Academic Education
Publishing House
-AEPH-

Research on New Energy Vehicle User Needs Identification and Intervention Strategy Based on Data Mining

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Abstract: This study aims to identify user needs and propose intervention strategies for new energy vehicles (NEVs) through data mining techniques. The study analyzed online feedback from NEV users, focusing on 77,052 high-quality reviews from 11 leading domestic manufacturers. Using the SnowNLP tool for sentiment analysis, the results showed that positive sentiment significantly outweighed negative sentiment, indicating a generally favorable user perception of NEVs. Latent Dirichlet Allocation (LDA) topic modeling revealed key areas of user feedback, including space design, dynamic performance, interior quality, control experience, comfort, seat design, driving range, pricing, vehicle noise, and more. Users expressed high satisfaction with spatial design, acceleration, interior quality, and handling, while concerns were raised regarding spatial comfort, seat design, driving range, price discounts, and in-car sound insulation. Based on the "push-pull anchor" framework, the study proposes specific intervention strategies from both macro and micro perspectives. Macro strategies include fiscal subsidies, tax incentives, and infrastructure development to enhance charging convenience and promote environmental awareness. Micro strategies focus on improving driving range, enhancing intelligent features, optimizing interior design, enhancing after-sales service, and strengthening user interaction. These strategies aim to address user needs, improve consumer satisfaction, and promote the healthy development of the NEV market. Future research could further validate these strategies through empirical studies and real-world market data.

Keywords: New Energy Vehicles; Data Mining; User Demand Identification; Intervention Strategy

1. Introduction

With the aggravation of the global energy crisis and the increasing awareness of environmental protection, new energy vehicles, as an effective alternative to traditional fuel vehicles, have become a key direction[1] for the transformation of the automobile industry. Governments around the world have introduced policies to support the research and development and promotion of new energy vehicles, aiming to reduce the dependence on fossil fuels, reduce greenhouse gas emissions, and promote sustainable economic development.

Under this background, the new energy automotive industry ushered in the unprecedented development opportunity, the size of the market continues to expand, accelerating technological innovation, for the global auto industry has brought profound changes.

However, with the rapid development of the market, the user demand for new energy vehicles also continues to evolve[2]. Early users may pay more attention to the basic performance of the vehicle, such as driving range and charging convenience; With the improvement of market maturity, consumers begin to pay more attention to the personalized experience, intelligent service and brand value of products. This change in demand not only reflects the impact of technological progress on consumer behavior patterns, but also puts forward higher requirements for new energy vehicle manufacturers, that is, how to meet the increasingly diverse and segmented market needs through technological innovation and service upgrading.

In such a rapidly changing market environment, it is particularly important to accurately identify and respond to the actual needs of users in a timely manner. Valid user demand recognition not only can help enterprises to optimize product design, improve the user

experience, also can guide the enterprise to set up the reasonable strategies, enhance competitiveness. At the same time, for a specific user community precise intervention strategy is put forward, such as customized marketing, value-added services, etc., to promote the healthy development of new energy automobile market is of great significance. Through the method based on data mining, this paper identifies the real demand of users for new energy vehicles, so as to guide the iterative strategy formulation of product software and hardware, guide the new energy vehicle industry from policy-driven to market-driven, and provide theoretical and practical reference for the upgrading of China's automobile industry structure and sustainable economic development.

2. Research Status at Home and Abroad

Consumers in the purchase of new energy vehicles will perceive multidimensional risk, financial risk, risk, and body function risk bigger influence on the purchase intention, consumer purchase intention of new energy vehicles is not into the main reason[3] for the actual purchase behavior. Text mining analysis consumer demand for products for the enterprise provides a rich material. Such as the Qin et al. (2024) through the analysis of the depth study of large-scale social media data research, reveals the present situation of public awareness of the electric car, change trend, gender differences and regional differences, and generating mechanism of different dimensions of emotion[4]. Yu et al. (2018) extracted product attributes based on the LDA model, used the SVM (support vector machine) model to analyze the sentiment of product attributes, and then used the neural network model to analyze the influence of different product attributes on consumer satisfaction. On this basis, according to the Kano model, consumers' demand for product attributes was divided into different categories[5]. Hou (2024) used the LDA model to analyze the sentiment of ChatGPT's user comments. 6309 comments were obtained from the Bilibili website, and the comments were clustered to explore the overall attention direction of the data to reflect the content of the user discussion. Finally, the positive sentiment accounted for 46.44%, the neutral sentiment accounted for 32.95%, and the negative sentiment accounted for 21.6%.

