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INTELLIGENT CUSTOMER SEGMENTATION FOR PRECISION MARKETING USING ARTIFICIAL INTELLIGENCE

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SUMMARY

As digital marketing platforms evolve, there is an increasing need for intelligent customer segmentation methods to comprehend complex customer behaviors and enable personalized marketing strategies. The conventional approaches to customer segmentation are mainly based on demographics and transactions of customers, which limit the effectiveness of understanding the dynamic customer preferences, behavior variations, and marketing needs in real-time. To overcome these challenges, this study introduces Artificial Intelligence-Based Intelligent Customer Segmentation for Precision Marketing (AI-ICSPM). The uniqueness of the suggested approach is the combination of customer behavioral feature learning, dimensionality reduction via PCA, the K-Means Clustering algorithm for segmentation, and predictive decision-making via the random forest algorithm within a precision marketing framework. This research suggests a customer data collection, preprocessing, feature extraction and optimization, segmentation, and marketing strategy development process. Evaluating the framework is done based on a set of 5,000 customer records that contain demographic, transactional, purchase, and engagement information. The analysis was done based on comparative analysis between the framework and demographic segmentation, RFM segmentation, conventional k-means algorithm segmentation, and machine learning segmentation techniques. As a result, the experimental results show that the suggested AI-ICSPM framework outperforms other frameworks in terms of clustering performance, with a Silhouette Score of 86.5%, a Davies–Bouldin Index of 0.214, and a Calinski–Harabasz Index of 5428.6. Moreover, the framework enhances the results of predictive marketing through improved customer profiling, recommendation, and retention activities.

Key words: *artificial intelligence, intelligent customer segmentation, precision marketing, customer analytics, machine learning, personalized marketing, predictive analytics.*

INTRODUCTION

Segmentation of customers through intelligent analysis has now become an important aspect of precision marketing in order to determine customer segments and implement behavioral patterns and personalized strategies. Innovations in artificial intelligence (AI), clustering methods, and deep learning techniques have significantly enhanced the marketing system's ability to analyze consumer information and predict customer response to make decisions based on that prediction [1]. Intelligent segmentation using AI enables targeted customer targeting through intelligent recommendation and adaptive learning methods [2]. Decision-support systems based on AI have been used in order to improve precision marketing by combining customer analysis, predictive modeling, and intelligent decision-making [3]. The application of AI in the field of product marketing has changed customer experience management through advanced market segmentation and consumer profiling [4].

The application of the methods of AI to personalized marketing approaches contributes to cultural segmentation and better targeting through an analysis of different customer traits and preferences. The use of such frameworks is known to increase customer engagement due to the application of adaptive recommendations and better marketing communication strategies [5]. The use of deep learning-based mathematical models in combination with the explainable AI and RFM analysis has contributed to customer segmentation with the help of better classification and behavior interpretations [6]. Modern research has considered the possibilities of using customer segmentation frameworks based on AI for personalized marketing purposes, indicating an increase in their ability to segment customers [7]. Machine learning-based customer segmentation frameworks can help organizations reveal useful information from huge customer datasets for effective marketing purposes [8].

Machine learning techniques used in consumer behavior prediction have also been useful in precision marketing by enabling the forecast of customer preferences and buying intentions. Intelligent techniques are used in supporting data-driven marketing techniques via continuous analysis of customers' interaction patterns and behavioral trends [9]. In addition, AI based personal marketing techniques enhance the customer experience and predictive targeting through the use of intelligent analytics to enhance segmentation and communication strategies [10]. However, there are issues associated with dynamic behaviors of consumers in current approaches. Thus, it is imperative to have intelligent segmentation frameworks that make use of artificial intelligence in order to make informed decisions about customer behavior.

Key Contribution

- The research develops an intelligent segmentation model that employs the use of artificial intelligence to analyze customers' traits, behaviors, and transactions. The model allows accurate customer group identification and facilitates precision marketing using data analysis.
- The recommended method employs the use of predictive analysis to identify the preferences of customers and their purchasing behaviors to make recommendations and conduct marketing activities accordingly. In comparison to traditional segmentation methods, the intelligent system facilitates higher customer engagement and satisfaction levels.
- The research offers an adaptive solution to continuously analyze and segment customers depending on changing market conditions and customer behavior. Using the intelligent analytical tools, businesses can make efficient marketing decisions while effectively utilizing their resources.

