

Exploration of the Application of Artificial Intelligence Technology and CCRT Automobile Evaluation

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Abstract

This study focuses on the integration and innovation of artificial intelligence technology and the China Car Consumer Research and Test (CCRT) system. It aims to address issues in the traditional manual analysis of the CCRT evaluation system, such as low efficiency, insufficient analysis accuracy, and limited data processing capabilities, by introducing AI technologies like machine learning and natural language processing. The goal is to improve evaluation efficiency and accuracy, provide more timely and reliable car purchase references for automotive consumers, and offer a scientific basis for automotive enterprises in product improvement and market promotion. The research systematically sorts out the development status and limitations of the CCRT evaluation system, deeply analyzes the application advantages of AI technology in the field of automotive evaluation, conducts research on subjective evaluation analysis using artificial intelligence technology, verifies the feasibility and effectiveness of combining AI with CCRT, and provides feasible ideas for the in-depth application of AI technology in CCRT automotive evaluation.

Keywords

Automotive Consumer Evaluation; CCRT Evaluation System; AI Technology Integration.

1. Introduction

1.1. Research Background

With the rapid development of the automotive industry, the iteration of vehicle models is accelerating, and consumers' requirements for quality, safety, and comfort are rising. A scientific and efficient vehicle evaluation system has become a guide for consumer decisions and an engine for industrial upgrading. As an authoritative domestic evaluation mechanism, CCRT is of great significance in the development of the industry. However, traditional CCRT evaluations[1] rely on manual work, and under the challenges of massive data, diverse demands, and complex technologies, the shortcomings in efficiency and accuracy have become increasingly prominent.

Meanwhile, artificial intelligence technology has made breakthroughs in fields such as data processing, classification[2] and recognition, and predictive analysis, and has been widely applied in multiple industries. Combining AI technology with the CCRT automobile evaluation system is expected to inject new vitality into the traditional evaluation system, solve current evaluation problems, and has important theoretical significance and practical application value.

1.2. Research Objectives

Sort out the current development status of the CCRT automobile evaluation system, and clarify its limitations in terms of evaluation efficiency, analysis accuracy, and data processing. Analyze the application advantages of AI technologies such as machine learning in the field of

automobile evaluation, and find more integration points between AI technologies and the traditional CCRT evaluation system. Through a practical case - a customer subjective evaluation analysis system based on machine learning, verify the feasibility and effectiveness of the combination of AI technology and the CCRT evaluation system. Put forward optimization strategies for the application of AI technology in CCRT automobile evaluation, provide directions for subsequent technology integration and system improvement, and promote the construction of an intelligent and all-dimensional new ecology of automobile evaluation.

1.3. Research Significance

This study aims to fill the theoretical gap in the intelligentization of CCRT evaluation and explore the integration path of artificial intelligence technology with traditional evaluation systems. For consumers, AI-enabled CCRT evaluation can quickly and accurately output evaluation results, providing strong support for their car purchase decisions. For enterprises, the evaluation data can serve as an important basis for product optimization and market strategy formulation. From the perspective of industry development, this research is committed to promoting the intelligent upgrading of CCRT evaluation and helping the automotive industry achieve high-quality transformation and development.

2. AI Technology and Current Status of CCRT Automobile Evaluation System

2.1. Current Status of the Development of the CCRT Automobile Evaluation System

CCRT (China Car Consumer Research and Evaluation) is a comprehensive automobile evaluation system oriented to consumers' needs. It evaluates mainstream vehicle models using scientific evaluation indicators and methods from multiple dimensions such as safety, comfort, handling, economy, and reliability, providing references for consumers in car purchasing and for automobile enterprises in product optimization.

After years of development, CCRT has continuously iterated and upgraded, with more comprehensive evaluation indicators and more scientific methods, covering multiple categories such as passenger vehicles and commercial vehicles. Its evaluation content focuses on core areas such as driving, safety, comfort, and economy. Through consumer satisfaction surveys and market research, it dynamically optimizes the evaluation system to adapt to market demands.

2.2. Limitations of the CCRT Automobile Evaluation System

The CCRT evaluation system has played an important role in the development of the automotive industry, but in the actual operation process, there are still some limitations, which are mainly manifested in the following aspects:

Low efficiency of traditional manual analysis: In the CCRT evaluation system, traditional manual analysis requires a lot of time and energy. Analysts not only have to manually collect massive amounts of data from multiple channels, but also sort out, check and interpret the data one by one. Faced with complex evaluation indicators and huge amounts of data, problems such as data entry errors and analysis deviations are prone to occur. This repetitive and high-intensity work mode is not only inefficient, but also makes it difficult to ensure the accuracy and reliability of the analysis results.

Insufficient analysis accuracy: In the analysis of consumer evaluations, the manual analysis process is highly susceptible to interference from subjective factors such as the analyst's emotions and cognitive biases, making it difficult for the data to accurately reflect the actual performance of the vehicle.

