

Optimizing allocation of scooter battery swapping facility in Minneapolis

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Problem description

With the popularity of the e-scooter, it is a necessary step to design a complete infrastructure system, especially the charging facility. Charging and maintaining scooters have become more and more important when the users increase sharply. Therefore, considering the usage and vehicle distribution, we plan to develop a novel optimization model in determining the location of battery swap stations where they would serve the all the demand with minimum cost.

Significance of the subject

Environmentally friendly means of personal transportation such as electric cars, e-scooters, and electric bikes are among the solutions available as global warming has worsened. E-scooters, as one of the contributors, assist to improve sustainable development of cities. Besides, scooters also considerably promote the safety and convenience of people travel during the Covid-19 pandemic.ⁱ

Methodology & Datasets

The model of battery swap station allocation will be primarily based on facility location problem. From the historical data, we can roughly estimate the daily electricity usage according to the number of rides and total distance they traveled. And the demand of battery swap can also be inferred. Then we will build an optimization model to minimum the total cost (or travel time), fulfilling all the charging demand.ⁱⁱ

Minneapolis scooter data: <https://www.minneapolismn.gov/getting-around/scooters/scooter-data/#d.en.111253>

Potential results

- **User behavior analysis**
Highlight the area that e-scooter are most frequently used based on visualization tool, and the variation trend over season and region.
- **Optimal solution for battery swap station allocation:**
Propose an allocation plan for scooter-sharing companies in Minneapolis to manage and charge all the scooters with minimum cost.

ⁱ Lin, Min-Der, et al. "Optimized allocation of scooter battery swapping station under demand uncertainty." *Sustainable Cities and Society* 71 (2021): 102963.

ⁱⁱ Chen, Yi-Wen, et al. "Location optimization for multiple types of charging stations for electric scooters." *Applied Soft Computing* 67 (2018): 519-528.