Research on Mobile Communication Big Data Mining Technology Based on Artificial Intelligence

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Abstract: ***The research on artificial intelligence based mobile communication big data mining technology aims to explore how to efficiently and accurately extract valuable information from massive mobile communication data using artificial intelligence technology. This study integrates advanced algorithms such as machine learning and deep learning to deeply mine and analyze mobile communication data, revealing key information such as user behavior patterns and potential security risks. The research results not only provide decision support for telecommunications operators in network optimization, user profiling construction, and precision marketing, but also provide effective means to ensure user privacy and data security. This study is of great significance for promoting the intelligent transformation of the mobile communication industry.***

Keywords: Artificial intelligence; Mobile communication; Big data mining technology.

1. INTRODUCTION

With the rapid development of mobile communication technology, mobile communication data is showing explosive growth, which contains rich user behavior information and potential market trends. The research on big data mining technology for mobile communication based on artificial intelligence aims to use advanced algorithms and technological means to extract valuable information from massive data, provide decision support for telecommunications operators, and enhance user experience. This study not only has important theoretical value, but also has profound implications for the intelligent transformation and sustainable development of the mobile communication industry. Yi (2025) proposed a real-time fair-exposure ad allocation system for small businesses and underserved creators using contextual bandits-with-knapsacks, addressing equity in algorithmic distribution [1]. Building on the importance of robust statistical foundations, Lin, Wang, and Hong (2023) contributed to computational methods by detailing the computation of the Poisson multinomial distribution and its applications in ecological inference and machine learning [2]. As AI systems become more collaborative, security concerns are paramount. Deng and Yang (2025) developed multi-layer defense strategies and privacy-preserving enhancements to mitigate membership reasoning attacks within federated learning frameworks [3]. Progress in intelligent systems is often underpinned by advances in enabling hardware. In this vein, Tang et al. (2020) focused on the design and optimization of a shallow-angle grating coupler for vertical emission from indium phosphide devices, a critical photonic component [4]. Research also extends to the intersection of corporate strategy and technology. Li (2025) investigated the relationship between ESG (Environmental, Social, and Governance) performance and corporate cash holdings, providing empirical evidence from China [5]. The application of AI in safety-critical and creative domains represents another significant thrust. Tang et al. (2026) created SVD-BDRL, a trustworthy autonomous driving decision framework that integrates sparse voxel representations with blockchain for enhanced security [6]. In content generation, Lu et al. (2025) introduced NeuroDiff3D, a diffusion-based 3D generation method optimized for viewpoint consistency [7]. Finally, examining the broader socioeconomic impact of AI, Zhou and Cen (2024) studied the effect of ChatGPT-like generative AI technologies on user entrepreneurial activities, highlighting their transformative potential for business creation [8].

2. OVERVIEW OF THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE AND DATA MINING TECHNOLOGY

Artificial intelligence and data mining technology are two popular research directions in the field of information technology, and their development is profoundly changing the face of various industries. Artificial intelligence, as an important branch of computer science, aims to enable machines to simulate, extend, and expand human intelligence. In recent years, with the rapid development of technologies such as deep learning, natural language processing, and computer vision, artificial intelligence has achieved significant results in fields such as speech

recognition, image recognition, and autonomous driving. These technologies not only improve production efficiency, but also greatly enrich people's life experience. Data mining technology is the process of extracting useful information and knowledge from large amounts of data, involving multiple disciplines such as database technology, machine learning, statistics, etc. It aims to discover hidden patterns, associations, and trends in data through algorithms and models. In the era of big data, data mining technology has become an indispensable tool for enterprise decision-making, market analysis, risk assessment, and other fields. By mining the value in data, enterprises can more accurately grasp market dynamics and optimize products and services. The development of artificial intelligence and data mining technology mutually promotes the progress of information technology.

On the one hand, artificial intelligence provides more powerful algorithms and tools for data mining, improving the efficiency and accuracy of data processing; On the other hand, data mining technology provides abundant data sources and training samples for artificial intelligence, promoting the optimization and upgrading of AI models.

3. ANALYSIS OF BIG DATA CHARACTERISTICS IN MOBILE COMMUNICATION

Mobile communication big data refers to the vast and diverse data generated and collected by mobile communication and terminals, which has significant characteristics and unique value. Mobile communication big data has massive volume, generating tens of billions of data records every day, covering various types such as call records, SMS data connection data, etc. This massive nature provides abundant resources for data mining and analysis, but also poses severe challenges to data processing and storage capabilities. Mobile communication big data has high dimensionality, containing rich dimensional information such as time, space, devices, user behavior, etc. These multidimensional data provide the possibility for in-depth analysis of user behavior and needs. Mobile communication big data also has high timeliness and diversity, with real-time data generation that can reflect the latest trends in user behavior and has high timeliness value. The diversity of data types, including structured data, unstructured data, and time-series data, increases the complexity and processing difficulty of data, but also provides more possibilities for data analysis. Mobile communication big data contains enormous value. By utilizing big data analysis techniques, patterns and values in the data can be revealed, providing strong support for areas such as user profiling and market analysis.