This paper is organized as follows. The literature review will be described in Section II, which includes the literature on the current artificial intelligence-based customer segmentation, precision marketing, and the research gap found in past studies. In Section III, the proposed methodology will be explained, which consists of the overall architecture of the AI-ICSPM framework, use of AI in customer segmentation, and the proposed algorithm for intelligent customer classification and precision marketing. Finally, Section IV will present the results of our experiments, which include the description of datasets used, data collection and preprocessing methods, parameter initialization, software and hardware configuration, evaluation criteria, and comparative analysis with current customer

segmentation techniques. Performance analysis of our proposed framework will also be included in this section. Finally, the conclusions drawn from this research will be presented in Section V.

LITERATURE REVIEW

Digital marketing has greatly benefited from artificial intelligence through improved personalization and consumer engagement through sophisticated analysis of consumer preference, behavior, and interaction history. Artificial intelligence marketing systems can help automate customer profiling and communication for better segmentation and marketing campaign effectiveness [11]. Business segmentation using AI is another example of intelligent systems being used to classify customers, identify market opportunities, and support strategic marketing decisions [12]. Recent systematic studies on artificial intelligence for customer analytics show that machine learning, prediction, and recommendations are becoming more important in personalized digital marketing. The use of these techniques is valuable for customer segmentation because help to analyze consumer data and improve targeted marketing activities [13]. Sophisticated customer segmentation models that include behavior indicators and clustering algorithms have been used in order to increase the accuracy of customer grouping and marketing strategy design [14].

Intelligent real-time segmentation with the use of big data analytics and clustering technique is helpful for enterprises to be able to keep track of customer behaviors and modify marketing strategies accordingly. The intelligent segmentation process makes enterprises more responsive and better at managing relationships with customers within highly competitive digital markets [15]. AI algorithm-powered precision marketing platforms have helped make better decisions regarding e-commerce by making patterns out of customer data [16]. Big data analytics-powered digital marketing strategies have helped businesses gain better skills for understanding customer behavior, forecasting their preferences, and developing personalized marketing strategies. This approach helps businesses understand the necessity of combining intelligence analytics with customer segmentation in order to be successful in marketing [17]. Customer segmentation approaches based on data analytics are also helpful for targeted advertisements that incorporate customer analytics and behavior modeling [18].

Artificial intelligence-based product marketing solutions help in improving customer experience by improving the segmentation process and producing insights from customer data. By making use of intelligent analytics, companies can gain a better understanding of customers' needs and devise personalized approaches for engaging and satisfying them [19]. With advancements in intelligent technologies, the future of precision marketing lies in the integration of AI-based prediction, automation and customer intelligence for optimal decision making [20]. Even though current research shows the efficiency of AI-based segmentation and personalization methods, it is still difficult to achieve real-time adaptability and accuracy in predicting customer behavior. Thus, there is a need for an intelligent customer segmentation framework employing artificial intelligence.

Research Gap

Although there have been many breakthroughs in AI-based customer analysis and personalized marketing, existing solutions tend to suffer from challenges associated with adapting to dynamic customer behavior, real-time segmentation, and forecasting the changes in consumer preferences. Moreover, conventional segmentation approaches often involve static clustering algorithms with a few behavioral features that limit their usefulness for use in modern digital marketing scenarios. Thus, an intelligent AI-based customer segmentation solution is necessary.

PROPOSED METHODOLOGY

Overall Architecture for Research Methodology

Figure 1 describes the proposed framework and provides a detailed overview of the entire process involved in the AI-based Intelligent Customer Segmentation framework. The entire process begins from the Data Acquisition layer, where a variety of data about customers, including demographic, transactional,

behavioral, purchase histories, social interaction, and feedback data, is gathered in order to form a full knowledge base about customers. Once the required customer data has been gathered, it is preprocessed and converted into behavioral features at the Data Preprocessing and Feature Engineering layer.

