Book Review

Internet of Energy Handbook

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Today, energy saving has become an important issue for a sustainable economic development globally as the global electricity challenge is increasing and expected to rise by two-thirds in the year 2035. The rising electricity demand leads to network congestion and power quality degradation issues; thus, the effective use of produced electricity is an important factor in the improvement of the world economy. In this scenario, the Internet of Energy (IoE) can be considered as an extension of smart grid for evaluating the full-duplex information and electrical energy flow.

Internet of Energy Handbook provides an elaborated view on technological and digital advancements in the energy management systems from an Internet of Things (IoT) perspective. The book examines various techniques for energy management in all the energy-driven sectors such as power distribution networks, electric vehicles, buildings, power generation, battery systems, and renewable sources of energy. In energy management, the book has included energy efficiency, optimization and computational intelligence and IoT. The book also successfully dels with the rising role of information technology (IT) and with time how the conventional way of energy management has overlapped with digital technology where communication protocols play a vital role. The recent developments in computational intelligence and later the involvement of internet sources have revolutionized IoT's new field of research. The major application of IoT has been to improve system performance with every change in operating conditions. Therefore, with the merging of IoT and its application for energy management, a new term got coined, 'IoE'. IoE in extension, can be viewed as the upgradation and automation of electricity infrastructures for both producers and consumers. Hence, IoE is the implementation of IoT technology into distributed energy system to optimize the efficiency of energy infrastructure and reduce wastage. The book also briefs on the ICE61850 protocol in the energy management system and the criticality of IoE in the different areas of technology, such as power distribution network and electric vehicles. IoE is marked as equally important for DSMs because of its vast capacity at improving energy efficiency of the system and for EVs to integrate their power management system into IoE.

This book summarizes the information flow networks of IoE which are crucial when understanding the working of IoE such as the machine-2-machine communication and its architecture. It elaborates extensively on the inclusion of IoE in plug-in electric vehicles (EV) as it is the need of the hour to look for means of sustainable transport using low or zero emission vehicles. The book discusses in brief the fundamentals of power system where the various aspects of power generation, integration of renewable, and demand-side management. The use of IoE for monitoring and protection of smart grids by estimating fault distance using WAMCP backed by IoT-based communication architecture is another focus area of the book. As there are various types of fault scenarios, different phasor

measurement methods have been explained, including the Rockefellr and Udren algorithm and Fast Fourier Transform. Subsequently, the book provides an exhaustive overview of the evolution, types, configurations, charging schemes, charging options, smart charging software, and plug-in hybrid EVs. Particular attention has been given to the role of vehicle-to-grid technology and the role of IoE in this field. Afterwards, the role of the IoE in plug-in hybrid EVs has been discussed along with a discussion on the process of information flow, data logging, and monitoring systems. Lastly, an approach has been discussed for implementation of the IoE in a hypothetical city of the future having a sizable number of electric vehicles. From this overview of the increasing penetration of HEVs, it can be concluded that, with an increase in the number of plug-in hybrid electric vehicles, the energy demands and the load forecast for the grid will become quite complex and this problem can be solved to a great extent by optimum usage of technologies like the IoE.

The performance of hybrid EVs has also been assessed in the book with the help of big data analysis, where big data refers to a massive volume of both structured and unstructured data that is too large and difficult to process using conventional database and software techniques. With big data analytics, a web-based technical platform can be constructed for the management of large quantities, variety, and speed of plug-in electrical vehicle-related information through broad data tools such as Hadoop to support the assessment of plug-in electrical vehicles. Pre-feasibility studies and data comprehension are also imperative when it comes to the structurization of electric vehicle system. The book provides examples of such studies where analysis is done through regression analysis and highlights the various types of data required for analytical processing. The modelling techniques for control, and economic and reliability assessment of an electric vehicle system has been calibrated and MapReduce, Hadoop and Apache frameworks are a few of the algorithms used for this and explained in the book.

