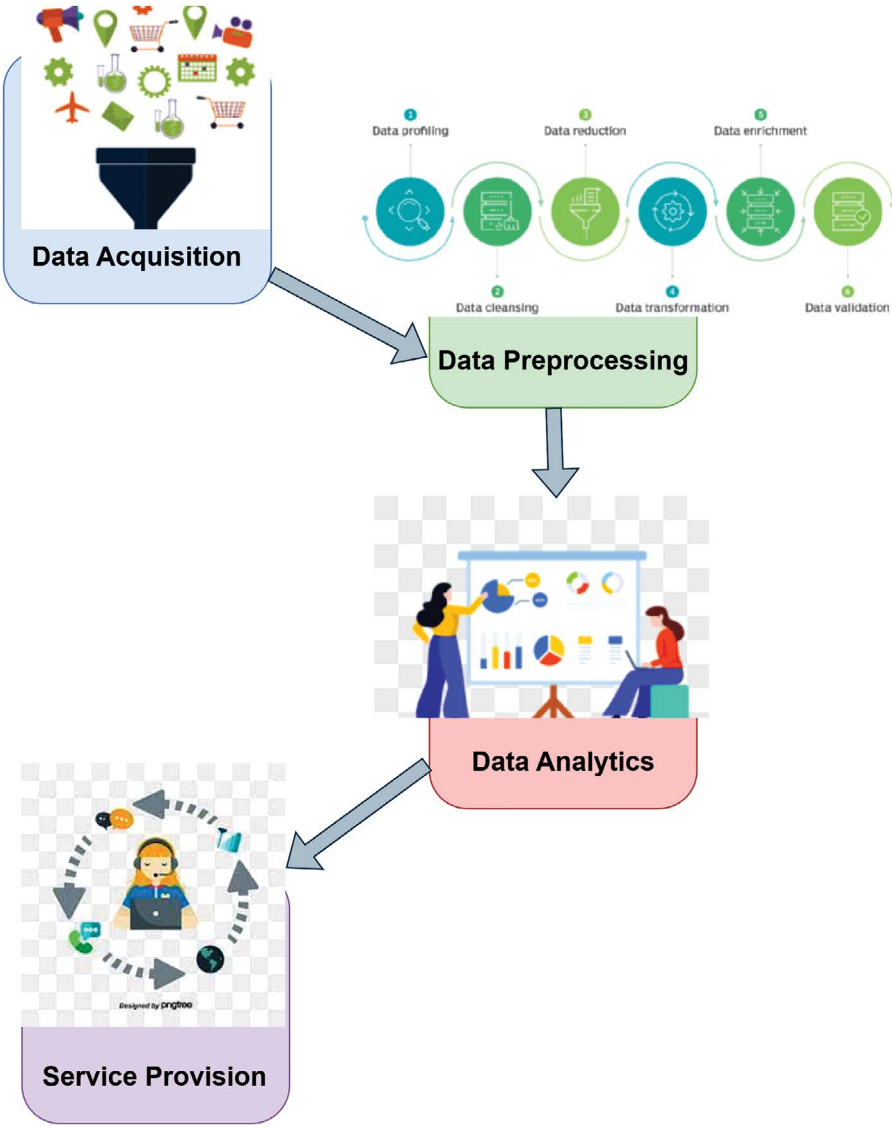

FIGURE 1.1 Steps for data analysis.

before statistics, and the data statistical analysis layer performs intelligent evaluation using various types of machine learning (ML). The data acquisition layer gathers and stores reliable city information from various fields and sources. Deep learning has lately received a lot of interest from the scientific community due to its amazing capabilities. It excels at managing massive quantities of data, reducing the need for a lot of manual data engineering work. Deep learning models beat shallow neural networks (NNs) in learning complex structures from large-scale datasets. Due to the wide nature of deep learning, its distinct characteristics enable it to handle enormous datasets without the need for additional dimensionality reduction procedures. Moreover, it surpasses conventional deep learning methods when applied to real data and eliminates the laborious data engineering processes they need. In contrast to traditional ML methods, deep learning provides the capacity to model extremely complex functions using layers of non-linear transformations that can be learnt from beginning to end. Deep learning-based methods have made significant strides in a number of fields, including neural machine translation and natural language processing. In addition, deep learning has significantly improved speech recognition and computer vision, outpacing state-of-the-art techniques in all of the areas [10].

