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Evaluating The Optimising Strategies For Electric Vehicle Charging Broadcasters

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ABSTRACT
Despite the restricted range of electric vehicles (EVs) and the limited number of charging stations, there are still drivers who are concerned about whether or not their batteries will be able to survive lengthy road journeys. For this reason, it is of the utmost importance to ascertain the most efficient technique of charging and to make certain that the strategy that is selected is technically possible. The purpose of this study is to demonstrate how the EVCSP issue may be solved by using MILP. This method addresses the challenges that are brought about by nonlinear charging times by using a technique known as piecewise linear approximation. When it comes to supporting drivers of electric cars with decision-making, this technique is very necessary. The suggested optimisation model (CSPM) for a particular route is responsible for determining the most effective sites to charge an electric car at the most ideal times with the most available power. This is done in order to maximise efficiency. The CSPM has been shown to be dependable and robust via the use of case studies on Turkey and the amount of time needed to solve large-scale test difficulties. Prior to the assessment of the case study, the lexicographic approach and the weighted sum method, both of which are multi-objective optimisation approaches, are also used to the case study. It was discovered that the various billing systems had a wide range of 46.09 percent, which indicates that the approach that was selected had a substantial influence on the total cost of the trip. On the other hand, the amount of time spent travelling is very stable, with a maximum variance of 19.77 percent. According to the findings of the study, the CSPM resulted in a cost efficiency improvement of 105.72% and a reduction in travel time equivalent to 60.1% when compared to a full charging strategy. The CSPM was the one that made this a possibility
Keywords: Urban Electric Vehicle Planning, EV infrastructure development, Creative charging, Vehicle-to-grid systems, Quick charging technology....

1. INTRODUCTION:

The immense enthusiasm for developing and distributing renewable energy sources throughout the world is even more remarkable in light of the present situation. Consequently, the majority of consumers support and even actively seek out electric vehicles that use new energy. That they represent the creation and dissemination of novel renewable energy sources is a major reason for their significance (Zhou et al., 2022). A growing network of dedicated charging stations has emerged to accommodate the surging demand for alternative-energy-powered electric automobiles. It is recommended that charging stations be strategically placed to meet the high demand from electric cars. Because of this, the researchers will be doing research to answer a major scientific question: where to best put charging stations for electric vehicles. A prime illustration of the high level of scholarly interest in this area is the construction of charging stations for public transportation, private electric vehicles, and taxis. From several angles, including environmental advantages, this study analyses the elements that affect the placement of charging stations for electric vehicles and suggests the best model and strategy for this task. Economics and user demand are two topics that attract many researchers. A lack of preparation and structure will have lasting consequences for the electric car sector. The electric car industry is huge and may be very profitable, yet charging stations are underfunded in many nations. As a result, finding the best spots for charging stations taking market and location-related factors into account is crucial to the expansion of the electric car sector. There has to be more charging stations since electric vehicles are becoming so popular, especially in major economies like the US, China, and the EU. It is most appropriate for state and local governments to oversee the expansion of charging infrastructure and the spread of electric cars. An increasing number of electric vehicles are sitting idle while connected but not charged, which is a major concern. Because of the difficulties, the infrastructure's size, cost, and accessibility are all reduced. Improvements in infrastructure management and increased EV adoption via more accurate idle time forecasts and management are two areas where ML has the potential to benefit all stakeholders, including politicians, network owners, and EV drivers. Fast overtaking even gas-powered vehicles in popularity are electric automobiles, which are more eco-friendly and rely less on fossil fuels (Luo et al., 2019).

