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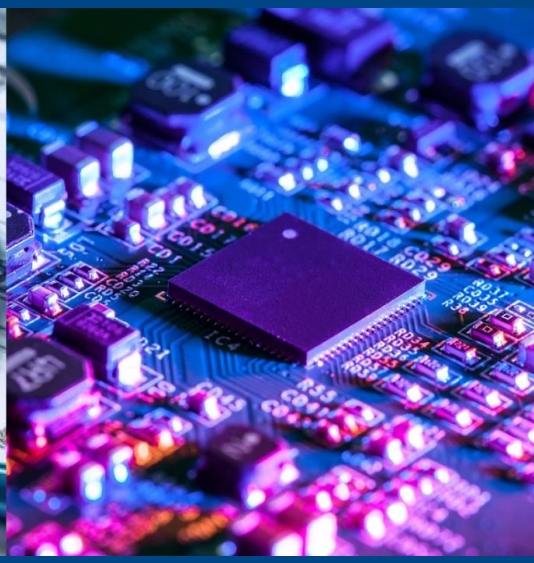

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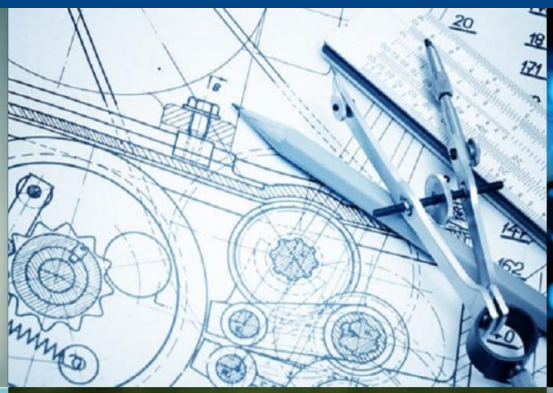

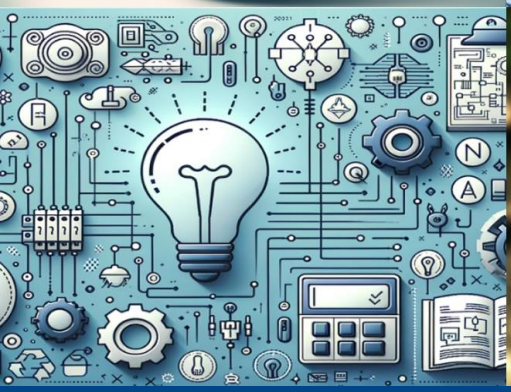

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Customer Relationship Management using Clustering Algorithm (K)

Lisha Bharani B R, Nitheesh Kumar B S

PG Student, St Josheph Engineering College, Vamanjoor, Manglore, India

Assistance Professor, St Josheph Engineering College, Vamanjoor, Manglore, India

ABSTRACT: Customer Relationship Management (CRM) in e-commerce platforms plays a crucial role in cultivating lasting relationships with customers and driving business growth. CRM helps to get customers by knowing their necessities, holding existing customers by fulfilling their necessities and drawing the attention of new customers by providing different marketing strategies. High value customers are performing vital role to measure the effectiveness in CRM. The competition for High value customers is the central point of CRM. Customer classification can help CRM to identify different type of customer for the growth of their organization. We have applied machine learning algorithms to classify the customers in CRM. Basically we have applied k-means clustering for this purpose.