The topic sentiment analysis of user comments was realized, and the information environment of improving human computer collaboration and the technical support[6] of Tsinghua ChatGPT were given.

The literature review found that the development of new energy vehicle industry has received extensive attention from academia and the business community. However, the existing research is mostly based on traditional methods such as questionnaires, and the research on new energy vehicle demand based on data mining is relatively lacking[7]. Therefore, this project will be based on the current situation of the development of new energy vehicles in China, with large data analysis method for user requirements.

3. New Energy Vehicles User Demand Mining

3.1 Research Methods

This study adopted a series of advanced data mining techniques to deeply analyze the online feedback of new energy vehicle users, identify user needs and propose corresponding intervention strategies. First of all, through the web crawler technology from 11 domestic mainstream manufacturers sell like hot cakes model review, cumulative fetching a record 80403 comments. After data cleaning to remove invalid information, 77,052 high-quality reviews are retained as the basis for analysis. In the data preprocessing stage, authoritative stop word lists such as HIT, Baidu, and Sichuan University are used to filter stop words[8], and punctuation marks are purified and standardized to ensure the purity and consistency of the data. Then, using SnowNLP tools for text intelligent word segmentation and part-of-speech tagging[9], and analyzed the primary emotion tendency, laid the foundation for subsequent quantitative analysis.

In order to further reveal the deep structure behind the data, LDA (Latent Dirichlet Allocation) topic model is used to extract a series of topics from a large number of text information, and each topic represents a group of co-occurrence keywords, revealing the main discussion focus behind the comments[10].

3.2 Data Collection and Preprocessing

Data collected from the home of car platform,

covers 11 domestic mainstream manufacturers hot selling models. Through advanced web crawler technology, a total of 80,403 review records were crawled. Data preprocessing phase, the first loads the leading stop word list, sifting of useless words, and compared the each user comment text participle. jieba, the mainstream word segmentation tool in Python, is mainly used for Chinese analysis. For example, a comment about Qunjie M5 "Qunjie M5 was introduced to me by a friend. At first, it was for its smooth and intelligent Hongmeng car machine. After a period of time, I found that the experience was really good. But I feel that the interior color is a bit monotonous, only agate brown, ivory white and polar night black can be selected, there is no pink interior I like, it is not butch enough. I hope it can be adjusted later "was segmented as" ask friends to buy a smooth intelligent Hongmeng car machine to experience the monotonous interior color agate brown ivory white night black three colors like pink interior macho adjustment ".

3.3 Data Mining Results

By analyzing the sentiment of the segmented review text, Python's SnowNLP library is used to convert each review into a sentiment score between 0 and 1, where a score close to 1 indicates that the review is more inclined to positive sentiment, and a score close to 0 indicates that the review is more likely to contain negative sentiment. Among the sentiment analysis scores, the positive ratings are obviously dominant, although there are a considerable proportion of negative ratings. A threshold of 0.5 was used to classify the sentiment orientation, and a value higher than this was considered positive, and a value lower was considered negative. The results show that the number of user reviews with positive sentiment is more than double that of negative sentiment reviews, which shows that the proportion of new energy vehicle consumers with a positive attitude is significant, as shown in figure 1.