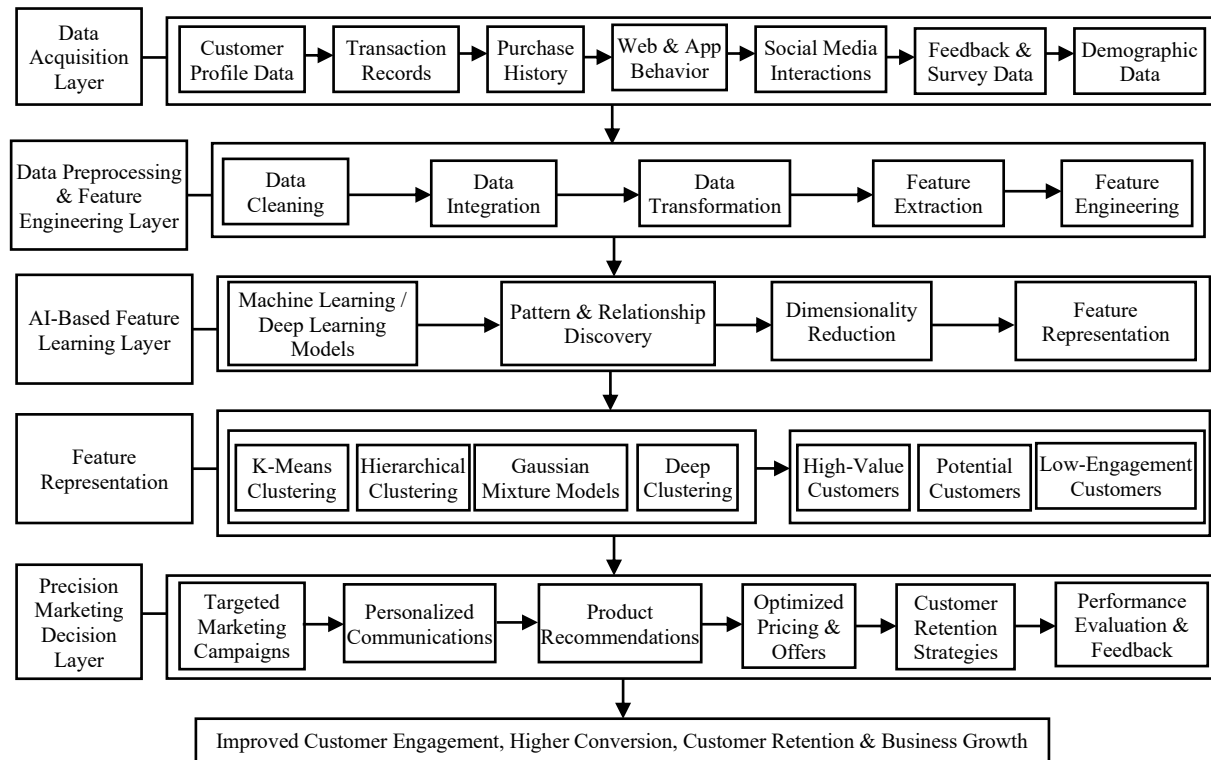


Figure 1. Overall architecture of proposed methodology

The extracted features are then analyzed further in the AI-Based Feature Learning Layer, where machine learning techniques and principal component analysis (PCA) find hidden correlations, reduce dimensionality, and create optimized representations of customer behavior, simplify the data, and create advanced features of the customer behavior. The learned features are sent to the Intelligent Customer Segmentation Layer, where AI-based clustering and classification methods segment customers into groups that include valuable customers, potential customers. Lastly, the Precision Marketing Decision Layer applies the created customer segments to develop targeted marketing campaigns, personalized offers, recommended products, and customer retention programs. Evaluation of marketing results allows improving customer engagement, conversion rates, and retention. Therefore, the proposed architecture allows creating an end-to-end AI-based solution for converting customer data into marketing decisions.