1. BACKGROUND OF THE STUDY

may lessen the impact of peak loads and improve grid stability while having a minimal impact on the rates that end users are charged is one of the primary goals of the project. The proposed technique was able to successfully minimise peak demand while simultaneously increasing energy consumption, as shown by simulations that were done under a variety of diverse conditions. Instead of charging lithium-ion batteries to their maximum capacity, it is recommended that they be charged to around 80 percent of their capacity. The vast majority of electric vehicles allow the driver choose the "target charge" level that best suits their needs (Asna et al., 2021). It is recommended that the researcher read the instructions in order to learn how to alter the charge level of the researcher's device. Even though charging at home is often safe, researchers should still contact a certified electrician to check that their electrical system is capable of handling the load before using a level-1 charging connection for lengthy periods of time. Although it is possible to charge plug-in hybrid electric vehicles (PHEVs) by utilising ordinary wall outlets, doing so is against the law. There is a possibility that the battery's lifetime will be reduced if the charge level is either too high or too low. The majority of contemporary chargers for electric vehicles are able to determine when a battery has reached its full capacity and then turn off automatically. For a researcher, the ideal charging range for their battery is between 30 and 80 percent. When the capacity of an electric vehicle reaches 80 percent, the charging rate begins to decline significantly; thus, it is best to avoid charging them all the way to 100 percent. In the long term, it is also beneficial to prevent the battery pack of the researchers' automobile from being discharged to its maximum capacity (Sachan, 2021).

2. PURPOSE OF THE RESEARCH

This project attempts to achieve a number of key objectives, two of the most important of which are the lowering of the charge that end users are compelled to pay for their transactions and the increase of grid stability. The recommended strategy was proved to be effective in reducing peak demand and producing the most efficient utilisation of energy to date via the use of simulations that were carried out under a range of scenarios. This was shown through the use of simulations. PEVs and conventional EVs are both able to receive electricity via chargers used for electric vehicles, which are often referred to as EVSEs. Regardless of the kind of electric vehicle, there is the potential for it to reduce the amount of pollution that is created, enhance fuel economy, and bring down the price of petrol. On the other hand, the researcher can see how this may be successful. Electricity is a magnificent source of power for transportation not only because it contributes to the establishment of a system that is more long-lasting, but also because it is helpful to both public health and the environment. The existence of electricity is also advantageous to the conservation of the environment. In addition to this, this leads to an improvement in the level of safety on the roadways. In addition to ensuring that the battery continues to be charged, charging systems are responsible for ensuring that the vehicle used by the researchers receives the necessary amount of electrical energy to function while it is in motion.

3. LITERATURE REVIEW

Researchers primarily consider three aspects while examining the optimal locations for electric car charging stations: the variables influencing the station's placement, the algorithm linked to the location model, and the procedure for developing the model for the perfect site. The greatest options, given the increasing environmental concerns and energy limits, seem to be electric automobiles and renewable energy. This tendency is likely to continue. Most people keep their passenger cars parked for more than 90% of the time, which means the batteries take a lot longer to recharge (Bilal, 2021). Thus, electric vehicles may potentially power the electronics inside and also function as a portable battery pack. Typically, lithium-ion cells make up the batteries of electric vehicles. It would be easier said than done to increase electric vehicles' range and decrease their carbon impact by making them lighter using conventional materials. As the number of people driving electric cars continues to climb, city planners in big cities are reconsidering where charging stations should be located. Electric vehicles have a higher charge demand and a longer charging distance than gas-powered ones. Electric four-wheel cars, in contrast to gas-powered vehicles, have less moving parts. Construction procedure became easier. As a result, maintaining such a vehicle is rather low maintenance. Pollutants are reduced and air quality is improved by electric cars. Plus, compared to others, these automobiles aren't too loud. In the event of an accident, an electric car is less likely to sustain damage. Reason being, the vehicles aren't meant to carry a lot of weight due to their lightweight construction. Many studies have examined the effects of charging electric vehicles on the power system. Regarding concerns regarding power network instability induced by EV charging, remarkably little attention has been paid (Ahmad & Bilal, 2024).

5. RESEARCH QUESTION

- How does pricing strategies effect on electric vehicle charging stations?

6. RESEARCH METHODOLOGY

6.1 Research design:

Quantitative data analysis was conducted with SPSS version 25. The researchers used the odds ratio and the 95% confidence interval to evaluate the strength and direction of the statistical association. The researchers established a statistically significant threshold at $p < 0.05$. An in-depth examination clarified the essential attributes of the data. Data collected via surveys, polls, and questionnaires, together with data processed using computer statistical techniques, are often evaluated using quantitative methods.

