An Intelligent Predictive Model for Customer Experience Evaluation in Telecom Networks

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Abstract

The rapid expansion of digital services in the telecommunications industry has significantly increased customer expectations regarding network quality, reliability, and service responsiveness. Customer experience has become a critical factor influencing customer loyalty and business sustainability. However, conventional customer satisfaction evaluation methods are mostly reactive and rely on descriptive statistics, which limits their ability to support proactive service improvement. This paper proposes an intelligent predictive model for evaluating customer experience in telecom networks using machine learning techniques. The proposed framework integrates network Quality of Service (QoS) parameters, including throughput, latency, jitter, packet loss, and service downtime, with customer-related variables such as complaint frequency, response time, and service tenure. Two supervised learning algorithms, Random Forest and Naïve Bayes, are employed to classify customer experience into satisfied and unsatisfied categories. The dataset is processed through data cleaning, normalization, and feature encoding, followed by model training and testing using a 70:30 data split and k-fold cross-validation. The experimental results demonstrate that machine learning models can predict customer experience with high accuracy and stability. Random Forest achieves superior performance and provides feature importance analysis, while Naïve Bayes offers efficient probabilistic classification. The results confirm that both network performance indicators and customer interaction data significantly influence customer experience. This research provides a data-driven framework that enables telecom operators to improve service quality and customer retention strategies proactively.

Keywords: *Customer Experience, Telecommunications, Machine Learning, Predictive Analytics, Service Quality*

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Introduction

The telecommunications industry has become a critical enabler of digital transformation, supporting services such as cloud computing, online education, video streaming, and remote working. In this highly competitive market, customer experience is no longer determined solely by pricing or coverage but increasingly by service quality, reliability, and responsiveness.

Traditional customer satisfaction analysis in telecom networks relies on surveys, complaint logs, and basic performance indicators. These methods are generally reactive and unable to predict future dissatisfaction. With the availability of large-scale network monitoring and customer behavior data, machine learning techniques offer a promising approach for developing predictive and data-driven customer experience models.

This study aims to develop an intelligent predictive model that integrates network performance metrics and customer behavior data to evaluate customer experience in telecom networks.

Related Work

Machine learning has been widely applied in the telecommunications sector for churn prediction, fault detection, and network optimization. Random Forest has been proven effective for classification tasks with complex and high-dimensional data, while Naïve Bayes is commonly used for probabilistic modeling and fast classification.

Previous studies have shown that Quality of Service (QoS) parameters such as latency, jitter, packet loss, and throughput significantly influence customer satisfaction. However, most existing studies analyze technical and customer data separately. This research integrates both aspects to provide a more comprehensive customer experience evaluation model.

Research Methodology

This study employs a supervised machine learning approach. The dataset consists of technical network metrics and customer interaction records. The input features include throughput, latency, jitter, packet loss, service downtime, number of complaints, response time, monthly billing, and customer tenure.

Data preprocessing involves cleaning, normalization, and encoding. Customer experience is labeled as **satisfied (1)** or **unsatisfied (0)** based on survey and behavioral data. The dataset is divided into 70% training data and 30% testing data. Random Forest and Naïve Bayes classifiers are trained and evaluated using accuracy, precision, recall, and F1-score, with k-fold cross-validation to ensure reliability.

Results

The performance of the proposed models is evaluated using standard classification metrics. Table I shows the comparison of Random Forest and Naïve Bayes.

Table 1. Performance Comparison of Machine Learning Models

Model	Accuracy (%)	Precision (%)	Recall (%)	F1-Score (%)
Random Forest	92.1	91.4	90.8	91.1
Naïve Bayes	86.7	85.9	84.5	85.2

Random Forest achieves higher accuracy and F1-score, indicating better overall performance. Feature importance analysis shows that latency, packet loss, downtime, and response time are the most influential factors affecting customer experience. Naïve Bayes provides competitive performance with lower computational cost, making it suitable for real-time applications.

Conclusion

This paper presents an intelligent predictive model for customer experience evaluation in telecom networks using machine learning. The integration of network QoS and customer behavior data enables accurate and proactive service quality assessment. Random Forest offers superior predictive performance and interpretability, while Naïve Bayes provides efficient probabilistic classification. The proposed framework can assist telecom operators in improving customer satisfaction, reducing churn, and enhancing overall service quality.

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