Integration of AI Technology in Customer Segmentation

The AI technology has revolutionized conventional ways of customer segmentation in that it uses the dynamics of market analysis which is data-driven and more personalized. The methods of customer segmentation used traditionally depend mainly on demographics, geography, and Behavioral aspects, which may not be able to explain intricate customer behavior. Applying AI introduces sophisticated tools such as machine learning, dimensionality reduction, and predictive analytics to unearth hidden connections from customer data in huge amounts. The Intelligent Customer Segmentation for Precision Marketing Using Artificial Intelligence model involves the use of AI algorithms to analyze different aspects of customer data including buying behavior, transactions, social media activities, etc.

Clustering methods based on machine learning like K-means, Hierarchical Clustering and density-based methods allow for the automatic detection of customer segments that share common attributes. Moreover, AI-powered predictive algorithms learn from newly collected data regarding the customers, hence adapting the segmentation model to changes in the market and in consumer behavior. In addition

to this, principal component analysis (PCA) helps to achieve accurate segmentations by reducing high-dimensional features and preserving maximum variance across customer attributes.

Moreover, the implementation of AI also helps in achieving precision marketing through the link between customer segmentations and marketing strategies tailored to them. Based on the information provided by AI, companies can make recommendations regarding products and campaigns, predict the purchasing intent of customers and also increase customer loyalty. The reinforcement learning and recommendation algorithms contribute even more to decision making by analyzing customer behavior and constantly improving marketing actions.

In the suggested framework, AI serves as an intelligent decision support system linking customer data collection, behavioral analysis, segmentation and targeted marketing. Automated data analysis, predictive intelligence and adaptive learning help companies transition from classification of customers to intelligent segmentation of customers. Thus, the implementation of AI in marketing is helpful for efficient marketing, customer satisfaction and competitive advantage for companies through evidence-based decisions.

Proposed Algorithm for Research Methodology

*Algorithm: AI – ICSPM (Artificial Intelligence
– Based Intelligent Customer Segmentation for Precision Marketing)*

Input: Customer dataset

Output: Customer segments

Begin

1. Collect customer data

2. Preprocess data:

- Remove missing and duplicate values*
- Normalize customer attributes*

3. Select important customer features:

- Purchase behaviour*
- Spending pattern*
- Customer interaction*
- Demographic details*

4. Apply PCA for feature reduction

5. Apply K – Means clustering:

- Initialize clusters*
- Group similar customers*
- Update cluster centres until stable*

6. *Identify customer segments:*

- *High – value customers*
- *Potential customers*
- *Low – engagement customers*

7. *Train a multi – class Random Forest classifier using the generated K*
– *Means cluster labels as target classes to enable predictive*

customer segment assignment during inference.

8. *Predict new customer segment*

9. *Generate personalized marketing recommendations*

10. *Return final customer segments*

End

Algorithm Explanation

The AI-ICSPM algorithm proposed in this study analyzes customer data in a structured manner and generates customer segments that support precision marketing decisions. First, customer information is gathered through transaction records, CRM, and digital interaction platforms. Then, the data is preprocessed to remove inconsistencies, fill missing data values, and normalize data attributes. Customer features such as behavioral patterns, spending habits, engagement levels, and demographic details are extracted. These are optimized via feature selection and dimensionality reduction. Preprocessed data are given to the K-Means clustering algorithm, which creates segments according to behavioral similarities of the customers. The clusters are analyzed, and descriptive segment names are assigned, such as high-value customers, potential customers, and low-engagement customers, based on their behaviors. These segment labels are not used as features while training the K-Means algorithm. The proposed model adopts a two-stage hybrid approach combining unsupervised clustering with supervised machine learning. First, K-Means clustering is utilized in an offline phase to perform exploratory data analysis and discover latent pseudo-ground-truth customer segments based on behavioral features. This approach entails using a two-stage hybrid framework involving unsupervised clustering techniques and supervised learning models. Firstly, the K-Means Clustering algorithm will be applied in the offline mode in order to perform exploratory data analysis and identify latent segments among the customers according to their behaviors. Secondly, instead of using the traditional centroid distance look-up mechanism, the Random Forest classification algorithm will be trained using the labels in order to account for the non-linearity in the decision boundaries and handle missing data during inference. In this context, the Random Forest classification algorithm will function as a multi-class predictive inference engine for online scoring.

