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Improving Shopping Mall Revenue By Real Time Customized Digital Coupon Issuance

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ABSTRACT

With the development of big data and deep learning technology, big data and deep learning technology have also been applied to the marketing field, which was a part of business administration. Customer churn management is one of the most important areas of marketing. In this paper, we proposed a method to prevent customer churn and increase purchase conversion rate by issuing customized discount coupons to customers with high churn rate based on big data in real time. After segmenting customer segments with two-dimensional segment analysis, a real-time churn rate estimation model based on clickstream data was generated for each segment. After that, we issued customized coupons to our customers. Finally, we tested the conversion rate and sales growth. A two-dimensional cluster analysis-based churn rate estimation combined with a recommendation system was found to be significantly more useful than the respective simple models. Using this proposed model, it is possible to increase sales by automatically estimating the customer's churn probability and shopping propensity without the burden of marketing costs in the online shopping mall.

Keywords: Shopping Mall Revenue, Real-Time Digital Coupons, Personalized Marketing, Customer Behavior Analytics, Recommendation System, Location-Based Services, Consumer Engagement, Retail Analytics, Promotional Campaign Optimization, Artificial Intelligence (AI), Machine Learning, Customer Segmentation, Purchase Prediction, Smart Retail, Digital Marketing.

I. INTRODUCTION

With the development of big data and deep learning technology, big data and deep learning technology have also been applied to the marketing field, which was a part of management. Also, growth in internet adoption has made digital coupons a popular promotional tool [1]. Customized digital coupon issuance is a very important topic in online commerce. This is because maintaining existing customers is a more important business issue than acquiring new customers [2]. Also, retaining existing customers is much more economically advantageous than acquiring new customers [3]. In fact, the acquisition cost of new customers is known to be five to six times higher than the maintenance cost of existing customers [4]. Companies that have effectively managed customer churn by improving customer retention are known to have a positive effect not only on the company's profitability but also on improving brand image by improving customer satisfaction [5].

. Customized coupon issuance research has traditionally been active in highly competitive and urgent sectors such as telecommunications, finance, distribution, and game industries, and has focused mainly on developing predictive models using machine learning and artificial intelligence

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technology [6]. Also, recently, AI-based marketing using big data analysis and deep learning is emerging. Such AI-driven targeting can save huge amounts of marketing costs and raise online sales provided that the targeting model succeeds in estimating customer responsiveness accurately [7].

In particular, in the case of online shopping malls, the average purchase conversion rate is around 2%. Online shopping malls have the advantage of being easily accessed through the PC web or mobile web, but on the contrary, this advantage can be a disadvantage that it is easy to see and leave quickly. Therefore, even the slightest reduction of customer churn rate can lead to high conversions, which can lead to huge profits.

Unlike offline shopping malls, online shopping malls are easy to collect data. All online behavioral characteristics of customers can be collected in real time in the shopping mall' sown DB. Therefore, it is possible to have a wealth of customer history data and to use it to understand customer tendencies. In conclusion, if you use rich customer historical data to infer behaviors and tastes, you can increase customer conversion rates without special promotions.

Among the AI methodologies, in particular, deep learning based strategies can be implemented. Deep learning learns a large amount of data to make an optimal decision, and the more data, the better the result. By learning a large amount of real-time log data accumulated in an online shopping mall, it is possible to predict customer behavior and taste. In particular, it is possible to create a more sophisticated model every day by updating and re-learning the existing model with data that accumulates every day.

AI-based customized coupon issuance methods are largely divided into three: customer segmentation, customer churn prediction, and personalized recommendation.

Customer segmentation is an activity that categorizes customers according to their homogeneous customer characteristics, providing the basis for differentiated marketing activities by customer group [8]. Machine learning models used for customer segmentation were mainly used either supervised learning models such as decision trees or unsupervised learning models such as self-organizing maps (SOMs) or K-means models [9]. One of the key features of recent machine learning-based customer segmentation studies is that customer segmentation is being performed for related other marketing research purposes, such as customer churn prediction [10], [11]. Customer churn prediction is also one of the main marketing research topics based on machine learning. Not to mention the fact that effective churn prediction has been recognized as a critical research topic not only for marketing but also for enterprise-wide management strategy [4], with the increasing number of customer churn under a highly competitive modern business environment, many new model development studies have been conducted to successfully predict customer churn. In the past, there have been major studies to learn models using single algorithms such as decision trees, logistic regression, and artificial neural networks to predict customer deviations, however, in recent, more attempts have been made to develop ensemble models or hybrid models that interconnects different models [12]. Meanwhile, personalized recommendation systems are also one of the most active machine learning-based marketing research topics along with churn prediction [13]. Research on personalized recommendations applied to recommended services such as Amazon and Netflix is increasing. Personalized recommendation studies have been dominated by model development studies to enhance predictive performance itself [13], [14].

