



CUSTOMER CHURN PREDICTION USING MACHINE LEARNING ALGORITHMS

A SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

MASTER IN COMPUTER APPLICATION

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1. ABSTRACT

Customer churn is a significant challenge for subscription-based businesses, leading to revenue loss and higher customer acquisition costs. Predicting churn is crucial for proactive customer retention. Machine learning (ML) offers a more accurate approach than traditional methods by analyzing historical data, transaction records, and customer behavior. ML techniques like logistic regression, decision trees, and deep learning can identify patterns indicative of churn. The churn prediction process involves data collection, preprocessing, feature engineering, and model training. Key features include purchase frequency, complaints, and service usage. The model predicts churn probabilities, allowing businesses to implement targeted retention strategies. Model performance is evaluated using metrics like accuracy, precision, recall, and AUC-ROC. Integrating churn predictions with CRM systems enables automated alerts for retention campaigns. ML-powered churn prediction helps businesses reduce revenue loss, enhance customer satisfaction, and optimize marketing efforts, ensuring long-term growth and competitive advantage.

Keywords: Machine Learning, Customer Retention, Churn Analysis

2. INTRODUCTION

2.1 PURPOSE

Customer churn prediction is a crucial application of machine learning (ML) in business, aiming to identify customers likely to leave a service or stop purchasing from a company. By leveraging ML techniques, businesses can analyze historical data to detect patterns that indicate potential churn, allowing them to take proactive measures to retain valuable customers. One of the primary purposes of customer churn prediction is to improve customer retention. Acquiring new customers is often more expensive than retaining existing ones, making churn prevention a cost-effective strategy. By identifying at-risk customers, businesses can implement targeted interventions such as personalized offers, discounts, improved customer support, or loyalty programs to increase customer satisfaction and loyalty. Another key objective is revenue optimization. Churn directly impacts a company's revenue, especially in subscription-based or service-oriented industries like telecommunications, banking, and e-commerce. Predicting churn enables businesses to minimize financial losses by engaging customers before they decide to leave. Machine learning models offer a data-driven approach to churn prediction by analyzing various factors such as transaction history, customer behavior, demographics, and engagement levels.

2.2 NEED AND SIGNIFICANCE

Customer churn prediction using machine learning is essential for businesses to retain customers, optimize revenue, and enhance customer satisfaction. Churn leads to financial losses and higher acquisition costs, making retention crucial. ML models analyze patterns in customer behavior, enabling proactive interventions like personalized offers and improved support. This predictive approach helps businesses make data-driven decisions, refine marketing strategies, and improve services. By reducing churn, companies increase customer lifetime value, maintain competitive advantage, and ensure long-term growth. In industries like telecom, banking, and e-commerce, ML-driven churn prediction is vital for sustaining customer loyalty and business success.

2.3 OBJECTIVE

The primary objective of customer churn prediction using machine learning (ML) is to identify customers who are likely to stop using a product or service. This enables businesses to take proactive measures to retain them. Key objectives include:

- Early Detection of At-Risk Customers – ML models analyze historical and behavioral data to detect customers likely to churn, allowing timely intervention.
- Improving Customer Retention – By predicting churn, businesses can implement personalized strategies such as discounts, special offers, or improved customer service to retain customers.
- Revenue Optimization – Reducing churn helps prevent revenue loss, especially in subscription-based industries like telecom, banking, and SaaS.
- Enhancing Customer Experience – Understanding churn drivers helps businesses improve services, address pain points, and boost customer satisfaction.
- Data-Driven Decision Making – ML models provide actionable insights, helping businesses refine marketing campaigns, product offerings, and engagement strategies.
- Reducing Customer Acquisition Costs – Retaining existing customers is more cost-effective than acquiring new ones, improving overall profitability.

By achieving these objectives, businesses can foster long-term customer relationships, increase profitability, and maintain a competitive edge in the market.

2.4 SCOPE

Customer churn prediction using machine learning has broad applications across industries such as telecommunications, banking, e-commerce, SaaS, and subscription-based services. ML models analyze customer behavior, transaction history, and engagement patterns to identify churn risks. The scope includes real-time churn detection, personalized retention strategies, and dynamic customer segmentation. Businesses can leverage ML for predictive analytics, improving customer satisfaction and reducing revenue loss. As data-driven decision-making grows, ML-driven churn prediction will evolve with advanced techniques like deep learning and real-time analytics, enhancing accuracy and effectiveness. This ensures sustained customer loyalty, competitive advantage, and long-term business success.

2.5 INTENDED USERS

- Marketing Teams – Use churn predictions to design personalized retention campaigns, offers, and engagement strategies.
- Customer Support Teams – Identify at-risk customers and provide proactive support to enhance customer satisfaction.
- Sales Teams – Focus on high-value customers likely to churn and implement targeted retention strategies.
- Business Analysts & Data Scientists – Analyze churn patterns, optimize ML models, and generate actionable insights.
- Product Managers – Improve product features and user experience based on churn analysis.
- Senior Management & Decision-Makers – Use churn insights for strategic planning, revenue optimization, and business growth.