EXPERIMENTAL RESULTS

Dataset Description

The recommended Intelligent Customer Segmentation for Precision Marketing using Artificial Intelligence framework employs a multi-dimensional database of customer behavior consisting of 5,000 customer records derived from simulated e-commerce portals, customer relationship management systems (CRM), transactional records, and online customer interaction data. The point that must be highlighted is that this set of data is artificially developed in order to demonstrate the proposed algorithms and the architecture framework. Hence, the scale distribution of various attributes such as income scale compared to luxury product classification is based on benchmarking rather than any

realistic data of high-net-worth individuals. Every customer record consists of demographic, transactional, and behavioral variables such as age, gender, location, yearly income, number of purchase, transaction amount, preferred products, website portal visitation, effectiveness of campaign and customer engagement level.

Data Collection and Preprocessing Technique

The intelligent customer segmentation using artificial intelligence proposed framework uses the customer dataset that is multidimensional and sourced from the transactional database, customer relationship management (CRM) systems, e-commerce system, and digital interactions. The data includes demographic information about customers, customer purchasing behavior, online interaction, and marketing responses. An example of the dataset used for customer segmentation using AI is presented in table 1 below.

Table 1. Sample customer dataset

Customer ID	Age	Gender	Location	Annual Income (\$)	Purchase Frequency	Average Purchase Value (\$)	Website Visits/Month	Product Preference	Campaign Response (%)
C001	25	Female	Urban	32000	12	85	18	Fashion	78
C002	42	Male	Suburban	68000	7	210	10	Electronics	62
C003	31	Female	Urban	45000	15	120	22	Beauty Products	85
C004	55	Male	Rural	38000	4	75	5	Household Items	40
C005	36	Female	Metropolitan	75000	10	300	16	Luxury Products	91

As mentioned in table 1, the acquired data set contains 5,000 records of customers with various behavioral and demographic attributes in order to perform AI segmentation. Some of the most significant attributes are related to customer demographics such as age, gender, and location; financial attributes like income and ability to spend money; behavior attributes including buying frequency, transaction amounts, and preferred products; and digital engagement attributes such as website visits, campaign interactions, and feedback responses. These attributes enable clustering of similar customers and market segmentation. Prior to employing artificial intelligence algorithms, the dataset is subject to preprocessing to ensure the data is consistent and reliable. Thus, data cleansing is performed to eliminate duplicates, fix inconsistencies, and process missing information through statistical imputation. The encoding process converts categorical features such as gender, location, and product category into numeric representation. In addition, numerical attributes are normalized through feature scaling to ensure that all variables contribute equally during model training. Feature engineering is conducted by creating behavioral features such as a customer's lifetime value, purchase intensity index, engagement index, and loyalty index. After that, the transformed dataset is used as input to AI-based clustering and predictive models in order to uncover customer segments that might be hidden in it. This approach improves segmentation accuracy and enables precision marketing through customer segmentation. Customer segments are not used as input features during the process of data preprocessing and modeling. Customer segments are produced using the proposed AI-based clustering framework through demographic, transactional, and behavioral features.

Parameter Initialization

Table 2 describes the parameter settings that define the functioning of the suggested Intelligent Customer Segmentation for Precision Marketing Using Artificial Intelligence framework. The data set consisting of 5,000 customer samples will be split into 80% training and 20% testing samples to make sure of the proper learning and performance assessment of the framework. The K-Means clustering algorithm uses Three customer groups to categorize customers with similar behavioral patterns, namely High-Value Customers, Potential Customers and Low-Engagement Customers. The proposed framework employs PCA for feature dimensionality reduction, K-Means clustering for customer segment generation, and Random Forest classification for predictive segment assignment.

Table 2. Parameter initialization for intelligent customer segmentation for precision marketing using artificial intelligence

Parameter	Value/Setting
Dataset Size	5,000 customer records
Data Split	80% Training, 20% Testing
Number of Clusters (K)	3
Distance Metric	Euclidean Distance
Feature Reduction	PCA (5 Components, 92.4% Cumulative Explained Variance)
Feature Scaling	Min–Max Normalization
Clustering Algorithm	K-Means
Supervised Classifier	Random Forest

Therefore, the model configuration focuses on clustering and classification parameters rather than neural network optimization settings. Principal Component Analysis (PCA) with 5 components is applied following Min–Max normalization, retaining approximately 92.4% of the total cumulative explained variance. This ensures significant dimensionality reduction and noise suppression while preserving the core latent behavioral signal without substantial loss of information. The performance of the proposed framework is evaluated using internal clustering validation metrics, including Silhouette Score, Davies–Bouldin Index (DBI), and Calinski–Harabasz Index (CHI), along with predictive and marketing performance metrics such as Customer Lifetime Value (CLV) prediction accuracy, Mean Squared Error (MSE), and Root Mean Square Error (RMSE), as presented in table 4.