OUR CONTRIBUTIONS

1. This chapter comprises motivation along with the development of smart cities, automatic homes, and intelligent industrial systems.
2. The fundamental prerequisites for smart cities, automatic homes, and intelligent industrial systems.
3. The corresponding attacks on smart cities, automatic homes, and intelligent industrial systems.
4. ML and DL in smart cities, automatic homes, and intelligent industrial systems.
5. Security solutions: Effective measures have been taken.

MOTIVATION

Automation has become more prevalent in many applications because of its capacity to process immense datasets with greater precision than conventional methods. These applications produce information gathered from a range of sources such as images, videos, text, and audio. As a result, this data is complex and extremely large. There are numerous formats for the data, including arranged, semi-arranged, and unstructured. Therefore, depending on the data analysis problem the SC is trying to solve, it may be acceptable to analyse the data using deep learning. Classification, clustering, and regression are three data analytics methods that may be coupled with deep learning. The SC may employ the deep learning architecture to execute duties such as object and voice recognition. Authors in Ref. [11] used ConvNet, for example, to classify images acquired by intelligent CCTV cameras in parking lot spaces. It has been discovered that ConvNet outperforms the conventional procedure. Comparable research conducted by researchers in Ref. [12] demonstrates that ConvNet outperforms ANN. In order to predict electrical energy usage in smart cities contexts, authors in Ref. [13] compare deep learning algorithms to established techniques like hidden Markov, support vector machines (SVM), and factored hidden Markov. The examination of the days and weeks and the energy predictions reveal the accuracy of the various prediction approaches that vary considerably, with the DBN providing the most dependable performance when compared to the older methods. In NLP and language modelling applications, recurrent NNs have demonstrated encouraging performance compared to conventional ML techniques [8].

DEVELOPMENT OF SMART CITIES, AUTOMATED HOMES, AND INDUSTRIAL INTELLIGENT SYSTEMS

Government agencies, urban planners, technology suppliers, industry specialists, and community involvement must work together to create smart cities, smart industries, and smart households. The transformation of conventional urban settings and industries into intelligent and sustainable entities depends on the deployment and use of cutting-edge technology, networking, and data-driven decision-making. The fusion of numerous technology and infrastructural elements results in smart cities, smart industries, and smart households. The creation of a smart city begins with a strategic plan that lays out the project's goals, objectives, and expected results. Collaboration between local government representatives, urban planners, IT companies, and community stakeholders is required for this. Physical and digital infrastructure, such as sensors, cameras, IoT devices, communication networks, and data centres, must be deployed in order for smart cities to function. The foundation for gathering and distributing data around the city is provided by this infrastructure. To acquire insights into municipal operations, infrastructure performance, and citizen behaviour, data is gathered from a variety of sources, including sensors, social media, and public records. To analyse and extract useful insights from the gathered data, advanced analytics methods are used, including ML and AI [14]. Different systems and elements of the city, such as public safety, waste management, transportation, and energy, are connected to allow for coordinated and effective operations. Through data exchange and interoperability standards, many systems are connected and integrated. Smart cities place a strong emphasis on including citizens in the decision-making process. Platforms and apps are created to let residents and the municipal government communicate, enabling comments, reporting problems, and accessing services. Smart industries improve production processes, boost productivity, and save costs by using automation technology, IoT gadgets, and sensor networks. To allow real-time monitoring and control, this entails integrating sensors, actuators, and control systems into industrial contexts [15].

Industrial IoT (IIoT) technologies are used to link network systems, equipment, and devices in the industrial sector. In addition to enabling centralized monitoring, control, and analysis of industrial activities, this facilitates seamless data interchange. Advanced analytics methods are used to examine data gathered from industrial machinery and processes. ML techniques are used to find trends, forecast faults, increase output, and allow predictive maintenance [16].

To safeguard industrial systems and data from online attacks, strong cybersecurity measures are put in place. This includes network segmentation, encryption,