Limited data processing capability: With the continuous development of automotive technology, the amount of data generated during vehicle evaluation is increasing, and the types of data are becoming more complex, including structured and unstructured data. Traditional CCRT lacks effective processing tools, making it difficult to tap into the value of unstructured data and unable to provide comprehensive support for evaluation.

2.3. Current Status of AI Technology Application in the Field of Automobile Evaluation

In recent years, artificial intelligence (AI) technology has achieved leapfrog breakthroughs in core fields such as data processing, pattern recognition, and predictive analysis, and has demonstrated significant application value in industries like medical diagnosis, intelligent transportation, and financial risk control. However, in the field of automobile evaluation, the in-depth application of AI technology is still in its infancy. Taking the CCRT automobile evaluation as an example, the intelligent analysis model based on machine learning[3] has not yet formed a complete practical verification system, and the potential value of massive evaluation data has not been fully explored. If an intelligent classification model based on machine learning can be constructed, and intelligent analysis of multi-dimensional evaluation data can be carried out through technologies such as natural language processing, the processing efficiency and analysis accuracy of evaluation data will be effectively improved.

3. Research on the Integration of Artificial Intelligence Technology and CCRT Automobile Evaluation

3.1. Overall Design Idea

This study mainly involves data preprocessing and manual annotation of the collected subjective evaluation data from consumers to ensure data quality. The processed data is reasonably divided into a training set and a validation set. Then, the training set is used to train the classification model, and the validation set is used to verify the trained classification model. Finally, the trained model is used to classify new datasets, and the differences from manual classification in the traditional CCRT evaluation system are compared to achieve the research objectives. The research roadmap is shown in Figure 1.

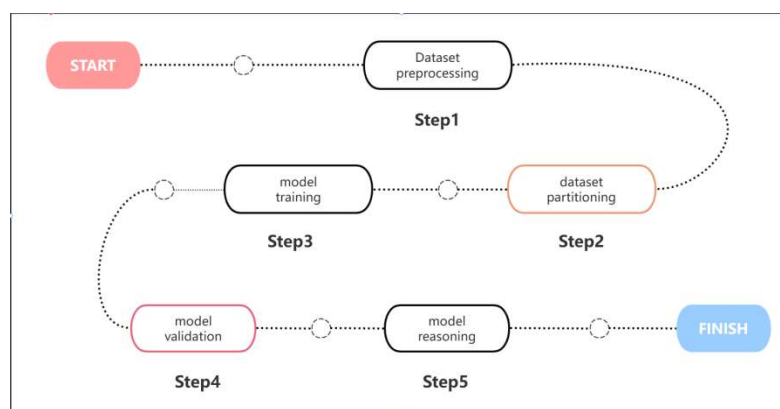


Figure 1. Research Roadmap for AI-based CCRT Subjective Evaluation Analysis

3.2. Data Preprocessing

The data mainly comes from two sources: first, the subjective evaluation data of consumers accumulated in the past by the CCRT evaluation system, including questionnaire feedback and interview records, with a total of 5,000 pieces of historical data collected; second, the recent consumer car evaluation data collected from automotive vertical platforms and social media

platforms, with a total of 5,000 valid pieces of data collected, covering evaluations of different brands and models (including 30 mainstream models).

The collected data mainly includes 30 hybrid/fuel-powered vehicle models, excluding pure electric vehicle models. The data content involves subjective evaluations such as consumers' assessments of attribute performance, user satisfaction, expected improvements, and user complaints, and does not extend to four dimensions of objective indicators such as safety/handling. The initially collected data has issues such as redundancy and noise, and needs to be preprocessed before it can be used for model training and analysis.

To convert unstructured text data into structured data suitable for processing by machine learning models, the following preprocessing operations are performed:

Data cleaning[4]: Remove meaningless characters (such as special symbols, garbled characters) and emojis from the data, and delete duplicate evaluation data. A total of 615 duplicate data entries and 385 noisy data entries were cleaned, and finally 9,000 valid data entries were obtained.

Human Annotation: Label each piece of cleaned data one by one from four dimensions to ensure the accuracy and consistency of the annotation results. For example, in terms of attribute performance evaluation indicators, there are 10 levels of three emotions: positive, negative, and neutral. In terms of user satisfaction indicators, they include very dissatisfied, somewhat dissatisfied, relatively satisfied, very satisfied, and completely satisfied.

3.3. Model Construction and Training

In this study, Chinese-MacBERT-Base[5] ("Chinese-MacBERT-Base, a pre-trained language model optimized for Chinese text, which performs better in few-shot and noisy data classification tasks") is selected as the pre-trained model for text representation and classification. This model has advantages in Chinese word segmentation granularity and word-level semantic modeling, has better robustness to few-shot samples and noise, and has relatively low training and inference costs, meeting the comprehensive balance of "accuracy - efficiency - engineering implementation" in this research.

In terms of dataset processing, the 9,000 valid samples after cleaning are divided in a stratified manner, with a 7:3 ratio used to construct the training set and the test set, i.e., 6,300 samples are used for training the model, and 2,700 samples serve as the final test set. To avoid information leakage, model selection and hyperparameter determination are both completed within the training set; the test set is only used to report the final generalization performance.

