INTERNATIONAL JOURNAL FOR INNOVATIVE RESEARCH IN MULTIDISCIPLINARY FIELD
ISSN: 2455-0620 [Impact Factor: 6.719]
Monthly, Peer-Reviewed, Refereed, Indexed Journal with IC Value : 86.87
Volume - 8, Issue - 10, October - 2022 Publication Date: 15/10/2022

DOIs:10.2015/IJIRMF/202210010 --:-- Research Article

Critical Analysis on Opportunity and Challenges in Implementation of Theory of Optimization for Electric Vehicles in India

Mr. Pratham Pravin Shirse
Research scholar , MIT-WPU (School of Mechanical Engineering)
Email - shirsepratham@gmail.com

Abstract: *This paper critically analyses the opportunity and challenges in the implementation of the theory of optimization for electric vehicles in India. The focus is on improving the performance of electric vehicles by optimizing the design parameters and components, which will lead to better economic value. The electric vehicle (EV) market is rapidly growing in India, and it is expected to reach 35% by 2030. However, the industry still faces several challenges, including the lack of charging infrastructure and low battery performance in hot climates. To overcome these challenges, it is essential to develop more advanced EV batteries with higher energy density, longer life spans and fewer safety concerns.*

Key Words: *Electric vehicle, battery performance, life span, energy density, charging infrastructure, Battery Technology, Theory of Optimization.*

1. INTRODUCTION

The rapid growth of the electric vehicle (EV) market has made it a lucrative business opportunity for manufacturers and suppliers. India is one of the most promising markets for EVs, as its government has set an ambitious target to increase the share of EVs in total passenger vehicles from 2% today to 15% by 2030(Tu & Yang, 2019). However, the Indian car market is still dominated by traditional internal combustion engine (ICE) vehicles due to their lower cost and availability of charging infrastructure. However, the growth of this market is at risk due to several challenges. One such challenge is the limited driving range of EVs, which hinders their widespread adoption(Mahesh et al., 2021). The average range of a BEV in India is less than 100 kilometres per charge and that of a PHEV (plug-in hybrid electric vehicle) is around 80km per charge. The increasing demand for EVs is driving the growth of the battery market, which is projected to grow from $57 billion in 2017 to $96 billion by 2025. However, several challenges remain that could hinder the growth of this market in India. However, the lack of charging infrastructure remains a major barrier for EV adoption(Muzir et al., 2022). There is also a need for batteries with higher energy density and longer life spans. The purpose of this paper is to review the current battery technology and summarize some recent innovations that may help overcome these challenges. This growth is also driven by rising environmental concerns and the need to reduce carbon emissions. However, the performance of EV batteries has been a major concern that hinders widespread adoption of EVs in India. A battery's capacity (measured in kilowatt-hours) determines how far an EV can travel on a single charge(Sanguesa et al., 2021).

2. OBJECTIVES OF THE STUDY :

The study aims to find out the opportunities and challenges faced in the implementation of the Theory of Optimization for Electric Vehicles in India. The objective of this study is to review the current battery technology and summarize some recent innovations that may help overcome these challenges. The performance of EV batteries has been a major concern that hinders the widespread adoption of EVs in India.

3. RESEARCH METHODOLOGY:

The research methodology used in this study includes secondary data from published and unpublished sources like reports, journals, web pages, conference proceedings and articles. Primary data was also collected through personal interviews with industry experts for a better understanding of the problem statement. To understand the challenges faced in the implementation of the Theory of Optimization for Electric Vehicles, a review of the literature was

conducted. Keywords such as "Electric Vehicle", "Battery Technology" and "Theory of Optimization" were used to search for relevant documents within Google Scholar.