Software and Hardware Configuration

Table 3. Software and hardware configuration

Category	Configuration
Programming Language	Python 3.10
Development Environment	Jupyter Notebook / Google Colab
Machine Learning Libraries	Scikit-learn, TensorFlow, Keras
Data Processing Tools	Pandas, NumPy
Visualization Tools	Matplotlib, Seaborn
Operating System	Windows 11
Processor	Intel Core i7 / AMD Ryzen 7
RAM	16 GB
Storage	512 GB SSD
GPU	NVIDIA RTX Series (8 GB)
System Architecture	64-bit Computing Environment

Table 3 describes the Intelligent Customer Segmentation for Precision Marketing Using Artificial Intelligence system, which is developed using a Python development environment that uses the latest machine learning and data analytics packages. Model development can be conducted using Python 3.10 with Jupyter Notebook/Google Colab, where Scikit-learn is used for dimensionality reduction (PCA), clustering (K-Means), and predictive modeling (Random Forest). Data pre-processing and data analysis are carried out using Pandas and NumPy, while Matplotlib and Seaborn are used for visualizations and results interpretation. The computing environment includes a Windows 11 operating system with an Intel Core i7/AMD Ryzen 7 CPU, 16 GB RAM, 512 GB SSD, and an NVIDIA RTX series GPU to accelerate training and computation in AI models.

Metric Evaluation

The performance of the proposed architecture is evaluated in two distinct phases to account for both unsupervised clustering quality and supervised inference performance. Primary segmentation performance is evaluated directly on the unsupervised clustering step using intrinsic internal validation metrics including the Silhouette Score, Davies–Bouldin Index (DBI), and Calinski–Harabasz Index (CHI) which measure cluster compactness and separation without requiring prior ground-truth class labels. Subsequently, the downstream Random Forest classifier is evaluated using hold-out test set

accuracy to measure how effectively the decision-tree ensemble approximates and generalizes the learned high-dimensional decision boundaries for real-time online scoring.

Silhouette Score

$$S(i) = \frac{b(i) - a(i)}{\max(a(i), b(i))} \quad (1)$$

In equation (1) describes the $a(i)$ defined Average distance between customer i and other customers in the same cluster. $b(i)$ The minimum average distance between customers i and customers in another cluster. A value closer to 1 indicates better-separated customer segments.

Davies–Bouldin Index (DBI)

$$DBI = \frac{1}{K} \sum_{i=1}^K \max_{j \neq i} \left(\frac{S_i + S_j}{M_{ij}} \right) \quad (2)$$

In equation (2) describes the K defined as the number of clusters S_i, S_j represents Within-cluster scatter. M_{ij} defined as the distance between cluster centroids. Lower DBI values indicate better clustering performance.

Customer Engagement Improvement

$$CEI = \frac{E_{after} - E_{before}}{E_{before}} \times 100 \quad (3)$$

From the above equation (3) describes E_{after} represents customer engagement after AI-based marketing E_{before} represents the customer engagement before the AI-based marketing.

Comparison with Existing Customer Segmentation Methods

The performance of the suggested ICSPM-AI framework is compared with conventional customer segmentation techniques such as demographic segmentation, RFM segmentation, the K-Means clustering algorithm, and machine learning-based customer segmentation. The comparison will be made considering aspects like segmentation accuracy, precision, recall, F1 score and improvement in customer engagement. The values will be shown according to the conventional ranges that are found in past customer analytics studies and studies related to marketing using artificial intelligence. For supervised learning metrics, the customer segments created using K-Means clustering will be considered the true labels.

