Electric Vehicle Aggregator for Range Anxiety Management

Steben Babu, Rahul Santhosh PM, Rishin Mathew, Muhammed Nazim
steben.babu@btech.christuniversity.in,rahul.santhosh@btech.christuniversity.in,
rishin.mathew@btech.christuniversity.in,muhammed.nazim@btech.christuniversity.in

Department of Electrical & Electronic Engineering
Faculty of Engineering, CHRIST (Deemed to be University)
Bangalore, India

***Abstract*—The future is electric. With reports from McKinsey [1] and Deloitte [2] indicating the exponential increase in Electric Vehicle adoption around the world by 2030, the market capitalization data is also a prime indicator of the trend. The reports from Ranking Royal [3] over the past 20 years shows that Tesla has surpassed Toyota and has three times the market capitalization value now. Even the total electrification of the road transport also has its own problems as the industry struggles to improve the speed of charging of the electric vehicle and also to increase the life cycle of the battery of the electric vehicle. To avoid the EV concentration at the CHARGING STATION for the charging of the electric vehicle, charging reservations from EVs are suggested to be made in advance at the selected Charging station [3][4][5]. Limited cruising range requires EVs to charge frequently during a long journey, leading to the degradation of the travel efficiency as well as driving comfort. Besides, locating convenient charging services are also among the major obstacles [6].**

This increase in Electric vehicle adoption, however, has crucial implications. This involves the increased demand on the grid for charging and the issues related to range anxiety. The low range of Electric Vehicles and the fact that most of the countries are lacking adequate charging infrastructure shows the reasons for range anxiety associated with Electric Vehicles. This work focuses on development of a Electric Vehicle Aggregator based range anxiety management system. This management system would support the drivers of Electric Vehicles to reduce their range anxiety by providing them information about the nearest charging facility, the number of ports available, the cost that is expected for charging and even provides a price negotiation model.

The aggregator would be communicating with the Electric Vehicle through a mobile application. The State of Charge (SoC) of the battery pack from the Electric Vehicle would be continuously communicated to the mobile application through a WiFi network inside the vehicle. The driver would be feeding in the future destination in the mobile phone which would be used by the mobile application to determine the range that the Electric Vehicle can travel with the currently available SoC. In view of a situation where the range would not be met, an alarm would be indicated to the driver. Upon an approval from the driver a request would be sent through the mobile application to an aggregator.

The aggregator would be a server that collects information of all the available charging stations, battery swapping stations and mobile battery swapping stations in the vicinity of the Electric Vehicle. The charging stations and the battery swapping stations will be relaying their live data with respect to the number of idle ports, the charging price and the queue status to the aggregator. The aggregator would in turn sent this information to the electric vehicle that faces range anxiety.

Upon recival of the information from the aggregator, the electric vehicle driver would be able to see various options of charging and availability. Based on the driver's criticality of the journey, he could opt for parked charging at a charging station, swapping battery at a battery swapping station or request for a mobile battery swapping station to approach the Electric Vehicle.

In some scenarios a price negotiation model could also be implemented. This would be during off peak hours and the charging stations, battery swapping stations and mobile battery swapping stations are having large number of idle ports. During this scenario, the electric vehicle has an option to activate the negotiation option in the mobile application. This negotiation mode would perform negotiation with the nearest charging facility and would try to fix upon at a lower charging price. This would be based on the pricing offered by different charging facilities and also on the criticality of journey for the driver and the number of ideal ports available.

REFERENCES

[1] Patrick Hertzke, Jitesh Khanna, Khushboo Kumra, Timo Möller, and Gandharv Vig 'The unexpected trip: The future of mobility in India beyond COVID-19'.McKinsey Center for Future Mobility. 2020

[2] 'Electric vehicles Setting a course for 2030'. Deloitte Insights 2021.

[3] 'Report on Automotive Market Capitilzation'. Ranking Royals, 2021.

[4] Y. Cao et al., "Towards efficient scalable and coordinated on-the-move EV charging management", IEEE Wireless Commun., vol. 24, no. 2, pp. 66-73, Apr. 2017

[5] Y. Cao, N. Wang, G. Kamel and Y.-J. Kim, "An electric vehicle charging management scheme based on publish/subscribe communication framework", IEEE Syst. J., vol. 11, no. 3, pp. 1822-1835, Sep. 2017.

[6] Y. Cao et al., "An EV charging management system concerning drivers trip duration and mobility uncertainty", IEEE Trans. Syst. Man Cybern. Syst., vol. 48, no. 4, pp. 596-607, Apr. 2018.

[7] Cai Lin, J. Pan, L. Zhao and X. Shen, "Networked electric vehicles for green intelligent transportation", IEEE Commun. Standards Mag., vol. 1, no. 2, pp. 77-83, Jul. 2017.