I. INTRODUCTION

In in advance days, commonly income crew used to go out on the street or door to door to speak with clients approximately their products and coming across the crucial facts. They used to preserve handwritten notes, laptops to hold all these facts or they had been seeking to memorize those records. Afterwards income team was using distinct systems to touch with their manager or head of the business enterprise thorough phone, e mail and social media to discuss approximately patron opinions and to observe up their orders. Information may be ignored or misplaced in that tremendous data without a commonplace platform for customer interactions, communications and it ends in an unsatisfactory response to their customers. So there's a hazard to lost the records, conferences are not monitored nicely andmay't priorities the customers. Even though they have been used to acquire statistics effectively, they faced with exclusive forms of problems. It may be difficult to extract intelligence and to locate treasured customers. It is difficult to create the reviews and it wastes treasured selling time. Managers can't provide the right aid at the ideal time to their team. So it could result a plenty of mistakes and shortage of responsibilities. In this situation, CRM is very crucial to gather, manipulate, and use data as a way to decide whether or not you fulfillment or fail. Now a days, many industries like Retail, Telecommunication, Insurance and Banking are using Customer Relationship Management (CRM) to huge their enterprise. A CRM device can offer a great define about clients of a selected employer. We can get to recognise the purchaser's preceding records, the modern reputation of their orders and customer support problems from the identical location. CRM systems can preserve the customer facts from different channels like cellphone, live chat, employer's website, mail, marketing substances and social networks. It also maintains clients' purchase history, shopping for options and private facts. Customer purchasing and interaction records can offer advanced and brief customer service.

II. LITERATURE

RFM (Recency, Frequency, Monetary) model and association rule algorithm have been used to recognize valuable customers. It can also measure the similarity and difference which is depended on three rules, i.e. Emerging Patten Rule, Unexpected Change Rule, and Added/Perished Rule. It helps to find the current and hidden pattern of customers' behavioural changes. So management can identify possible variations of customer preference and delivers their product as earliest. They can expand their business by giving more preference to the customers and can retain them [1]

Customer data warehouse and mining are used to give the complete customers' information, find the valuable customers and identify the customer behavioural changes. Customers' behaviour has analysed to form the customers' profile properly under Internet and e-commerce environment. It helps to make more effective marketing strategy [2].

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Naive Bayesian classification algorithm has been used to predict and classify the customer in Customer Relation Management for optimizing the business process. It helps the organization to identify marketing strategies and customer's pattern [3].

A prediction model has been used to identify the customers who responded more for different offers based on their purchased history. Different classifications have been used to compare the efficiency of those techniques and identify the algorithm which is giving maximum accuracy for the existing data [5].

III. METHODOLOGY

A) Data normalization :

$$X_{norm} = \frac{X - \mu_f}{\sigma_f} \quad \text{------ (1)}$$

It is needed to normalize the range of independent variables or features of data. It is needed to prepare the data. It helps to enhance the clustering performance. All training data are transformed to the range of -2 to +6. Normalization includes min-max, scaling and z-score. Here we have used z-score to normalize the data and then the normalized data is used for the algorithm.

The above equation is used to normalize the data using z-score where Xnorm is the normalized value, x is the original value, μf is the mean value of features, σf is the standard deviation. Initially we have considered three centroids for three clusters. We have used orange color point to indicate the centroids and blue color square to represent customers in normalized form.

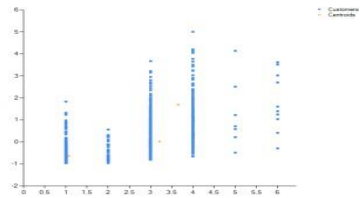

Fig. 1. Normalized data of k-Means algorithm

B) Dynamic Rule Based classification:
Always same data set will not be assigned to the same cluster like cluster1. Sometimes it will be assigned to cluser2 or cluster3. So it is very difficult to find a cluster where high value customer belongs. Because of that we have found high value cluster, mid value cluster and low value cluster dynamically by comparing the centroids of their clusters. Again we have applied dynamic rule based classification to classify each cluster. Actually we have considered these clusters to classify the customer more accurately based on last one year data. We have considered six types of customer. We have classified those three cluster customers into

- High value customer,
- Most Growth customer
- Ordinary customer
- Below Average customer
- Negative Customer
- New customer.