6.2 Sampling:

Respondents completed questionnaires to provide data for the study. Utilising the Rao-soft software, researchers ascertained a study sample of 657 individuals, prompting the distribution of 896 questionnaires. The researchers received 823 responses and removed 45 for incompleteness, resulting in a final sample size of 778.

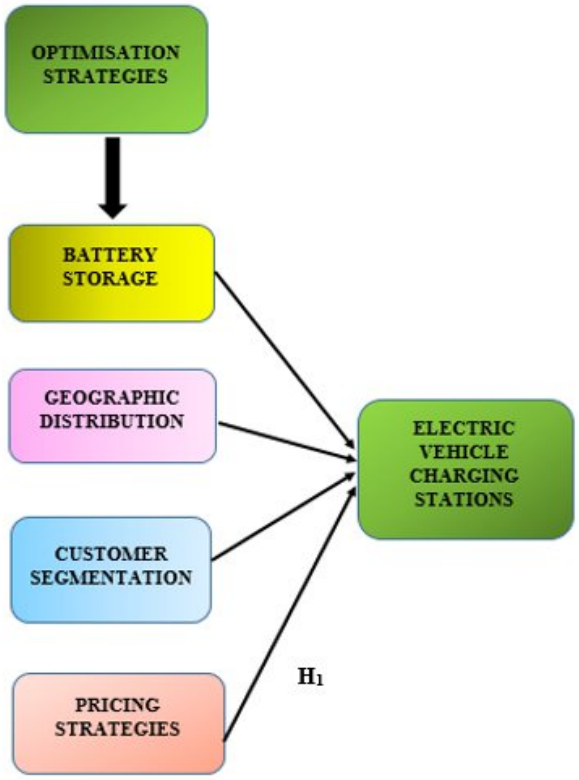
6.3 Data and Measurement:

The study mostly used data acquired from a questionnaire survey. The participant's essential demographic information was requested first. Participants were then given a 5-point Likert scale to evaluate the online and offline channels. The researchers rigorously analysed several resources, especially internet databases, for this secondary data gathering.

6.4 Statistical Software: The statistical analysis was performed with SPSS 25 and MS Excel.

6.5 Statistical Tools: To grasp the fundamental character of the data, descriptive analysis was used. The researcher is required to analyse the data using ANOVA.

7. CONCEPTUAL FRAMEWORK



8. RESULTS

- **Factor Analysis**

One typical use of Factor Analysis (FA) is to verify the existence of latent components in observable data. When there are not easily observable visual or diagnostic markers, it is common practice to utilise regression coefficients to produce ratings. In FA, models are essential for success. Finding mistakes, intrusions, and obvious connections are the aims of modelling. One way to assess datasets produced by multiple regression studies is with the use of the Kaiser-Meyer-Olkin (KMO) Test. They] verify that the model and sample variables are representative. According to the numbers, there is data duplication. When the proportions are less, the data is easier to understand. For KMO, the output is a number between zero and one. If the KMO value is between 0.8 and 1, then the sample size should be enough. These are the permissible boundaries, according to Kaiser: The following are the acceptance criteria set by Kaiser:

A pitiful 0.050 to 0.059, below average 0.60 to 0.69

Middle grades often fall within the range of 0.70-0.79.

With a quality point score ranging from 0.80 to 0.89.

They marvel at the range of 0.90 to 1.00.

Table1: KMO and Bartlett's Test

Testing for KMO and Bartlett's

Sampling Adequacy measured by Kaiser-Meyer-Olkin .957

The results of Bartlett's test of sphericity are as follows: approx. chi-square

df=190

sig.=.000

This establishes the validity of assertions made only for the purpose of sampling. To ensure the relevance of the correlation matrices, researchers used Bartlett's Test of Sphericity. Kaiser-Meyer-Olkin states that a result of 0.957 indicates that the sample is adequate. The p-value is 0.00, as per Bartlett's sphericity test. A favourable result from Bartlett's sphericity test indicates that the correlation matrix is not an identity matrix.

Table: KMO and Bartlett's

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.957
Bartlett's Test of Sphericity	Approx. Chi-Square	3252.968
	df	190
	Sig.	.000

Bartlett's Test of Sphericity further confirmed the general relevance of the correlation matrices. The Kaiser-Meyer-Olkin measure of sample adequacy is 0.957. The researchers computed a p-value of 0.00 using Bartlett's sphericity test. The correlation matrix was deemed invalid due to a significant result from Bartlett's sphericity test.

