Electrification of Smart Cities

Lai, Chun Sing; Tsang, Kim Fung; Wang, Yinhai

Published in:
Electronics (Switzerland)

Published: 01/04/2022

Document Version:
Final Published version, also known as Publisher's PDF, Publisher's Final version or Version of Record

Published version (DOI):
10.3390/electronics11081235

Publication details:
Lai, C. S., Tsang, K. F., & Wang, Y. (2022). Electrification of Smart Cities. *Electronics (Switzerland)*, *11*(8), [1235]. https://doi.org/10.3390/electronics11081235

electronics

Editorial

Electrification of Smart Cities

Chun Sing Lai [1,*], Kim Fung Tsang [2] and Yinhai Wang [3]

1 Brunel Interdisciplinary Power Systems Research Centre, Department of Electronic and Electrical Engineering, Brunel University London, London UB8 3PH, UK
2 Department of Electrical Engineering, City University of Hong Kong, Hong Kong 999077, China; ee330015@cityu.edu.hk
3 Department of Civil and Environmental Engineering, University of Washington, Seattle, WA 98195, USA; yinhai@uw.edu
* Correspondence: chunsing.lai@brunel.ac.uk

Citation: Lai, C.S.; Tsang, K.F.; Wang, Y. Electrification of Smart Cities. *Electronics* **2022**, *11*, 1235. https://doi.org/10.3390/electronics11081235

Received: 31 March 2022
Accepted: 9 April 2022
Published: 14 April 2022

1. Introduction

Electrification plays a key role in decarbonizing energy consumption for various sectors, including transportation, heating, and cooling. There are several essential infrastructures for a smart city, including smart grids and transportation networks. These infrastructures are the complementary solutions to successfully developing novel services, with enhanced energy efficiency and energy security.

Five papers are published in this Special Issue that cover various key areas expanding the state-of-the-art in smart cities' electrification, including transportation, healthcare, and advanced closed-circuit televisions for smart city surveillance.

2. Publications in the Special Issue

With regard to transport electrification in smart cities, Gao et al. [1] proposed an improved multi-exposure image fusion method for intelligent transportation systems. In addition, a novel multi-exposure image dataset for traffic signs, TrafficSign, is presented to verify the proposed method. In the intelligent transportation system, as a type of important road information, traffic signs are fused by this method to obtain a fused image with moderate brightness and intact information. By estimating the degree of retention of different features in the source image, the fusion results have adaptive characteristics similar to that of the source image. Considering the factors of weather and environmental noise, the source image is preprocessed by bilateral filtering and a dehazing algorithm. In addition, the authors used adaptive optimization to improve the quality of the fusion model's output image. The qualitative and quantitative experiments on the new dataset show that the multi-exposure image fusion algorithm proposed in this paper is effective and practical in the intelligent transportation systems.

In another work of this Special Issue, Mansfield et al. [2] claimed that achieving carbon-neutral transportation is the ultimate goal of the ongoing joint efforts of governments, policy makers, and the transportation research community. The electrification of smart cities is a very important step towards the above objective; therefore, accelerating the adoption and widening the use of electric vehicles are required. However, to achieve the full potential of electric vehicles, ground-breaking detour computation and charging station selection schemes are needed. Hence, Mansfield et al. [2] developed a new scheme that finds the most suitable detour/route for electric vehicles whenever an unexpected event occurs on the road. This scheme is based on A* and uses an original, Simple Additive Weighting (SAW)-based charging station selection method. The performance evaluation carried out using the open-source traffic simulation platform SUMO under a grid map, as well as a real road network map, highlighted that our scheme ensured that more than 99% of electric vehicles will reach their destination within a reasonable time, even if a battery recharge is needed. This is a significant improvement compared to the baseline scheme that uses A* only.