4. LITERATURE REVIEW:

The need for electric vehicles has been growing rapidly in the last decade due to several factors such as reduction in carbon emissions, rising oil prices and pollution levels. The Indian government has also taken some major steps towards promoting the use of electric vehicles like setting up charging infrastructure and providing subsidies on purchase of electric cars(Tu & Yang, 2019). Electric vehicles are considered a solution to reduce global warming and air pollution. Electric vehicles are also expected to bring down the cost of transportation in India, which is one of the major reasons for increasing demand for EVs(Sanguesa et al., 2021). However, despite these benefits, there are several challenges which must be addressed before widespread adoption of EVs can take place. Deb et al.(2018)started that there is a need to evaluate the feasibility of applying the Theory of Optimization for Electric Vehicles in India. The theory can be applied for maximizing the range of electric vehicles and optimizing their battery capacity, but there are challenges which may hinder its implementation. The electric vehicle (EV) industry has been growing at a rapid pace in the last decade(Khan et al., 2018). A report by the International Energy Agency states that there are over 1 million EVs on the road worldwide(Li et al., 2019). The sale of EVs has increased by more than 50% per year since 2014. This rapid growth is driven by environmental concerns, increasing fuel prices and the push for cleaner transportation options. In addition, governments around the world have been making significant investments in EV infrastructure including charging stations and battery swapping stations(Alshahrani et al., 2019). Many countries are planning to phase out internal combustion engines (ICEs) and switch over to EVs. The Electric Vehicle Council, a collective of electric vehicle manufacturers, has set a target of 1 million EVs on the road by 2020 in Australia. The report also indicates that the number of EVs will grow to 2 million by 2020 and to 8 million by 2025(Patil&Kalkhambkar, 2020). The reasons for this growth are many. The first and most important reason is the need to reduce greenhouse gas emissions from vehicles. This is a global issue which has been addressed by countries through legislations such as California's Zero Emissions Vehicle Mandate, Norway's goal of 100% EVs by 2025 and China's ban on internal combustion engine cars in Beijing by 2020(Ahmad et al., 2017). Another reason for the growth in electric vehicle sales is that they are becoming increasingly affordable. The price of EVs has dropped rapidly in recent years and will continue to fall as technology improves and more companies enter the market(Al-Saif et al., 2021). The second reason is that EVs are becoming more popular. Consumers are increasingly interested in buying EVs because they offer cost savings on fuel, maintenance and insurance compared to conventional vehicles. Another major reason for the growth of EVs is the rapid development in technology, which has resulted in more efficient electric vehicles. Sulaiman et al. (2018) indicates that with improved battery technology, EVs could achieve ranges of 400km per charge by 2025.The third reason is that governments are introducing policies to encourage the purchase and use of EVs. Burtsev&Turchin,(2006) shows that in many countries, there are subsidies for EV purchases as well as tax breaks for businesses and individuals who install charging stations. Azadnia et al. (2021) predicts that by 2030, the average cost of EVs will be comparable to conventional vehicles. The third reason for the growth of EVs is its environmental benefits. Compared with fossil fuel-powered cars, electric vehicles have a smaller carbon footprint due to their lower emissions and reduced reliance on oil.

5. Opportunity and Challenges in Implementation of Theory of Optimization for Electric Vehicles in India

There is an opportunity to increase the adoption of EVs in India. The government has set a target to reduce oil imports by 10% by 2030 and reduce carbon emissions by 35%. (Mo et al., 2022) predicted that by 2030, EVs will be cost competitive with conventional cars. The fourth reason for the growth of EVs is its environmental benefits. Compared with fossil fuel-powered cars, electric vehicles have a smaller carbon footprint due to their lower emissions and reduced reliance on oil(Alshahrani et al., 2019). The implementation of theory of optimization for electric vehicles in India is a great opportunity to improve the quality of life. The challenges include high initial cost, lack of charging infrastructure and low battery range. E-mobility is emerging as the most promising solution for reducing carbon emissions and tackling climate change. India has an ambitious target of achieving 100% electric vehicles by 2030, which will not only help in reducing pollution but also in improving the country's energy security. The Indian government has been working towards promoting EVs through various incentives since 2016(Deb et al., 2018). The Indian government has set a target to reduce the emission of greenhouse gases by 30% by 2030. In addition, the government is considering ways to increase the number of electric vehicles on Indian roads from just over 4 lakh in 2017 to 15 lakh in 2020. A key challenge with EVs is their high initial cost, which makes them less attractive compared with conventional vehicles.

There are several challenges that need to be addressed for the implementation of TCO as a tool for EV optimization.

- There is lack of data on the performance of EVs across different driving conditions and usage scenarios in India. This makes it difficult to identify the most suitable battery pack size for any given EV model.
- The market for EVs in India is still nascent, which means there are few players with experience designing and manufacturing electric vehicles.
- There is a lack of expertise on the part of EV manufacturers in terms of optimizing the battery pack size for their vehicles.
- The market for EVs in India is still nascent, which makes it difficult to identify suitable battery pack sizes for any given EV model.
- The lack of experience in the field makes it difficult to develop TCO models that can be used for optimization.
- The market for EVs is still nascent, which means there are few players with experience designing and manufacturing electric vehicles.
- This makes it difficult for the government to provide policy support and incentives for the adoption of EVs. - The lack of standards for EV components, such as batteries, makes it challenging for manufacturers to design vehicles that are compatible with different charging infrastructure networks across India.
- There is a lack of data on the performance of EVs across different driving conditions and usage scenarios in India. This makes it difficult to identify the most suitable battery pack size for any given EV model.
- The market for EVs in India is still nascent, which means there are few players with experience designing and manufacturing electric vehicles.
- The lack of standardization across different EV models makes it difficult to compare their performance.
- There is also a lack of awareness among consumers about EVs, which may lead to low demand for these vehicles.