3. PROBLEM STATEMENT

Customer churn is a major challenge for businesses, especially in industries such as telecommunications, banking, e-commerce, and subscription-based services. Churn occurs when customers stop using a product or service, leading to revenue loss and increased costs for acquiring new customers. Retaining existing customers is more cost-effective than acquiring new ones, making churn prediction a critical aspect of business strategy.

- Customer Attrition Challenge - Businesses face high customer churn rates, leading to revenue loss and increased acquisition costs and Retaining existing customers is more cost-effective than acquiring new ones.

- Limitations of Traditional Methods - Rule-based and statistical models fail to detect complex churn patterns and Manual analysis is time-consuming and lacks accuracy in large datasets.
- Need for Machine Learning-Based Prediction - ML can analyze vast amounts of customer data to identify churn patterns and Algorithms like logistic regression, decision trees, random forests, and deep learning improve prediction accuracy.
- Challenges in Churn Prediction - Data quality issues, missing values, and feature selection complexities and Customer behavior evolves, requiring continuous model updates and real-time insights.
- Business Impact of Churn Prediction - Helps businesses proactively identify at-risk customers and Enables personalized retention strategies such as targeted offers, loyalty programs, and improved customer service.

4. GENERAL DESCRIPTION

Customer churn prediction using machine learning (ML) involves analyzing customer data to identify patterns that indicate potential churn. ML models process historical and behavioral data, such as purchase history, customer interactions, and engagement levels, to predict which customers are likely to leave. Techniques like decision trees, logistic regression, and deep learning enhance prediction accuracy. Businesses use these insights to implement targeted retention strategies, such as personalized offers and improved support. By leveraging ML, companies can reduce revenue loss, optimize customer retention, and improve overall satisfaction, making churn prediction a crucial tool for long-term business success and sustainability.

4.1 SYSTEM ARCHITECTURE

The system architecture for customer churn prediction using machine learning consists of multiple interconnected components, ensuring efficient data processing, model training, and actionable insights. Below is a breakdown of the architecture:

1. Data Collection Layer
2. Data Preprocessing Layer
3. Model Training and Selection Layer
4. Prediction & Scoring Layer
5. Decision & Action Layer
6. Monitoring & Evaluation Layer

This architecture ensures accurate, scalable, and real-time customer churn prediction, helping businesses make data-driven decisions and improve customer retention strategies.

5. FUNCTIONAL AND NON FUNCTIONAL REQUIREMENTS

5.1 FUNCTIONAL REQUIREMENTS

- Data Collection and Integration
- Data Preprocessing
- Model Selection and Training
- Churn Prediction and Scoring
- Real-Time and Batch Prediction
- Performance Monitoring and Model Updating
- User Interface and Reporting

By meeting these functional requirements, businesses can effectively predict and mitigate customer churn, improving retention and revenue.

5.2 NON FUNCTIONAL REQUIREMENTS

- Scalability
- Performance and Speed
- Reliability and Availability
- Usability and User Experience
- Maintainability and Upgradability
- Accuracy and Interpretability

By fulfilling these non-functional requirements, the churn prediction system can ensure efficiency, reliability, and long-term sustainability.

6. HARDWARE AND SOFTWARE REQUIREMENTS

6.1 HARDWARE REQUIREMENTS

The hardware requirements for a machine learning (ML) model focused on Customer Churn Prediction depends on the complexity of the model, the volume of data to be processed, and the specific application needs. Below are the typical hardware requirements:

- OS : Windows 10
- Installed RAM : 4 GB

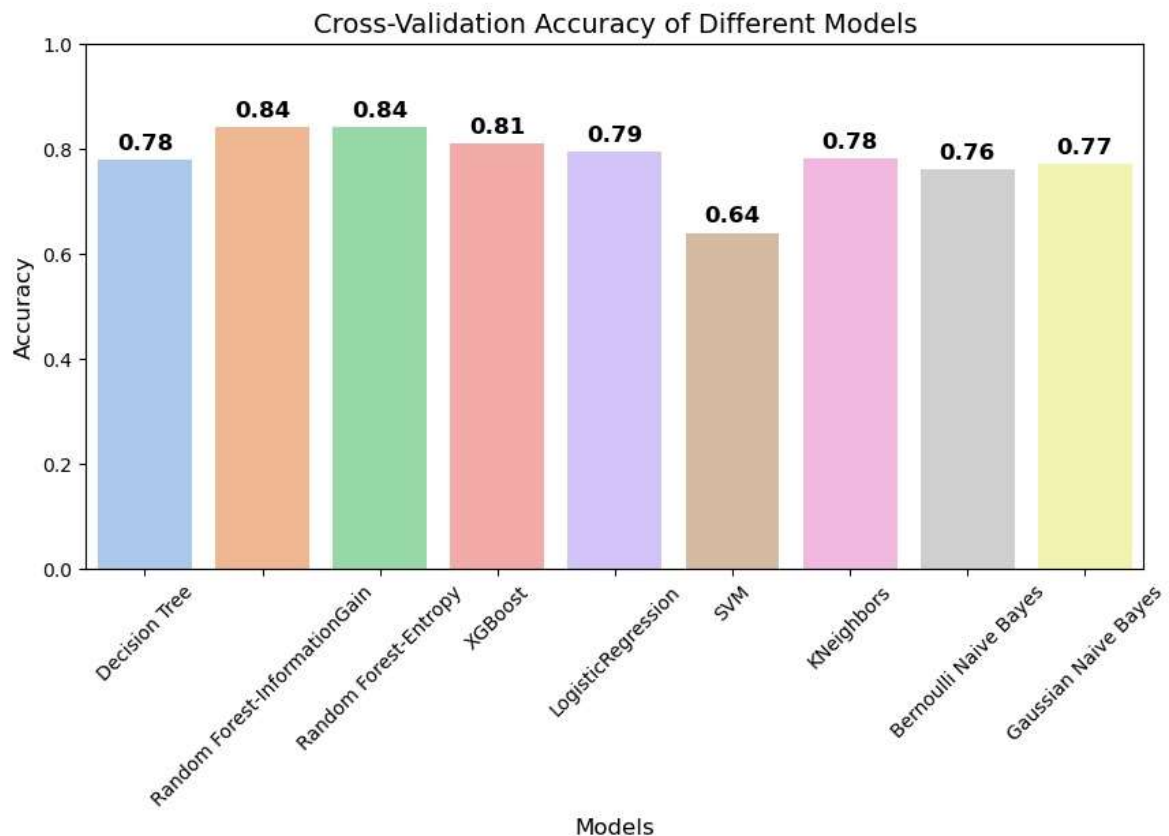
- Processor : intel i3 or above
- System type : 64 bit OS

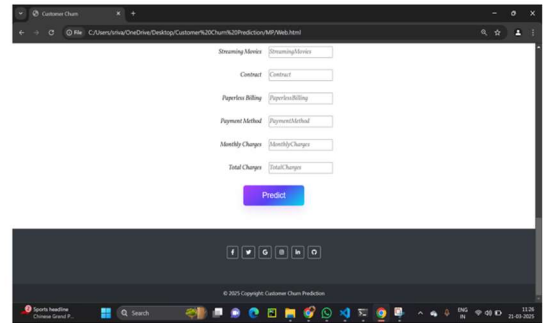
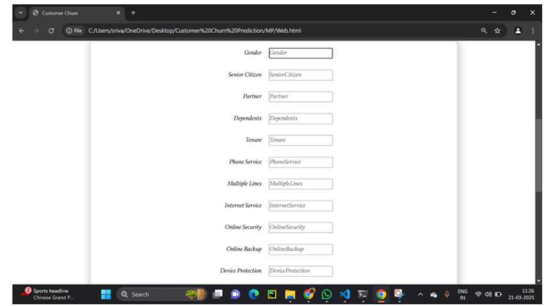
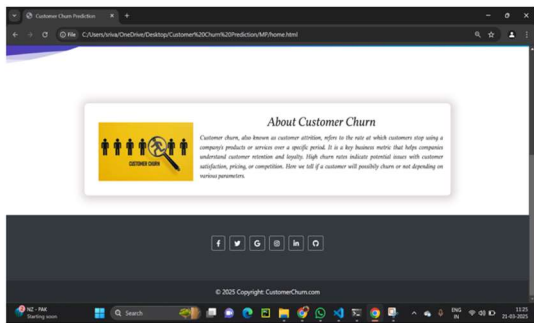
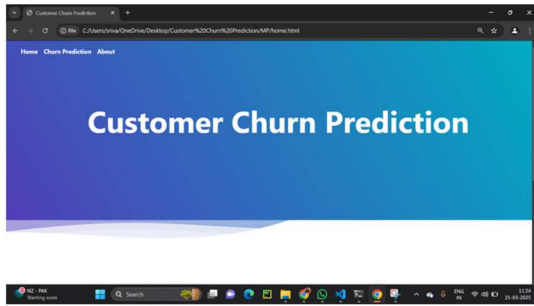
6.2 SOFTWARE REQUIREMENTS

The software requirements for a machine learning (ML) model focused on customer churn prediction are essential for developing, training, and deploying models effectively. These requirements include the necessary frameworks, libraries, and tools that enable the model to function optimally across various stages of the ML pipeline (data collection, model training, inference, and deployment). Below are the key software requirements:

- HTML
- CSS
- JavaScript
- Python and its libraries

7. RUNNING SNAPSHOTS





8. REFERENCES

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