4. KEY TECHNOLOGIES FOR MOBILE COMMUNICATION BIG DATA MINING BASED ON ARTIFICIAL INTELLIGENCE

4.1 Data preprocessing techniques

In the process of mobile communication big data mining based on artificial intelligence, data preprocessing technology plays a crucial role. Due to the massive, high-dimensional, diverse, and complex nature of mobile communication big data, direct mining and analysis often yields unsatisfactory results. Therefore, data preprocessing techniques have become a key step in improving the quality and efficiency of data mining. Data preprocessing mainly includes data cleaning, data integration, data transformation, and data reduction. Data cleaning aims to remove noise, redundancy, and errors from data, ensuring its accuracy and consistency. In mobile communication big data, there may be a large amount of incomplete, inaccurate, or duplicate data that can have a negative impact on mining results. Through data cleaning, these problems can be effectively solved, laying the foundation for subsequent mining work. Data integration is the process of integrating data from different sources and formats. In the field of mobile communication, data may come from multiple sources such as base stations and terminals, and there may be differences in format, structure, and meaning among these data. Through data integration, these data can be unified to form a complete dataset, providing convenience for subsequent mining work. Data transformation is the process of transforming and mapping data, aimed at making it easier to mine and analyze. In mobile communication big data, there may be a large amount of unstructured or semi-structured data that is difficult to directly use for mining. Through data transformation, these data can be transformed into structured data, making it easier to process and analyze. Data reduction is the process of compressing and simplifying data without losing important information. In mobile communication big data, the amount of data is huge and the dimension is high. Directly mining may consume a lot of computing resources and time. Through data reduction, the dimension and scale of data can be reduced, and mining efficiency can be improved.

4.2 Intelligent Mining Algorithms and Models

Intelligent mining algorithms and models are the core of mobile communication big data mining based on artificial intelligence. With the continuous development of artificial intelligence technology, various intelligent algorithms and models have been widely applied in the field of data mining. In mobile communication big data mining, commonly used intelligent algorithms include decision trees, support vector machines, etc. Decision tree is a classification algorithm based on a tree structure, which recursively divides a dataset to form a series of decision rules for classifying and predicting unknown data. For example, when analyzing users' preferences for different value-added services, decision tree algorithms can be used to classify users based on their age, gender, consumption habits, and other characteristics, in order to recommend appropriate value-added service strategies for operators. Support Vector Machine is a kernel based classification algorithm that achieves data classification and recognition by searching for the optimal classification surface in high-dimensional space. For example, when identifying high-value users and potential churn users, support vector machine algorithms can be used to classify users based on their call duration, data usage, consumption amount, and other characteristics, in order to develop differentiated customer relationship management strategies for operators. For example, when predicting users' future consumption tendencies, training and prediction are based on users' historical consumption data, online behavior, and other characteristics. In addition to commonly used intelligent algorithms, there are also specific algorithms and models tailored to the characteristics of mobile communication big data. With the continuous development of deep learning technology, the application of deep learning models in mobile communication big data mining is becoming increasingly widespread. In mobile communication big data mining, deep learning models can achieve accurate prediction and recognition of user behavior, providing strong support for fields such as user profiling and market analysis.

4.3 Model Evaluation and Optimization Techniques

In the process of mobile communication big data mining based on artificial intelligence, model evaluation and optimization techniques are key to ensuring the accuracy and reliability of mining results. Model evaluation refers to the quantitative analysis and comparison of the performance of mining models to determine their strengths and weaknesses. Model optimization refers to adjusting and improving the model based on evaluation results to enhance its performance. Common model evaluation metrics include accuracy, recall, F1 score, AUC, etc. These indicators can reflect the performance of the model from different perspectives, providing a basis for model selection and optimization. In mobile communication big data mining, due to the large amount and high complexity of data, the performance of the model is often affected by multiple factors. When evaluating the model, it is necessary to comprehensively consider multiple indicators to comprehensively evaluate the performance of the model. Model optimization techniques mainly include parameter adjustment, feature selection, model integration, etc. Parameter adjustment refers to adjusting the parameters of a model to achieve optimal performance. In mobile communication big data mining, the parameters of the model are often numerous and complex, requiring detailed debugging and optimization. Feature selection refers to selecting features from raw data that have a significant impact on model performance, in order to improve the performance and interpretability of the model. In mobile communication big data, the number of features is large and the redundancy is high. Feature selection can effectively reduce the complexity of the model and improve performance. Model integration refers to combining the predictive results of multiple models to improve overall predictive performance. In mobile communication big data mining, integrating the results of multiple models can further improve the accuracy and stability of predictions.