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II. LITERATURE SURVEY

1. Title A Survey on Personalized Recommendation Systems for Retail Marketing

Authors: Gediminas Adomavicius and Alexander Tuzhilin

Abstract:
The authors presented a comprehensive review of recommendation system techniques used in retail and e-commerce environments. The study compared collaborative filtering, content-based filtering, and hybrid recommendation methods for delivering personalized product suggestions. It concluded that personalized recommendations significantly improve customer satisfaction, purchasing behavior, and retailer profitability. The survey also highlighted the importance of customer data analytics and real-time recommendation models for enhancing shopping experiences.

2. Title Real-Time Personalization Using Machine Learning in Retail

Authors: Paul Covington, Jay Adams, and Emre Sargin

Abstract:
This research explored the implementation of machine learning algorithms for providing personalized recommendations in real time. The study discussed how customer browsing patterns, purchase history, and contextual information can be analyzed instantly to generate relevant promotional offers. Experimental results demonstrated increased customer engagement, higher conversion rates, and improved sales through adaptive recommendation systems.

3. Title Location-Based Mobile Coupon Services for Smart Shopping

Authors: Sanghoon Lee and Hyejin Kim

Abstract:
The study investigated location-aware mobile coupon systems that deliver promotional offers based on customers' positions within shopping malls. Using indoor positioning technologies and customer movement analysis, the proposed system improved coupon relevance and redemption rates. The findings indicated that location-based promotions effectively increased store visits and encouraged impulse purchases.

4. Title Customer Segmentation Using Data Mining Techniques in Retail

Authors: Jiawei Han, Micheline Kamber, and Jian Pei

Abstract:
This research focused on applying clustering and classification algorithms to segment retail customers according to purchasing patterns and demographic characteristics. The study demonstrated that accurate customer segmentation enables retailers to design personalized promotional campaigns, resulting in improved customer loyalty and enhanced business performance.

5. Title Artificial Intelligence for Personalized Marketing in Smart Retail

Authors: Chih-Lin I, Shuangfeng Han, and Zhikun Xu

Abstract:
The paper examined the integration of artificial intelligence technologies into modern retail marketing strategies. AI-based predictive analytics were utilized to forecast customer preferences and automate personalized coupon generation. The results showed increased customer retention, optimized promotional expenditures, and higher overall revenue for retail organizations.

6. Title Predictive Analytics for Consumer Purchase Behavior

Authors: Foster Provost and Tom Fawcett

Abstract:
This study introduced predictive analytics techniques for forecasting customer purchasing decisions using historical transaction data. Machine learning models identified potential buyers and predicted product preferences with high accuracy. The research concluded that predictive analytics supports effective marketing decisions and enables targeted promotional campaigns that maximize return on investment.

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III. EXISTING SYSTEM

Customer segmentation is a starting point for marketing research. After grouping customers based on the characteristics of homogeneous customers, marketing strategies for each target segment can be done. Customer segmentation should not end in segmentation, but should be accompanied with subsequent marketing strategies. Companies that use customer segmentation techniques perform better by building differentiated and efficient marketing for each segment of customers. In addition, companies can gain a deeper understanding of customer preferences and requirements. Among various customer segmentation techniques, RFM methods are the most classical yet universally utilized methods. The RFM splits the purchasing behavior into three dimensions and scores each dimension. R is the last time since the last purchase, F is the total frequency of purchase, and M is the total purchase amount. The scores are calculated for each of the three dimensions. Subsequently, it constructs segments according to three dimensional classes [15].

IV. PROPOSED SYSTEM

In this study, applying deep learning techniques to real-time click stream data, we find customers with high chance of churning rates and issue a coupon that suits customers' preferences. This study has the following significance: First, we segmented the customer and develop a suitable model for customer churn pre- diction for each segmentation. Second, we made a clickstream-based real-time customer churn risk pre- diction model using deep learning models. Third, we improved the actual conversion rate by issuing customized coupons in real shopping mall website.