❖ **INDEPENDENT VARIABLE**

- **Optimisation Strategies:**

The objective of performance optimisation may be realised via the use of a number of different strategies. The modification of the system, the optimisation of the code, and the distribution of the load are all instances of those kinds of procedures. Adding load balancing to the list of alternative ways is yet another possibility that should be taken into consideration. By making systems more computationally efficient, one of the primary goals of this technology is to reduce the amount of resources that are used as well as the amount of delay that occurs (Abdelaziz et al., 2024). A series of methodical activities that comply with particular restrictions are what determine optimal solutions with regard to one or more parameters. These solutions are determined by the set of actions. These actions need to be carried out in order to either raise or decrease the results that are sought from the options that are currently being considered. Any such collection of measurements is referred to collectively as "optimisation strategies" in this context. MOST, which stands for Multiphase Optimisation Strategy, is a technique that may be used to develop therapies that are not only effective but also adaptable and economical. The vast majority of the time, MOST is applied with the main objective of improving the efficacy of medications in connection to improving health or certain characteristics among individuals. When it comes to maintaining equilibrium, if attaining an objective is required, then this kind of equilibrium is one that can be optimised. The researchers may also say that this is a "goal equilibrium" situation. This is another way of putting it. As an example, one may determine, given the constraints of the budget, the quantity of consumption that is necessary to satisfy the requirements of the customer to the greatest extent that is practical while still achieving the highest possible level of utility (Malik et al., 2020).

❖ **FACTOR**

- **Pricing Strategies:**

The adoption of pricing techniques by businesses allows them to determine prices that are reasonable for their goods. It is necessary to do research on the market and consumer demand, as well as to collect information on client demands, assess production costs, and other measures, in order to establish pricing in a manner that is competitive while simultaneously optimising profits. Producers are able to determine the amount of money they will get for their products and services via the use of prices (Ramadhani et al., 2020). Because it is a tool, pricing assists in finding a balance between the interests of the producer and those of the consumer. Pricing is considered to be one of the four Ps of marketing. The monetary worth that anything has is referred to as its price. Pricing strategies are different methods of thinking about and putting into action the process of deciding pricing for goods and services based on a variety of factors. It is quite useful for firms to have a pricing strategy that has been well laid out. The bottom line is immediately impacted as a result. In order for a company to be successful, it is essential to establish pricing that generates sufficient income to cover expenses and offer room for growth. There is a correlation between pricing tactics and the activities of customers. Brands are able to depict themselves as premium, accessible, or competitive via the use of strategic pricing, which is often related with people's views of the worth of a product or service. Finally, but certainly not least, a company that has a transparent pricing structure may be able to offer clients a value proposition that is one of a kind (Solanke et al., 2021).

❖ **DEPENDENT VARIABLE**

- **Electric Vehicle Charging Stations:**

Proposing a powered electric vehicle so that it can operate is the simple definition of what the phrase "EV charging" means. Electric cars may have their batteries replaced to a theoretical capacity of 250 miles in as little as six to eight hours when hooked up to a Level 2 charger. Electric car battery charging is similar to charging any other electrical appliance or piece of equipment; both involve plugging the device into an electrical outlet. That means it can charge at 240 volts and then transfer that voltage to the vehicle (Mohammad et al., 2020). Potential benefits include lower energy prices and less pollution, as well as more flexible charging alternatives for vehicles. Electric vehicle charging stations are a crucial part of the puzzle for creating greener transportation options. The term used to describe the process of restoring electricity to an electric vehicle is "charging" the battery. This may be achieved for electric vehicles by use a charger or by visiting a charging station. The phrase "electric vehicle charging station," sometimes shortened to "EVSE," describes a location where drivers may plug in their EVs to recharge them. Some of the many methods for charging EVs include level 1 and level 2 chargers, diesel-powered rapid chargers, and others (Nikam & Kalkhambkar, 2021).