Huang et al. [3] presented a novel blockchain-based energy-trading mechanism for electric vehicles consisting of day-ahead and real-time markets. In the day-ahead market, electric vehicle users submit their bidding price to participate in the double auction mechanism. Subsequently, the smart match mechanism will be conducted by the charging system operator to meet both personal interests and social benefits. After clearing the trading result, the charging system operator uploads the trading contract made in the day-ahead market to the blockchain. In the real-time market, the charging system operator checks the trading status and submits the updated trading results to the blockchain. This mechanism encourages participants in the double auction to pursue higher interests, in addition to rationally utilize the energy unmatched in the auction and to achieve improvements in social welfare. Case studies are used to demonstrate the effectiveness of the proposed model. For buyers and sellers who successfully participate in the day-ahead market, the total profit increase is 22.79% and 53.54%, respectively, as compared to profits without energy trading. With the consideration of social welfare in the smart match mechanism, the peak load reduces from 182 kW to 146.5 kW, which is a 19.5% improvement.

Examining the topic of smart healthcare with regard to electrification, Taha et al. [4] presented a new methodology to identify potential energy waste and negative energy usage behavior in an NHS hospital. The work presents an analysis of electricity consumption vs. occupancy during minimal consumption periods (i.e., bank holidays and weekends), and it presents a log of any equipment left switched on outside of working hours in order to highlight the level of energy-conscious behavior. The results revealed that the proposed technique is not only able to identify negative energy usage behavior amongst the hospital staff but helps identify areas where immediate energy savings can be made, with potential savings of more than GBP 30,000 if action is taken.

The final article to be presented is with regard to advanced closed-circuit televisions for smart city surveillance. Wang, Teng, and An [5] claimed that with the help of deep neural networks, video super-resolution has made a huge breakthrough. However, these deep-learning-based methods are rarely used in specific situations. In addition, training sets may not be suitable because many methods only assume that under ideal circumstances, low-resolution datasets are downgraded from high-resolution datasets in a fixed manner. Hence, Wang, Teng, and An [5] proposed a model based on Generative Adversarial Network and edge enhancement to perform super-resolution reconstruction for low-resolution and blurry videos, such as closed-circuit television footage. The adversarial loss allows discriminators to be trained to distinguish between super-resolution frames and ground truth frames, which is helpful to produce realistic and highly detailed results. The edge enhancement function uses the Laplacian edge module to perform edge enhancement on the intermediate result, which helps to further improve the final results. In addition, we add the perceptual loss to the loss function to obtain a higher visual experience. At the same time, we also tried training the network on different datasets. A large number of experiments show that our method has advantages in the Vid4 dataset and other low-resolution videos.

Funding: This research received no external funding.

Acknowledgments: The guest editors would like to express their deepest gratitude to researchers who contributed articles to this Special Issue. The guest editors are also grateful to the reviewers who supported with the rigorous review process and providing constructive comments to enhance the articles. Last but not least, the guest editors are indebted to the *Electronics* editorial board for the invitation to establish this Special Issue, as well as, the Editorial Office team, who have worked relentlessly to make this Special Issue a success.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Gao, M.; Wang, J.; Chen, Y.; Du, C.; Chen, C.; Zeng, Y. An Improved Multi-Exposure Image Fusion Method for Intelligent Transportation System. *Electronics* **2021**, *10*, 383. [CrossRef]
2. Mansfield, C.; Hodgkiss, J.; Djahel, S.; Nag, A. An Efficient Detour Computation Scheme for Electric Vehicles to Support Smart Cities' Electrification. *Electronics* **2022**, *11*, 803. [CrossRef]
3. Huang, Z.; Li, Z.; Lai, C.S.; Zhao, Z.; Wu, X.; Li, X.; Tong, N.; Lai, L.L. A Novel Power Market Mechanism Based on Blockchain for Electric Vehicle Charging Stations. *Electronics* **2021**, *10*, 307. [CrossRef]
4. Taha, A.; Hopthrow, T.; Wu, R.; Adams, N.; Brown, J.; Zoha, A.; Abbasi, Q.H.; Imran, M.A.; Krabicka, J. Identifying the Lack of Energy-Conscious Behaviour in Clinical and Non-Clinical Settings: An NHS Case Study. *Electronics* **2021**, *10*, 2468. [CrossRef]
5. Wang, J.; Teng, G.; An, P. Video Super-Resolution Based on Generative Adversarial Network and Edge Enhancement. *Electronics* **2021**, *10*, 459. [CrossRef]