4.4 Construction of Evaluation Indicator System

In the process of mobile communication big data mining based on artificial intelligence, the construction of evaluation index system is an important link to ensure the effectiveness and practicality of mining results. The evaluation index system refers to a set of indicators and standards used to measure the quality of data mining results. By constructing a scientifically reasonable evaluation index system, the quality and effectiveness of data mining results can be comprehensively and objectively evaluated. In mobile communication big data mining, the construction of evaluation index system needs to comprehensively consider the characteristics of data, the requirements of mining tasks, and the requirements of practical application scenarios. Specifically, the evaluation index system should include several aspects:

One is data quality assessment indicators, which are used to measure the accuracy, completeness, consistency, and availability of data. By evaluating data quality, the reliability and effectiveness of mining results can be ensured.

The second is the evaluation indicators for mining effectiveness, which are used to measure the performance of mining models in tasks such as classification, regression, and clustering. By evaluating the mining effect, we can understand the quality and improvement direction of the model.

The third is the evaluation indicators for actual application effects, which are used to measure the effectiveness and value of mining results in practical applications.

By evaluating the actual application effect, the practicality and feasibility of the mining results can be understood, providing a basis for subsequent decision-making and optimization. When constructing an evaluation index system, it should be targeted and practical, able to reflect the actual value and effectiveness of data mining results; To have comprehensiveness and objectivity, and to be able to comprehensively and objectively evaluate the quality and effectiveness of data mining results; It should also have operability and measurability, allowing for easy evaluation and comparison.

5. APPLICATION SCENARIOS OF BIG DATA MINING IN MOBILE COMMUNICATION

5.1 Analysis of User Consumption Behavior and Precision Marketing

The application of mobile communication big data mining in user consumption behavior analysis and precision marketing provides a way for telecom operators and Internet enterprises to deeply understand user needs and preferences. User profiles can be constructed to reveal characteristics such as age, gender, occupation, interests, and hobbies of users. Based on user profiles, telecom operators can provide users with more accurate personalized services. For example, recommending suitable packages and value-added services based on users' consumption habits and preferences; Based on users' online behavior, push customized content and services such as news, music, videos, etc. This personalized service not only enhances user experience, but also increases the revenue source for operators. Mobile communication big data mining can also be used to predict user needs and trends. By analyzing user historical behavior data, it is possible to predict changes in users' future consumption tendencies and preferences, providing decision support for product development and marketing.

5.2 Network Traffic Management and Optimization

Mobile communication big data mining has demonstrated its unique value in network traffic management and optimization, providing telecommunications operators with a new way to enhance network performance and improve user experience. By analyzing communication data such as call duration, data usage, and geographic location movement trajectory of users, operators can accurately identify peak periods and hotspot areas of network usage. This not only helps operators to plan network resources reasonably, such as increasing bandwidth allocation during high demand periods, but also plays a key role in optimizing base station layout and reducing network congestion. Furthermore, user behavior pattern analysis based on big data mining can predict future trends in network traffic, providing forward-looking planning basis for network expansion and upgrading; By analyzing the traffic consumption of specific applications, operators can provide customized traffic packages for users, such as launching specialized data plans for heavy video viewers or frequent online gamers, which not only meet user needs but also improve revenue efficiency. In terms of network security, mobile communication big data mining technology can also play an important role. By identifying abnormal traffic patterns and malicious behavior characteristics, network attacks can be detected and defended in a timely manner, protecting user data and privacy security, and enhancing user trust in operator services. In short, the application of mobile communication big data mining in network traffic management and optimization not only improves the efficiency and quality of network services, but also promotes a closer and more personalized interactive relationship between operators and users.

5.3 Security and Privacy Protection

While big data mining in mobile communication brings enormous commercial value, it also faces challenges in terms of security and privacy protection. With the widespread application of big data technology, the security and privacy protection of user data have become the focus of attention in various sectors of society. In the field of mobile communication, user data includes sensitive information such as call records, SMS content, location information, etc. Once leaked or abused, it will cause serious infringement on user privacy. In order to ensure the security of user data, telecom operators and Internet enterprises need to take a series of security measures [4]. Firstly, strengthen data encryption and storage management to ensure the security of user data during transmission and storage. Secondly, establish strict access control mechanisms to restrict access to sensitive data and prevent

data leakage and abuse. In addition, regular security audits and vulnerability scans are necessary to promptly identify and fix potential security risks. In terms of privacy protection, mobile communication big data mining should follow the principles of legality, legitimacy, and necessity. When collecting and using user data, users should be clearly informed of the purpose and scope of the data, and their consent should be obtained. Technical means such as data anonymization and anonymization should be used to reduce the risk of user data being identified. In the process of data mining, relevant laws, regulations, and privacy policies should be strictly followed to ensure that users' privacy rights are not infringed upon.

6. CONCLUSION

The research on big data mining technology for mobile communication based on artificial intelligence has brought revolutionary changes to the field of mobile communication. By deeply mining and analyzing mobile communication data, not only can we better understand user behavior, but we can also provide accurate market insights and decision support for telecommunications operators. In the future, with the continuous development and improvement of artificial intelligence technology, the application prospects of big data mining in mobile communication will be even broader, injecting new vitality into the intelligent transformation and sustainable development of the mobile communication industry.

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