In terms of model training[6], the training set data is used to train the classification model. The training set is divided into 5 parts. Four parts are used for training in turn and one part for validation to ensure the stability of model parameters, so as to select the optimal combination of hyperparameters and the number of training rounds. The final model is retrained with the selected hyperparameters on the entire training set. The training parameters are shown in Table 1.

Table 1. Model Training Parameter Configuration

param	value
Tokenizer	MacBERT with WordPiece
Optimizer	AdamW, learning rate set to 2e-5, with weight decay of 0.01
Batch size	32; mixed-precision training enabled
Maximum training epoch	200, with early stopping
Random seed fixed	42

3.4. Experimental Results

The trained model is validated using the test set data, and the classification accuracy of the model on the test set is calculated. The results show that the accuracy of the model on the test set is $80\% \pm 0.6\%$. The trained model is applied to 1,000 newly collected consumer review data for classification prediction.

Using manual methods, two experienced CCRT evaluators independently analyzed 1000 pieces of data. The consistency accuracy rate of their analysis results was calculated to be 85%, and this result was taken as the manual benchmark.

Use AI model analysis methods to analyze 1,000 pieces of data, and take the results as the benchmark for AI model analysis.

Comparing the analysis results of this AI model with those of traditional manual analysis (Table 2: Efficiency Comparison), traditional manual analysis of 1,000 pieces of data takes 2 days; while the AI model only takes 0.5 days with an accuracy rate of $85\% \pm 1\%$. In comparison, the accuracy rate is within an acceptable range, but the analysis efficiency is increased by 4 times. This study verifies the significant advantages of AI technology in CCRT customer subjective evaluation analysis in the scenario of processing massive evaluation data.

Table 2. Efficiency Comparison

Method	Days	Accuracy
Traditional manual analysis	2 days	85%
AI-based model analysis	0.5 days	$85\% \pm 1\%$

4. AI Technology in CCRT Automobile Evaluation: Analysis of Optimization Strategies

4.1. Improving Data Quality

Data quality is a core element for the effectiveness of artificial intelligence technology in CCRT automotive evaluation, and a multi-dimensional quality control system needs to be established. In terms of data integrity, in addition to expanding diverse data sources such as social media and traffic environments, standardized data collection templates should be created to ensure no key indicators are missed. For data accuracy, data should be verified through a cross-validation mechanism, and a dual review process combining expert review and AI automatic error correction algorithms should be introduced. At the level of data consistency, a complete data cleaning script should be developed to remove duplicate and conflicting data as much as possible. Meanwhile, data security management should be strengthened, and a sound data security guarantee system should be established. Technical measures such as encrypted transmission, hierarchical storage, and access permission control should be adopted to prevent data leakage, loss, and tampering, thereby comprehensively protecting consumers' privacy and enterprises' trade secrets.

4.2. Strengthen Model Training and Optimization

To enhance the application effectiveness of artificial intelligence in CCRT automotive evaluation, a systematic model training optimization system should be established. Firstly, a transfer learning strategy is adopted, leveraging the feature representation capabilities already learned by pre-trained models to conduct targeted fine-tuning on automotive evaluation data. This approach can not only reduce the time and computational resource consumption caused by training from scratch but also rely on the generalization of general models to quickly adapt to the characteristic requirements of the car evaluation scenario. Secondly, establish a dynamic

training mechanism, and regularly iterate and optimize the model based on the actual situation such as the iteration of CCRT evaluation standards and the upgrading of new car technologies in the market. By continuously introducing the latest evaluation data and feedback results, ensure that the model always maintains a high adaptability to the latest evaluation requirements, and achieve a dynamic balance between the accuracy and timeliness of evaluation results.

4.3. Enhancing Technology Integration and Innovation Capabilities

Deeply explore the collaborative innovation points between artificial intelligence technology and the CCRT automobile evaluation system. Through cross-technical empowerment, improve the intelligence level of the evaluation process and the accuracy of data processing, achieve a dual breakthrough in evaluation efficiency and result reliability, and build a more scientific and efficient automobile quality evaluation system.

5. Conclusion

This study verifies the feasibility of deep integration between artificial intelligence (AI) technology and the user subjective evaluation analysis module under the CCRT automobile evaluation system through a systematic method. Compared with the traditional manual evaluation mode, AI technology shows significant advantages in data processing efficiency, complex scenario simulation, and multi-dimensional analysis, and can realize the intelligent upgrading of the evaluation process. However, it should be noted that AI models have the problem of "hallucination", which poses a potential challenge to the accuracy of evaluation results. Therefore, high-quality data collection and refined data cleaning are the key prerequisites for ensuring model performance. Improving data quality can effectively optimize model training effects, thereby significantly improving the efficiency and accuracy of automobile evaluation. With the continuous innovation and breakthrough of AI technology, it will surely usher in broader application prospects in the field of CCRT evaluation, promoting the automobile evaluation industry to move towards intelligence and scientization.

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