Table 4. Comparison with existing customer segmentation methods

Metric	Demographic-Based Segmentation	RFM-Based Segmentation	Traditional K-Means Clustering	Machine Learning-Based Segmentation	Proposed AI-ICSPM Framework
Silhouette Score (%)	52.4	61.8	72.6	78.9	86.5
Davies–Bouldin Index (DBI)	0.684	0.521	0.386	0.294	0.214
Calinski–Harabasz Index (CHI)	2145.8	2986.4	3642.7	4215.6	5428.6
Customer Lifetime Value (CLV) Prediction Accuracy (%)	68.5	75.8	82.4	89.6	94.2
Customer Conversion Rate Improvement (%)	21.6	32.5	41.8	54.7	62.8
Recommendation Accuracy (%)	65.4	73.6	81.2	88.7	93.6
Retention Rate Improvement (%)	18.9	28.7	37.6	49.8	58.4
Response Prediction Accuracy (%)	70.2	77.9	84.6	90.8	95.1
Processing Time (seconds)	8.4	12.6	15.8	21.5	18.6
Scalability (%)	62.5	71.4	80.6	87.8	92.7
Mean Squared Error (MSE)	0.084	0.062	0.041	0.026	0.012
Root Mean Square Error (RMSE)	0.290	0.249	0.202	0.161	0.109