Topics were used to analyze the content of satisfied and unsatisfied reviews of NEVs. In the satisfied reviews, words such as "space", "acceleration", "interior", "handling", and "endurance" appeared most frequently, reflecting users' positive evaluation of these aspects. In the unsatisfied reviews, words such as "space", "seat", "battery life", "discount",

"soundproofing" and "ventilation" appeared more frequently, revealing users' dissatisfaction in these aspects.
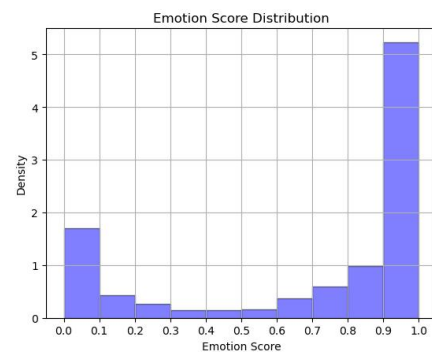

Figure 1. Sentiment Score Plot

3.4 Interpretation of Results

The data analysis results reveal the specific needs and opinions of NEV users in various aspects. The positive comments focused on the spatial design, dynamic performance, interior quality and handling experience of the vehicles, showing that consumers have a high recognition of NEVs in these aspects. Negative reviews focused on spatial comfort, seat design, driving range, price concessions and in-car sound insulation, suggesting that companies still have room for improvement in product design and marketing strategies. Especially in terms of driving range, different brands have adopted different solutions, such as NIO easing its endurance anxiety through a battery-swapping strategy, while BYD has improved its endurance through battery technology. These results not only provide valuable market feedback for new energy vehicle manufacturers, but also provide important reference basis for policy makers and industry analysts. By comprehensively considering the multi-dimensional needs of users, enterprises can better optimize product design and enhance user experience, so as to take an advantage in the fierce market competition.

4. Intervention Strategy Formulation

Consumers' purchase decision on NEVs is a complex process involving multiple psychological factors. However, consumer demand satisfaction has been confirmed to be an important positive factor affecting purchase intention. Based on an in-depth analysis of online feedbacks from NEV users and combined with the "Push-PullMooring" (PPM) framework, this paper proposes specific

intervention strategies from two perspectives of the government and enterprises, aiming to improve consumers' demand satisfaction and promote the healthy development of the NEV market.

4.1 Intervention Strategies at the Government Level

4.1.1 Policy promotion

Fiscal subsidies and tax incentives: We will continue to implement fiscal subsidy policies to reduce the burden of car purchase on consumers. At the same time, we will further reduce consumers' car purchase costs and increase their purchase intentions by reducing and exempting purchase taxes, vehicle and vessel taxes and other preferential tax policies.

4.1.2 Infrastructure construction

Increase investment in charging infrastructure, especially in densely populated cities and areas, increase the number and distribution density of charging piles, and solve the problem of inconvenient charging. In addition, we will encourage and support the development of power-changing technologies to provide consumers with more diverse charging options.

4.1.3 Environmental protection policies

We will strengthen environmental protection regulations, restrict the use of high-polluting vehicles, raise the cost of using fuel vehicles, and encourage consumers to switch to new energy vehicles. At the same time, more efforts should be made to publicize the environmental advantages of new energy vehicles and raise consumers' awareness of environmental protection.

4.2 Intervention Strategies at the Market Level

4.2.1 Consumer education and publicity

Through the media, social platforms and other channels, strengthen the publicity of the performance, advantages and use experience of new energy vehicles, and improve consumer awareness and acceptance.

We will carry out new-energy vehicle experience activities so that consumers can experience the driving experience of new-energy vehicles in person and eliminate doubts.

4.2.2 Incentives for car purchases

A car purchase point system will be introduced, where consumers can obtain points for purchasing new energy vehicles, which can be used to offset future maintenance costs or other related services, and increase consumers' car purchase motivation.

Green travel advocacy: Encourage and support enterprises, public institutions, communities and other institutions to purchase new energy vehicles, set an example of green travel, and drive more consumers to follow suit.

4.2.3 Standardization and normalization

Formulate unified technical standards and quality standards for new energy vehicles, regulate market order, and enhance consumer trust in new energy vehicles. We will strengthen supervision over after-sales services for new-energy vehicles to ensure that consumers can receive timely and effective services after purchasing a car.

4.2.4 Scientific and technological innovation support

Special funds will be set up to support research and development and innovation of key technologies for new-energy vehicles, promote technological progress, and improve the performance and competitiveness of new-energy vehicles. Enterprises and scientific research institutions will be encouraged to work together to solve technical problems.