High value customers indicate highest purchased customer for last year. Most growth customers indicate that initially they were not purchasing the goods online but they started purchasing in last 3 months. Ordinary customers indicate that they purchase the goods infrequently and for fewer amounts. Negative customers never purchase any goods after creating their accounts. If any customer created his/her account in last three months then that customer will be considered as New customer without purchasing any item also. We can find the highest product item for last year by analyzing the purchased data history. Based on that company can change their business strategies to sale the other products or to sale the same product in a better way to grow their business. We can find the highest purchasing month and according to that company can give some attracting offers for that particular upcoming month in next year to

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attract more people. We can analyze the behavior of customers by analyzing their data

C) Messaging the Upcoming offers to the Potential Profitable customers:
CRM companies are completely dependent on customers. It is very difficult to go through the complete customer data. Company is giving the priority to the Potential Profitable customers those are most likely to buy their products. Here High value customers and Most Growth customers are considered as Potential Profitable customers. Always CRM companies try to retain the existing customer and get new customers by giving some attracting offers. To do that, they send the upcoming offers through messages to the Potential Profitable customers to increase their business. So customers will be benefitted by getting the offers and they can recommend others also. We have used Twilio to send the messages for Potential Profitable customers.

IV. IMPLEMENTATION

A. Algorithms Used
Clustering Algorithm: We have applied k-Means algorithm after normalizing the data. There are two types of clustering 1)Hierarchical clustering 2) Partition clustering. Hierarchical clustering algorithm forms the groups of similar objects depends on some hierarchies. There are two types of Hierarchical clustering 1)top-down Hierarchical clustering 2)bottom-up Hierarchical clustering. More related objects will be grouped into the same cluster. The top- down approach is also known as divisive clustering and the bottom-up approach is also called as agglomerative clustering. The various partitions can be created by Partition clustering algorithms and then evaluate them based on some criterion. k-means algorithm is a famous Partition clustering algorithm, k-means algorithm groups the complete data into three clusters based on purchased history. We used different colours to represent different clusters where violet indicates High value customer, orange indicates Average customer and red indicates Low value customers in figure 2.

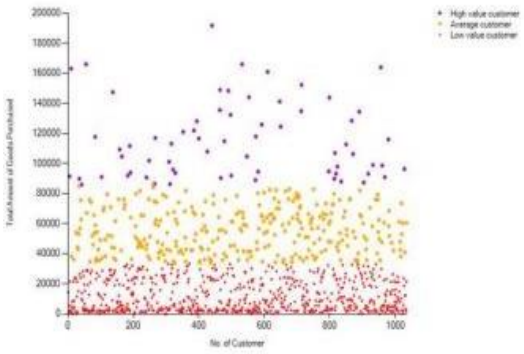

Fig. 2. Three clusters after k-Means algorithm

We can consider the different types of customers separately to analyze them in a better way. Fig. 4 presents High Customer data for last one year. Similarly Fig. 5, Fig 6, Fig. 7, Fig. 8, Fig. 9 represent Most Growth customers, Ordinary customers, Below Average customers, New customers and Negative customers respectively. We can get to know about New customers and Negative customers from Fig. 8 and Fig. 9 like their user id and sign up date. Fig 10 represents the total amount of goods purchased by customers and the no of transactions made by them. So we wil get to know maximum how many transactions happened and according to that, they can plan in a better way to increase the no of transactions . For this, they should know that in which month , the maximum transactions happened.

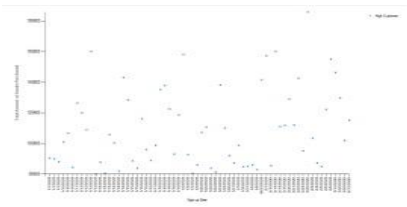

Fig. 4. High value customers

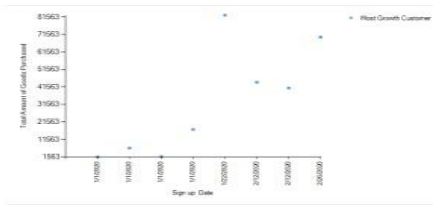

Fig. 5. Most Growth customers

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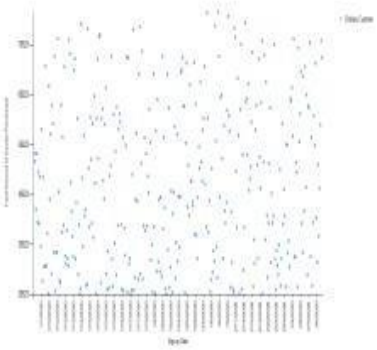