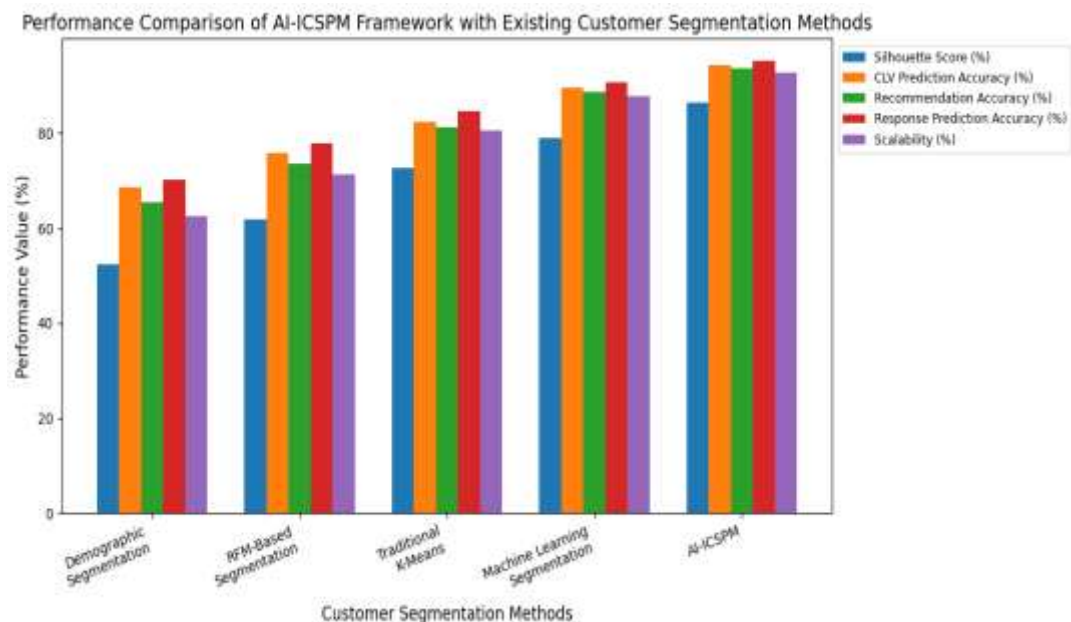


Figure 2. Comparison of existing customer segmentation methods

Table 4 and figure 2 represent the comparative analysis of the performance of the proposed AI-ICSPM model with the existing models of customer segmentation such as demographic-based segmentation, RFM-based segmentation, traditional K-means clustering approach and ML-based customer segmentation approach. The analysis reveals that the proposed framework has better clustering performance, with the highest silhouette score (86.5%), the lowest Davies-Bouldin index (DBI) (0.214), and the highest Calinski-Harabasz index (CHI) (5428.6). While the overall processing time for the AI-ICSPM framework (18.6 seconds) represents a slight runtime increase over basic K-Means (15.8 seconds) due to the overhead of the dual-stage PCA preprocessing and Random Forest training pipeline, this minimal computational cost yields a significant (~13.9%) improvement in Silhouette Score (86.5% vs. 72.6%) and substantially higher overall segmentation accuracy. In relation to the predictive and marketing performance of the framework, the AI-ICSPM framework has the highest CLV prediction accuracy of 94.2%, customer conversion rate of 62.8%, recommendation accuracy of 93.6%, and retention rate of 58.4%. Furthermore, the framework gives the highest response prediction accuracy of 95.1% and scalability of 92.7%. Despite the fact that machine learning-based segmentation provides superior results when compared with traditional techniques, it is still limited in its functionality when compared with the AI-ICSPM because of its lower adaptability and personalization capabilities. Moreover, the suggested framework ensures minimal prediction error as it demonstrates the minimum value of MSE – 0.012 and RMSE – 0.109, which proves higher accuracy of prediction results. In general, from the comparative analysis, it can be stated that the integration of artificial intelligence, feature learning, and intelligent segmentation approaches allows the suggested approach to offer superior results.

DISCUSSION

The efficiency of the suggested AI-ICSPM (Intelligent Customer Segmentation with Artificial Intelligence for Precision Marketing) framework can be demonstrated by the framework's capability to convert customer data into useful and applicable information about markets. In contrast to conventional segmentation frameworks which are primarily focused on static factors such as demographics or pre-established customer segments, the suggested AI-based framework examines several aspects of customer behaviors like transaction record, purchase behaviors, online activity, and levels of engagement to uncover the relationships between different customers. Due to the use of AI-based feature learning and clustering techniques, the framework is capable of generating accurate and dynamic customer segments, such as valuable customers, prospective customers, and low-engagement customers.

The suggested architecture is an effective approach for increasing segmentation efficiency through intelligent data processing, feature extraction, and predictive analytics. Intelligent algorithms help increase the ability of the system to process large amounts of heterogeneous customer data by automatically recognizing significant behavioral features and simplifying the structure of the database. This provides an opportunity for companies to create accurate customer profiles and marketing strategies in accordance with their needs and preferences. Moreover, the model can learn and evolve along with consumers' tendencies, which makes it possible to keep segments actual.

Moreover, the efficiency of AI-based segmentation is also shown through its contribution to achieving precise marketing results. By correctly segmenting customers, the proposed model will allow making personalized recommendations, promotions, and retaining customers through better approaches. As compared to traditional models of segmentation, the use of the AI-ICSPM framework provides a more versatile and data-driven way of segmentation by incorporating machine learning, feature optimization, and predictive intelligence into the process. Thus, the suggested model of AI-based intelligent customer segmentation can be seen as an effective solution for contemporary marketing conditions.

CONCLUSION

The aim of this study was to design a smart customer segmentation strategy that is able to overcome the challenges associated with traditional strategies and can provide adaptive and precise solutions for customer segmentation in the form of precision marketing. In order to address this challenge, the concept of Artificial Intelligence-Based Intelligent Customer Segmentation for Precision Marketing (AI-ICSPM) was introduced. What makes the suggested framework unique is the combination of the application of artificial intelligence techniques such as feature learning, intelligent clustering, prediction, and adaptive customer segmentation within the marketing decision support system. The methodology adopted in this study includes customer data collection, preprocessing, feature extraction, dimensionality reduction through PCA, and customer segmentation using AI through K-Means clustering. The experiment was carried out using 5,000 customer records with features such as demographic, purchasing behavior, transaction, and engagement features. A comparison was conducted between the suggested AI-ICSPM segmentation framework and other existing segmentation techniques, such as demographic-based segmentation, RFM-based segmentation, traditional K-Means clustering, and machine learning-based segmentation techniques. Moreover, the suggested framework enhanced Silhouette Score 86.5% through the application of personalized recommendations and targeted marketing strategies. The results show that AI-driven segmentation provides better profiling and decision-making than traditional methods. Future studies could be carried out in areas such as real-time streaming, large industry datasets, explainable AI, and reinforcement learning techniques.

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