4.3 Intervention Strategies at the Enterprise Level

4.3.1 Improve the driving range

Increase research and development investment in battery technology, improve battery energy density, extend the driving range, and solve consumers' worries about endurance anxiety. At the same time, the battery management system should be optimized to improve the service life and safety of the battery.

4.3.2 Enhance the intelligent experience

Improve the intelligent level of on-board systems to provide a more convenient and safe driving experience. For example, the development of intelligent navigation, voice assistant and other functions to improve user satisfaction.

Optimize interior design: Focus on the selection and design of interior materials to improve in-car comfort and aesthetics. Solve users' dissatisfaction with interior odor, single color and other problems, and provide more personalized choices.

4.3.3 Improve after-sales service

Establish a perfect after-sales service system to provide fast and efficient repair and maintenance services. Carry out customer

satisfaction survey regularly, find and solve problems in time, and improve customer loyalty.

User interaction and feedback: Through social media, user forums and other channels, strengthen interaction with users, collect user feedback and suggestions, and continuously optimize products and services. Hold regular user communication activities to enhance users' sense of belonging to the brand.

4.3.4 Test drive experience activities

Carry out large-scale test drive experience activities to let consumers experience the performance and driving experience of new energy vehicles in person, eliminate doubts and improve purchase intentions. Establish strategic partnerships with relevant enterprises and institutions to jointly promote new energy vehicles. For example, work with real estate developers to set up charging piles in newly built residential areas, and work with travel companies to launch new energy car rental services.

4.3.5 Diversified marketing strategies

Carry out diversified marketing activities by combining online and offline channels. Leverage emerging media such as social media and short video platforms to increase brand exposure and influence. Create a unique brand culture and story to convey the company's core values and social responsibility. Enhance consumers' sense of identity and trust in the brand through the dissemination of brand stories.

5. Conclusion

Through data mining technology, this study deeply analyzed the online feedback of new energy vehicle users, identified user needs and proposed corresponding intervention strategies. Through web crawler technology, a total of 80,403 comments were crawled from the reviews of popular models from 11 domestic mainstream manufacturers. After data cleaning and preprocessing, 77,052 high-quality reviews are retained as the basis for analysis. The SnowNLP tool was used for sentiment analysis, and the results showed that the number of user reviews with positive sentiment was more than double that of negative sentiment reviews, indicating that the proportion of new energy vehicle consumers with a positive attitude was significant. By LDA topic model, we extract from a large number of text information series of theme, reveals the user of new energy vehicles in space design, dynamic performance and interior quality, control experience, positive feedback and comfort in the space, seat design, range, price concessions, the car of sound insulation, etc.

The results show that consumer demand for new energy vehicles is constantly evolving from the early focus on basic performance to the focus on personalized experience, intelligent service and brand value. These findings not only provide valuable market feedback for NEV manufacturers, but also provide important reference basis for policy makers and industry analysts. By comprehensively considering the multi-dimensional needs of users, enterprises can better optimize product design and enhance user experience, so as to gain an advantage in the fierce market competition. Based on the "push-pull anchor" framework, this paper puts forward specific intervention strategies from three perspectives of the government, the market and enterprises, including: continue to implement financial subsidies and tax incentives, increase investment in charging infrastructure, strengthen environmental protection regulations, increase the use cost of fuel vehicles, and strengthen the promotion of environmental protection advantages of new energy vehicles. Enhance driving range and intelligent experience, optimize interior design, improve after-sales service, strengthen user interaction and feedback, carry out diversified marketing activities, shape unique brand culture and story, and establish strategic cooperative relationships.

Although this study has achieved some meaningful results, there are still some shortcomings. Firstly, the data source is limited to a well-known automotive forum in China, and the representativeness of the sample needs to be further verified. Secondly, the accuracy of sentiment analysis and topic model depends on the quality of data and the effect of preprocessing. Future research can consider introducing more data sources and more advanced analysis methods. In addition, this study mainly focused on the identification of user needs and the proposal of intervention strategies, and further empirical studies are needed to evaluate the actual effect of intervention. Future studies can track and

evaluate the proposed intervention strategy in combination with actual market data to verify its effectiveness and feasibility.

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