Fig. 6. Ordinary customers

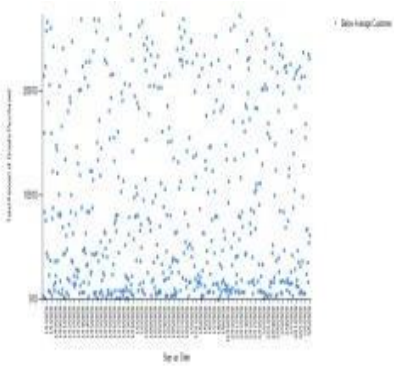

Fig. 7. Below Average customers

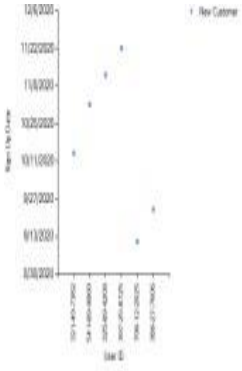

Fig. 8. New customers

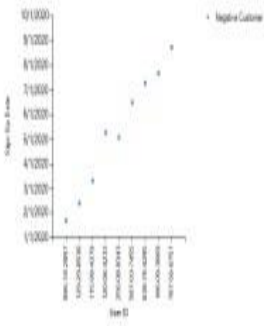

Fig. 9. Negative customers

V. RESULTS

In Customer Relationship Management (CRM),the application of machine learning algorithms, particularly clustering algorithms, has shown substantial benefits in understanding and segmenting customer bases. Due to increasing commercialization, consumer data is increasing exponentially. When dealing with this large magnitude of data, organizations need to make use of more efficient clustering algorithms for customer segmentation. These clustering models need to possess the capability to process this enormous data effectively. Each of the above discussed clustering algorithms come with their own set of merits and demerits. The computational speed of k-Means clustering algorithm is relatively better as compared to the hierarchical clustering algorithms as the latter require the calculation of the full proximity matrix aftereach iteration. K-means clustering gives better performance for a large number of observations.

VI. CONCLUSION

Customer Relationship Management (CRM) within e-commerce platforms has proven to be transformative. These algorithms enable businesses to effectively segment their customer base, uncovering distinct groups with unique behaviors and preferences. We are able to aggregate the customers properly by using thsese algorithms. It will help the company to avail the following benefits: can customize their market strategies which will be suitable for their customers, will be able to take business decision in case of risky situation such as credit relationship with its customers, can identify the valuable products and how to manage the demand and supply, can able to find potential profitable customers and defect customers, will try to find the association between products and customers which the business may not aware og and gathering additional market research questions to provide guidelines of finding solutions. Customers also will be benefitted in their future online marketing by receiving the messages from them.

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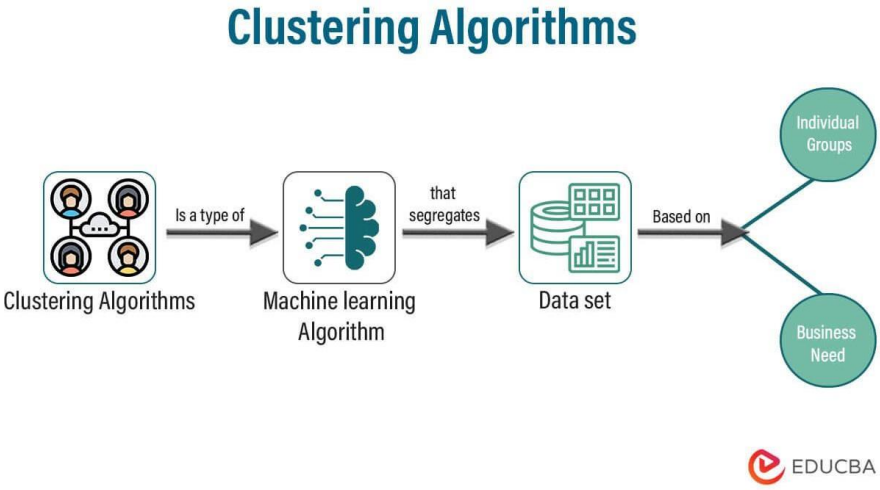

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