Blockchain Applications for Engineering Systems

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Abstract

Engineering systems have been designed to facilitate society. These systems can be seen everywhere in our daily lives ranging from electrical systems to mechanical systems, and from bio-medical systems to industrial systems. With tight coupling with information and communication technology (ICT), these engineering systems can be even controlled and monitored remotely. These systems are supported massively with sensors through which they capture enormous data, which is then used to improve the performance of the systems. Moreover, complex processes are involved in the overall functioning of these engineering systems. The management of data and processes within these engineering systems has been done through traditional ways such as database management systems or spread sheets, however, involvement of multiple parties makes these engineering systems more complex to operate, track, and audit. Blockchain technology has the potential to replace traditional database systems and offers a level of trust in an untrusted environment. With features of immutability, traceability, transparency, availability, and decentralization, blockchain technology is a good match for engineering systems. Blockchain technology can help in supply chain in these engineering systems, but it can also be used to facilitate data, process, and parties. Considering enormous applications of blockchain technology in engineering systems, this Special Issue in Wiley Engineering Reports invited for the original scientific and technical contributions.

Editorial

Blockchain Applications for Engineering Systems

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Engineering systems have been designed to facilitate society. These systems can be seen everywhere in our daily lives ranging from electrical systems to mechanical systems, and from bio-medical systems to industrial systems. With tight coupling with information and communication technology (ICT), these engineering systems can be even controlled and monitored remotely. These systems are supported massively with sensors through which they capture enormous data, which is then used to improve the performance of the systems. Moreover, complex processes are involved in the overall functioning of these engineering systems. The management of data and processes within these engineering systems has been done through traditional ways such as database management systems or spread sheets, however, involvement of multiple parties makes these engineering systems more complex to operate, track, and audit.

Blockchain technology has the potential to replace traditional database systems and offers a level of trust in an untrusted environment. Satoshi Nakamoto is recognized as the father of blockchain technology when he first introduced Bitcoin Cryptocurrency and used this blockchain technology to store the transactions related to Bitcoin. Among thousands of cryptocurrencies in the market, Bitcoin is still one of the largest cryptocurrencies in the market terms of market capital. However, cryptocurrencies are not the only use-case where blockchain technology has been in use. There are many other application areas where blockchain

technology has been in used such as education, telecommunication, health, government, logistics, and asset management, just to name a few.

With features of immutability, traceability, transparency, availability, and decentralization, blockchain technology is a good match for engineering systems. Blockchain technology can help in supply chain in these engineering systems, but it can also be used to facilitate data, process, and parties. Considering enormous applications of blockchain technology in engineering systems, this Special Issue in Wiley Engineering Reports invited for the original scientific and technical contributions.

In this Special Issue, we received eight submissions, out of which, after rigorous peer-review process, three high-quality papers were accepted. In the first paper entitled "Machine-as-a-Service: Blockchain-based management and maintenance of industrial appliances" by Viet Hoang Tran et al., authors considered an industrial setting where an emerging service model i.e., Machine-as-a-Service has been considered in which industrial machines are rented and then track through blockchain based system. In the proposed system, authors suggested to use Ethereum, and Inter Planetary File System (IFPS) and a reference architecture was also proposed. Interestingly, both experiments on Microsoft Azure Cloud platform and network emulation over Enoslib were conducted to show the performance of the proposed architecture.

The second paper entitled "SENSIBLE: SEquestered aNd SynergIstic BLockchain Ecosystem" by Meghana Kshirsagar et al., authors proposed a personalized patient healthcare framework using blockchain technology. Using the open-source synthetic patient dataset generator Synthea, the proposed framework was evaluated on Ethereum to show the effectiveness of secured data access in this setting.

The third and last paper entitle "A blockchain-enabled solution to improve intra-inter organizational innovation processes in software small medium enterprises" by Chetna Gupta et al., authors considered blockchain technology to manage security, knowledge sharing, and information management of software small medium enterprises (SSMEs).

In the end, we would like to thank the authors who submitted their works in this Special Issue and to the reviewers, who provided their in-depth reviews, which ultimately helped the authors enhance the quality of their work. The Guest Editor is also thankful to the Editor-in-Chief and Editorial Office Staff of Wiley Engineering Reports for their guidance and help during the whole process of this Special Issue. We have you enjoy reading this Special Issue.

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Mubashir Husain Rehmani (M'14-SM'15) received the B.Eng. degree in computer systems engineering from Mehran University of Engineering and Technology, Jamshoro, Pakistan, in 2004, the M.S. degree from the University of Paris XI, Paris, France, in 2008, and the Ph.D. degree from the University Pierre and Marie Curie, Paris, in 2011. He is currently working as Lecturer in the Department of Computer Science, Munster Technological University (MTU), Ireland. Prior to this, he worked as Post-Doctoral Researcher at the Telecommunications Software and Systems Group (TSSG), Waterford Institute of Technology (), Waterford, Ireland. He also served for five years as an Assistant Professor at COMSATS Institute of Information Technology, Wah Cantt., Pakistan. He is serving as an Editorial Board Member of *NATURE Scientific Reports* . He is currently an Area Editor of the *IEEE Communications Surveys and Tutorials* and *IEEE Open Journal of Communications Society.* He served for three years (from 2015 to 2017) as an Associate Editor of the *IEEE Communications Surveys and Tutorials.* He served as Column Editor for Book Reviews in *IEEE Communications Magazine* . He is appointed as Associate Editor for *IEEE Transactions on Green Communication and Networking* and *IEEE Transactions on Cognitive Communications and Networking* . Currently, he serves as Associate Editor of Elsevier *Journal of Network and Computer Applications (JNCA)* , and the *Journal of Communications and Networks (JCN)* . He is also serving as a Guest Editor of Elsevier *Ad Hoc Networks* journal, Elsevier *Future Generation Computer Systems* journal, the *IEEE Transactions on Industrial Informatics,* and Elsevier *Pervasive and Mobile Computing* journal. He has authored/edited total eight books. Two books with Springer, two books published by Global, USA, three books published by Press – Taylor and Francis Group, UK, and one book with Wiley, U.K. He received "Best Researcher of the Year 2015 of COMSATS Wah" award in 2015. He received the certificate of appreciation, "*Exemplary*

Editor of the IEEE Communications Surveys and Tutorials for the year from the IEEE Communications Society. He received Best Paper Award from IEEE ComSoc Technical Committee on Communications Systems Integration and Modeling (CSIM), in IEEE ICC 2017. He consecutively received research productivity award in 2016-17 and also ranked # 1 in all Engineering disciplines from Pakistan Council for Science and Technology (PCST), Government of Pakistan. He received Best Paper Award in 2017 from Higher Education Commission (HEC), Government of Pakistan. He is the recipient of Best Paper Award in 2018 from Elsevier Journal of Network and Computer Applications. He is the recipient of *Highly Cited Researcher* award thrice in 2020, 2021, and 2022 by Clarivate, USA. His performance in this context features in the TOP 1% by citations in the field of Computer Science and Cross Field in the Web of Science citation index. He is the ONLY Researcher from Ireland in the field of "Computer Science" who received this International prestigious award. In Oct 2022, he received Science Foundation Ireland's CONNECT Centre's Education and Public Engagement (EPE) Award 2022 for his research outreach work and being a spokesperson for achieving a work-life balance for a career in research.

CONFLICT OF INTEREST

Authors have no conflict of interest relevant to this article.