- **Relationship Between Pricing Strategies and Electric Vehicle Charging Stations**

Pricing strategies have a considerable impact on the availability of charging stations for electric vehicles, as well as their practicability and the extent to which they are currently being used. The price structures of charging services that are offered to customers have an effect on a number of factors, including customer behaviour, patterns of station utilisation, and the financial viability of charging infrastructure. There are a few different models that might be used, including a subscription-based approach, a per-kilowatt-hour model, a per-minute model, or a flat-rate strategy. The price structure of electric cars will become more transparent, which will result in an increase in the number of people who purchase them and utilise public charging stations. On the other hand, demand may be reduced during peak hours via the use of dynamic pricing or time-of-use pricing, which ultimately leads to increased energy efficiency and station availability (Zhou et al., 2022). In order to achieve this goal, it is necessary to encourage charging during off-peak hours or to reduce the pressure placed on the grid. In addition to this, the pricing must to be moderately priced and user-friendly, while at the same time enabling the operators to generate a profit. If drivers discover that public charging stations are either unreliable or excessively costly, they may choose to charge their electric vehicles at home rather than at public charging stations. This is because drivers may find that public charging stations are either unreliable or excessively expensive. On the other hand, if the expenditures are too low, businesses run the danger of becoming bankrupt or seeing a decline in the quality of their services as a consequence of a rise in the number of customers. Pricing strategies that are able to successfully attract and retain users of electric cars are vital to the financial and operational sustainability of charging networks that are equipped with electric vehicles. Therefore, in order to accomplish the goals of sustainable mobility, a pricing model that has been thoroughly considered must find a way to strike a balance between the incentives for users and the needs for energy management and infrastructure investment (Luo et al., 2019).

Since the above discussion, the researcher formulated the following hypothesis, which was analyse the relationship between Pricing Strategies and Electric Vehicle Charging Stations.

"H_{01}: There is no significant relationship between Pricing Strategies and Electric Vehicle Charging Stations."

"H_1: There is a significant relationship between Pricing Strategies and Electric Vehicle Charging Stations."

Table 2: H_1 ANOVA Test

ANOVA					
Sum					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	39588.620	349	5438.563	1015.415	.000
Within Groups	492.770	428	5.356		
Total	40081.390	777			

The result is significant in this study. Statistical significance is attained with a p-value of 0.000 (below the 0.05 alpha level), and the F value is 1015.415. This indicates that researchers may endorse the alternate theory, ***"H_1: There is a significant relationship between Pricing Strategies and Electric Vehicle Charging Stations"*** is accepted and reject the null hypothesis.

9. DISCUSSION

Issues with expanding the current network of charging stations are a persistent barrier to fully electric vehicles. More and more people are urging businesses to install charging stations in employee parking lots in anticipation of the rapid adoption of electric vehicles among people of all ages and backgrounds. According to a recent research by Charge UK, the number of workplace chargers will expand fivefold by 2030 to accommodate the predicted rates of electric vehicle uptake. The majority of the responsibility for addressing the technical and financial obstacles related to charging station growth has been borne by regional and municipal network providers. Businesses have been unable to do predicted effect assessments of the increased demands created by electric car charging due to a lack of information and competence in this area. In addition, the researchers found very little written on how particular companies could approach the creation of their strategies to expand their workplace charging infrastructure for EVs (in the introduction). This study fills a knowledge vacuum in the literature by demonstrating how transportation industry managers and owners may speed up the shift to low-carbon power. The research found that significant inefficiencies, such as higher peaks, more carbon emissions, and inflated charging prices, might result from unregulated, large-scale deployments of charging infrastructure for electric vehicles in the workplace. Modern control mechanisms and efficient SC techniques, on the other hand, may help save money, help the environment, and cut costs significantly. In a temporal sensitivity study, researchers found that the models consistently outperformed UCC on all

showing that they are resilient to time-variant factors. When the EV adoption rate surpasses a certain threshold, the researchers demonstrated that a CCM or CEM model design that only targets one objective could impact the relative performance of other measures, such maximum peak. This emphasises the inherent trade-offs in varied goal functions and the result evaluations that go along with them. Researchers used real-world data to test models in diverse circumstances regularly, and these findings are the outcome.