Unlike other studies, the scientific contribution of this study was to analyze customers in real time using data collected in real time as well as going through three steps to prevent customer churn. Also, we applied our model to the actual shopping mall, demonstrating the economic effectiveness and efficiency of the three steps of our model.

V. SYSTEM ARCHITECTURE

The proposed Improving Shopping Mall Revenue by Real-Time Customized Digital Coupon Issuance system is designed using a client-server architecture that integrates a Remote User, Service Provider, Web Server, and Web Database. The architecture enables the collection of customer information, processing of shopping data, machine learning model training, and generation of personalized digital coupons in real time. The interaction between these components ensures secure data management, efficient prediction, and improved customer engagement, ultimately contributing to increased shopping mall revenue.

The Remote User represents customers who access the system through a web or mobile application. Users first register and log in to the platform, after which they can view their profiles and receive personalized digital coupons. Based on their shopping history, preferences, browsing behavior, and real-time location within the shopping mall, the system predicts the most suitable promotional offers. This personalized approach enhances customer satisfaction while encouraging repeat purchases and higher spending.

The Service Provider acts as the central administrator responsible for managing the entire system. After logging into the administrator dashboard, the service provider uploads training and testing datasets, initiates machine learning model training, and evaluates model performance. The administrator can visualize training and testing accuracy through bar charts, review prediction results, monitor revenue prediction ratios, download predicted datasets, and manage registered users. This module provides complete

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control over the prediction system and ensures that only validated models are deployed for generating customized coupons.

The Web Server functions as the middleware that connects users, administrators, and the database. It receives requests from both the service provider and remote users, processes all user queries, executes prediction algorithms, and returns the appropriate results. The web server also coordinates communication with the database by storing uploaded datasets, retrieving customer information, and maintaining prediction outputs. This centralized processing ensures efficient handling of multiple user requests while supporting real-time coupon issuance.

The Web Database serves as the permanent storage repository for the application. It stores customer registration details, shopping transaction records, uploaded datasets, trained machine learning models, prediction results, coupon information, and system logs.

Overall, the architecture supports an intelligent retail environment by combining customer behavior analytics, machine learning-based revenue prediction, and personalized digital coupon generation. The seamless interaction among the remote users, service provider, web server, and database enables real-time decision-making, improves promotional effectiveness, increases coupon redemption rates, and ultimately enhances shopping mall revenue and customer loyalty.