In addition to the role of IoE, the discussion on the role of blockchain and IoT in the modern energy systems is a value addition in the book. It has been asserted that blockchain together with IoT can drive types of intelligent multi-agent frameworks and security strategies with its immutable consensus mechanism. The integration of blockchain into the IoE paradigm is especially necessary, as the growth in privately owned and controlled, distributed energy resources as well as IoT devices on the grid pose security vulnerabilities. It has to be noted that the aforementioned evolution of energy systems has come to intersect with blockchain and IoT technologies, and the book has managed to examine the implications of their widespread deployment. Blockchain also ensures flexibility, reliability, and trust in the IoE platform. The book, focusing on the role of blockchain, has explained the recent advances of IoT and blockchain in the energy sector by analysing the evolution of energy architectures and their functional and physical implementations. The regulatory and energy policy players are key players here to mitigate uncertainties relating to the usability and sustainability of blockchain technology.

Seeing the increasing role and share of cleaner fuels in the energy system, *Internet of Energy Handbook* has included a chapter on the integration of IoE and solar energy generation. The renewable energy sources are now being integrated into the existing power grids to make a decentralized power network, but to manage all the complexity of the power network integrated with RES requires a better performance analysis tool. In such a case, as an automated power network IoE offers an imperative point. It provides a better communication network with a secure transformation of data and information, especially bidirectional flow of energy. The book then elaborates on the role of IoE in the overall solar industry as solar PV energy which is now playing a crucial role as a source of sustainable energy supply to meet the upcoming energy crisis in the future. The role of IoE in protecting the

integrated grids and the automation of power system network has also been explained here. For enhancing the performance of energy supply, IoE-based technologies are preferable. In the case of transferring information, maintaining communication, and measurements on transmission and sub-transmission systems, IoE can provide an accurate platform and optimize the environment in the coordination process. The EVs and grid systems can work bidirectionally and IoE-embedded electric vehicles can be interconnected with grids, which may be called grid-to-vehicle and vehicle-to-grid technologies. In this regard, IoE is beneficial as it is useful to sell the extra power to other electrical vehicles or back to the grids remotely. IoE provides various tools and pathways to optimize the exchange of data and power along with other transactions between the grids and users in an effective bidirectional way. The IoE has also extended its scope of application in the industrial energy market in the form of the Industrial Internet of Things (IIoT). The integration of numerous IoT devices in the energy network allows a decentralized and diversified power supply in the network. In addition, IoE facilitates a better communication network between consumers and distributed sources of energy generation. Also, to handle the excessive amount of data in a secured and efficient way, a revolutionary blockchain technology based on the IoE platform needs to be introduced in the field of decentralized energy trading.

Internet of Energy Handbook very clearly tries to map the future challenges of the integration of IoE in the solar energy systems but also back it up with advantages and underlying opportunities. In all, the IoE environment can provide various opportunities for the urban energy market, such as charging stations for electrical vehicles, decentralized energy controlling mechanism, other transportation networks, energy trading platforms, etc. But the challenging parts are system planning, commercial operation, the configuration of equipment, controlling of operation, etc. which should be investigated in the future.

Lastly, the book focuses on the battery management system of automated guided vehicles via system dynamics. The different strategies of battery charging were analysed with the system dynamics approach. Other than the technological aspect, considering the economic aspects is also imperative and its importance has been shown here as determining system requirements and evaluating economically. It helps decision makers to perform their project effectively. Evaluating changing strategies also determines charging capacity and battery type that influence investment costs and project performance.

Overall, *Internet of Energy Handbook* provides the readers a very clear understanding of the whole notion of IoE and captured its scope across the different sectors, however, the book needs to give a more elaborate view on the future opportunities. Even the challenges regarding the adoption and integration of IoE across all sectors are not explained extensively, which are required for the successful uptake of digital technology in the future. But, in all the book should be applauded for capturing the overall concept of IoE and across the different sectors that are important for the energy transition that many economies are going through currently. The world is changing fast and IoE, still an unexplored frontier in the world of energy systems, *Internet of Energy Handbook* has managed to give the readers a deep dive into the notion supported by credible content and certainly with conviction.