10. CONCLUSION

Finally, the widespread availability of convenient electric vehicle charging stations is critical to the success of the electric vehicle industry as a whole. Find a happy medium between the benefits and drawbacks of sustainable mobility if the researcher want to promote and execute it successfully. Less congestion while charging might result from better use of the charging infrastructure, which could be achieved by this improvement. It is important to note that the model considers both the availability and unpredictability of renewable energy sources. Raising the rate of efficiency in the use of various sources helps stabilise the power system. An EV is a car that uses electricity to power its propulsion system, either totally or partially. From electric cars that run on roads and trains to electric boats and vessels that function underwater, electric aero planes and electric spaceships—EVs cover a wide range of modes of mobility. Most people charge their electric cars overnight by plugging them in whenever they go to bed. Set the timer on the researcher's charger if it has one, so it turns off at least an hour or two before the researcher plans to leave the house in the morning. Due to the lack of exhaust emissions, electric vehicles significantly reduce human-caused greenhouse gas emissions compared to their fossil fuel-powered counterparts. the researcher may save the researchers annual fuel costs by up to Rs. 1, 50,000 and the researchers greenhouse gas emissions by up to one tonne if the researcher switch to an electric car. Sometimes referred to as "EVs," electric vehicles are cars that run on electricity. Some basic particles have an intrinsic property called electric charge, which governs how these particles react to external fields like electric or magnetic fields. the researcher may find positive or negative electric charge in nature, and it comes from certain units. Neither creation nor destruction of electric charge occurs

REFERENCES

1. Abdelaziz MA, Ali AA, Swief RA, Elazab R (2024) A reliable optimal electric Vehicle charging stations allocation. Ain Shams Engineering Journal 15(7):102763
2. Ahmad F, Bilal M (2024) Allocation of plug-in electric vehicle charging station with integrated solar powered distributed generation using an adaptive particle swarm optimization. Electr Eng 106(3):2595–2608
3. Asna M, Shareef H, Prasanthi A (2021) Optimal Fast Charging Station Development Model Using Real Time Traffic Information. In: 8th Zero Energy Mass Custom Home International Conference, ZEMCH 2021, pp. 437–445. ZEMCH Network
4. Bilal M et al (2021) AI-based approach for optimal placement of EVCS and DG with reliability analysis. IEEE Access 9:154204–154224
5. Luo L, Wei Gu, Zhou S, Huang He, Gao S, Han J, Zhi Wu, Dou X (2019) Optimal planning of electric vehicle charging stations comprising multi-types of charging facilities. Appl Energy 226:1087–1099
6. Malik, M.Z.; Kumar, M.; Soomro, A.M.; Baloch, M.H.; Farhan, M.; Gul, M.; Kaloi, G.S. Strategic planning of renewable distributed generation in radial distribution system using advanced MOPSO method. Energy Rep. 2020, 6, 2872–2886.
7. Mohammad, A.; Zamora, R.; Lie, T.T. Integration of electric vehicles in the distribution network: A review of PV based electric vehicle modelling. Energies 2020, 13, 4541.
8. Nikam, V.; Kalkhambkar, V. A review on control strategies for microgrids with distributed energy resources, energy storage systems, and electric vehicles. Int. Trans. Electr. Energy Syst. 2021, 31, e12607.
9. Ramadhani, U.H.; Shepero, M.; Munkhammar, J.; Widen, J.; Etherden, N. Review of probabilistic load flow approaches for power distribution systems with photovoltaic generation and electric vehicle charging. Int. J. Electr. Power Energy Syst. 2020, 120, 106003.
10. Sachan S (2021) Automatic learning-based charging of electric vehicles in smart parking. Electric Power Components Syst 49(9–10):860–866
11. Solanke, T.U.; Khatua, P.K.; Ramachandaramurthy, V.K.; Yong, J.Y.; Tan, K.M. Control and management of a multilevel electric vehicles infrastructure integrated with distributed resources: A comprehensive review. Renew. Sustain. Energy Rev. 2021, 144, 111020.
12. Zhou G, Zhu Z, Luo S (2022) Location optimization of electric vehicle charging stations: Based on cost model and genetic algorithm. Energy 247:123437