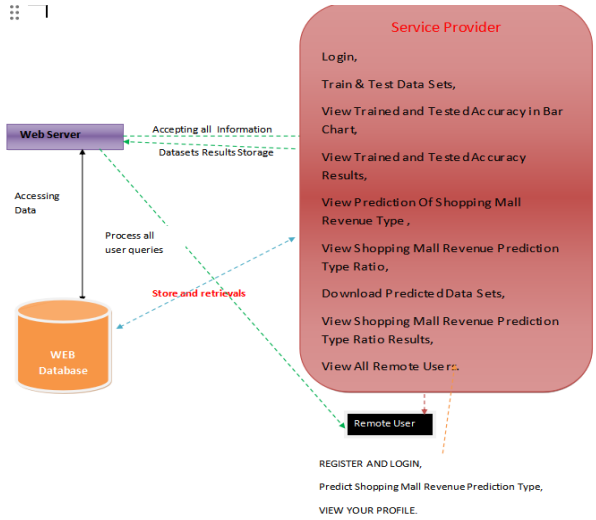


Fig 5.1: System Architecture

VI. IMPLEMENTATION



Fig 6.1: Admin Login Page

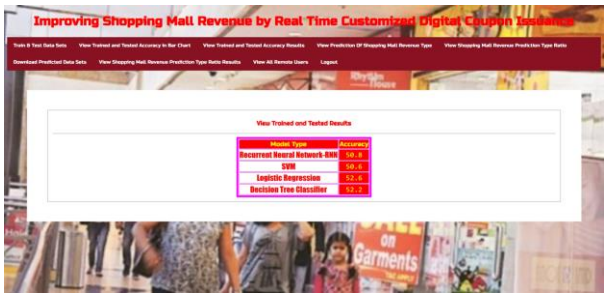


Fig 6.2: Model Training

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Fig 6.3: Bar Graph

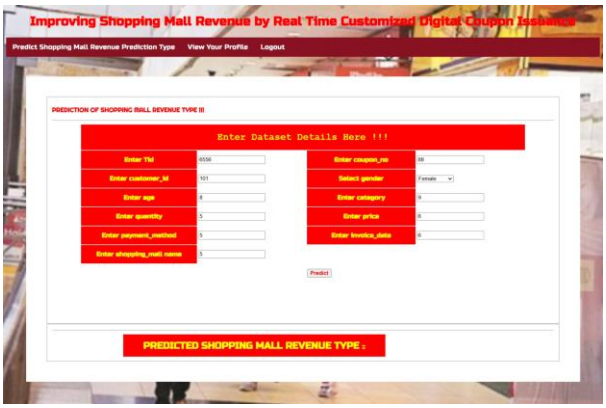


Fig 6.4: Prediction inputs

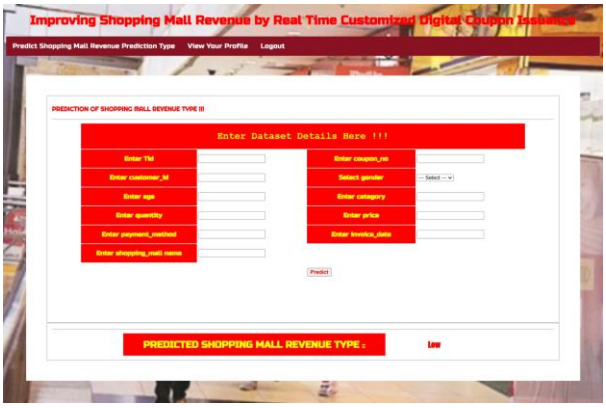


Fig 6.5: Result Page

VII. CONCLUSION

We identified previous e-commerce marketing approaches to derive user behavior prediction. A deep learning method for real time customer churn prediction showed an appropriate result. We applied our research to online shopping mall to raise conversion rate and sales. To check whether our experiment carry out monetary value, we developed a framework to measure the sales amount when used with segment model and personalized recommended digital coupon. We found that our model (scenario1) shows the best results. We found it is suitable for e-commerce online shopping mall to raise conversion rate and sales. Our study empirically showed that marketing, which was a field of management, could be solved more efficiently and quickly by applying big data and deep learning technologys.

VIII. FUTURE SCOPE

The proposed Improving Shopping Mall Revenue by Real-Time Customized Digital Coupon Issuance system has significant potential for future enhancement as retail technologies continue to evolve. Future versions can incorporate advanced Artificial Intelligence (AI) and Deep Learning algorithms to better understand customer preferences, purchasing patterns, and seasonal shopping trends. By analyzing larger volumes of customer data, the system can generate more accurate and personalized coupon recommendations, leading to higher customer engagement and increased revenue.

The system can be integrated with Internet of Things (IoT) devices such as smart shelves, Bluetooth beacons, RFID sensors, and indoor positioning systems to provide location-aware coupon recommendations. Customers can receive customized offers instantly when they enter specific stores or product sections within the shopping mall, creating a highly interactive and personalized shopping experience.

Another promising enhancement is the integration of mobile payment platforms and digital wallets. Coupons can be automatically applied during checkout through UPI, QR-code payments, or NFC-enabled transactions, eliminating the need

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for manual coupon redemption. This seamless payment experience can improve customer convenience while increasing coupon utilization rates.

Future implementations may also include Augmented Reality (AR) and Virtual Reality (VR) technologies to create immersive shopping experiences. Customers could receive virtual product demonstrations, interactive store navigation, and personalized promotional offers while exploring the shopping mall through AR-enabled mobile applications or smart devices.

The system can further benefit from incorporating customer sentiment analysis using social media data, online reviews, and feedback surveys. Natural Language Processing (NLP) techniques can identify customer opinions and preferences, allowing retailers to design more effective promotional campaigns and improve overall customer satisfaction.

Additionally, cloud computing and big data analytics can be employed to support large-scale deployment across multiple shopping malls and retail chains. Cloud-based infrastructure would enable real-time processing of millions of customer interactions while ensuring scalability, reliability, and secure data management. Integration with loyalty programs, CRM systems, and inventory management platforms can further optimize promotional strategies.

Finally, future research can explore reinforcement learning and predictive recommendation systems that continuously learn from customer responses to previously issued coupons. Such self-learning models can dynamically optimize promotional offers based on changing customer behavior, market trends, and inventory levels, enabling shopping malls to maximize revenue, improve customer retention, and maintain a competitive advantage in the rapidly evolving retail industry.

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