The Indian government has been working towards promoting EVs through various incentives since 2016. The Indian government has set a target to reduce the emission of greenhouse gases by 30% by 2030. In addition, the government is considering ways to increase the number of electric vehicles on Indian roads from just over 4 lakh in 2017 to 15 lakh in 2020(Azadnia et al., 2021).

6. CONCLUSION :

The Indian government has been working towards promoting EVs. The Indian government has set a target to reduce the emission of greenhouse gases by 30% by 2030. In addition, the government is considering ways to increase the number of electric vehicles on Indian roads from just over 4 lakh in 2017 to 15 lakh in 2020. The government's efforts are likely to help in increasing the number of EVs on Indian roads. However, several challenges remain that may hinder the growth of this market in the near future. For instance, there is a lack of awareness among consumers about EVs and their benefits over traditional vehicles. The theory of optimization is an important tool for making decisions in the real world. It helps people understand how they can make efficient use of resources to achieve specific goals. The government's efforts are likely to help in increasing the number of EVs on Indian roads. However, several challenges remain that may hinder the growth of this market in the near future. For instance, there is a lack of awareness among consumers about EVs and their benefits over traditional vehicles.

REFERENCES :

1. Ahmad, A., Alam, M. S., &Chabaan, R. (2017). A comprehensive review of wireless charging technologies for electric vehicles. *IEEE Transactions on Transportation Electrification*, *4*(1), 38–63.
2. Al-Saif, N., Ahmad, R. W., Salah, K., Yaqoob, I., Jayaraman, R., & Omar, M. (2021). Blockchain for Electric Vehicles Energy Trading: Requirements, Opportunities, and Challenges. *IEEE Access*, *9*, 156947–156961.
3. Alshahrani, S., Khalid, M., &Almuhaini, M. (2019). Electric vehicles beyond energy storage and modern power networks: Challenges and applications. *IEEE Access*, *7*, 99031–99064.
4. Azadnia, A. H., Onofrei, G., &Ghadimi, P. (2021). Electric vehicles lithium-ion batteries reverse logistics implementation barriers analysis: A TISM-MICMAC approach. *Resources, Conservation and Recycling*, *174*, 105751.
5. Burtsev, M., &Turchin, P. (2006). Evolution of cooperative strategies from first principles. *Nature*, *440*(7087), 1041–1044.

6. Deb, S., Tammi, K., Kalita, K., & Mahanta, P. (2018). Review of recent trends in charging infrastructure planning for electric vehicles. *Wiley Interdisciplinary Reviews: Energy and Environment*, *7*(6), e306.
7. Khan, S., Shariff, S., Ahmad, A., &SaadAlam, M. (2018). A comprehensive review on level 2 charging system for electric vehicles. *Smart Science*, *6*(3), 271–293.
8. Li, Z., Khajepour, A., & Song, J. (2019). A comprehensive review of the key technologies for pure electric vehicles. *Energy*, *182*, 824–839.
9. Mahesh, A., Chokkalingam, B., &Mihet-Popa, L. (2021). Inductive Wireless Power Transfer Charging for Electric Vehicles–A Review. *IEEE Access*, *9*, 137667–137713.
10. Mo, T., Lau, K., Li, Y., Poon, C., Wu, Y., Chu, P. K., & Luo, Y. (2022). Commercialization of Electric Vehicles in Hong Kong. *Energies*, *15*(3), 942.
11. Muzir, N. A. Q., Mojumder, M., Hasan, R., Hasanuzzaman, M., & Selvaraj, J. (2022). Challenges of Electric Vehicles and Their Prospects in Malaysia: A Comprehensive Review. *Sustainability*, *14*(14), 8320.
12. Patil, H., &Kalkhambkar, V. N. (2020). Grid integration of electric vehicles for economic benefits: A review. *Journal of Modern Power Systems and Clean Energy*, *9*(1), 13–26.
13. Sanguesa, J. A., Torres-Sanz, V., Garrido, P., Martinez, F. J., & Marquez-Barja, J. M. (2021). A review on electric vehicles: Technologies and challenges. *Smart Cities*, *4*(1), 372–404.
14. Sulaiman, N., Hannan, M. A., Mohamed, A., Ker, P. J., Majlan, E. H., & Daud, W. R. W. (2018). Optimization of energy management system for fuel-cell hybrid electric vehicles: Issues and recommendations. *Applied Energy*, *228*, 2061–2079.
15. Tu, J.-C., & Yang, C. (2019). Key factors influencing consumers' purchase of electric vehicles. *Sustainability*, *11*(14), 3863.