Research on Customer Relationship Management Based on Data Mining

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Abstract

This paper studies the application of customer relationship management based on data mining. Through the use of data mining technology to mine all aspects of customer relationship management, scientifically and orderly manage customer relationships, help companies reduce and avoid risks, and improve company profits. This article takes the mall customer relationship management system as an example, uses the SPRINT classification algorithm to classify customers, improves the accuracy of customer classification, and makes the mall's related decisions more credible. The best customer retention strategy algorithm is used in customer retention to help the shopping center make decisions, so as better to retain customers and maximize the profit of the shopping center.

Keywords: Data Mining, Customer Relationship Management, Shopping Malls

1. Introduction

With the development of science and technology and the continuous progress of society, people have higher and higher requirements for quality of life. As consumers, people not only pay attention to the quality of products provided by enterprises, but also pay more attention to the quality of services that enterprises can provide. In other words, people pay more attention to the shopping experience when shopping. Relatively speaking, the competition between modern enterprises is becoming increasingly fierce. Enterprises no longer only focus on products, but on customers. Customers are the foundation of an enterprise. Enterprises should carefully study the needs of each customer and pay more attention to how to better provide quality services to customers. Customer relationship management came into being. The customer relationship management system is to find out the part of the information that is valuable to the enterprise

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from a lot of customer information. It is to provide customers with the most satisfactory service in the right way at the right time[1]. Customer relationship management systems can help companies understand and listen to customers' voices. Find new customers, retain old customers and reduce customer churn.

Customer relationship management (CRM) is a concept and a system. The customer relationship management system is to find out the potential relationship from a lot of customer information, and then to better manage the customer and truly achieve customer relationship management, can not do without data mining technology. Data mining is based on scientific algorithms and modeling analysis, and draws scientifically-based conclusions. Through data mining technology, rational induction can be made. So as to provide enterprises with data that can be referenced, and then help enterprise managers to make decisions. Help enterprises to reduce costs and avoid risks, and improve the benefits of enterprises, so that the development of enterprises is getting better and better. In the early days, companies began to use databases to store customer information, and computers to analyze customer information. For each enterprise, more and more data warehouses have been established, with more and more information. Our data mining technology uses this information. Data mining technology is indispensable for truly scientific customer relationship management. The data mining technology that has emerged in recent years can provide technical support for customer relationship management. Enterprises should be customer-centric and at the same time better serve the customer's philosophy to maintain customer relations. The use of data mining technology can better achieve the maintenance of customer relationships and give full play to the role of customer management systems.

With China's accession to the WTO, competition among enterprises has become fiercer. Many small and medium-sized enterprises in our country are facing challenges, and every enterprise is trying to manage enterprises with advanced concepts[2]. According to statistical data, in 2008, the scale of the SME customer relationship management market was very large, as high as 800 million US dollars. In the next five years, it rapidly increased to US \$ 1.8 billion. It accounts for more than 30% of the entire customer relationship management market. But customer relationship management based on data mining needs further research and discussion. CRM research in China is still in its infancy. The domestic customer relationship management system leads a brand, integrates domestic and foreign mainstream sales management ideas, and develops a free version with low prices and strong functions, providing no functional restrictions. This system can increase the company's sales performance by more than half, and it can also increase the number of customers. China's customer relationship management will

certainly catch up with or surpass foreign customer relationship management research.

Customer relationship management systems based on data mining technology are used in many industries, such as banks, large-scale retail industries, and e-commerce companies. Through data mining technology and application in customer relationship management systems, credit assessment, customer retention, price setting, financial analysis, and marketing planning can be conducted in these industries, thereby reducing costs and increasing profits for enterprises. The customer relationship management system based on data mining technology can not only bring more economic benefits to an enterprise, but also improve the management and decision-making level of Chinese enterprises[3].

2. Customer Relationship Management (CRM) Analysis

The concept of customer relationship management was born in the United States. Customer relationship management in English is Customer Relationship Management, so customer relationship management is also referred to as CRM. The customer relationship management system is an idea and a software system. In terms of thinking, the main purpose is to meet the needs of each customer. Establish contact with each customer and provide personalized service. The software system is to take the customer as the foundation and establish a system for collecting, collating, analyzing and processing customer information for the customer. So as to help enterprises realize the integration of sales, marketing and services[4].

The core of customer relationship management (CRM) is “customer-centric”, business operations should be carried out around customers, because customers are the foundation of the enterprise. Customer relationship management is not only a management idea, but also a management system. The most important thing for customer relationship management is to have corresponding customer relationship management software, so as to change from theory to practice. Customer relationship management system, including customer service, customer relationship analysis, sales automation, customer data mining, etc. Customer relationship management has effectively helped companies solve the corresponding problems to cope with the fierce competitive environment. Many companies have also begun to enter this field, and have made many achievements. In order to win in the fierce market competition, enterprises pay more and more attention to customers’ feelings. Therefore, customer relationship management becomes more and more important, because it can provide a strong support for the development of enterprises[5]. The decision-making of an enterprise has changed from traditional product-centric to service-centric. Customer relationship management becomes very

important and can provide decision support to enterprises. Customer relationship management has also injected new vitality and goals into traditional enterprises. Taking marketing as an example, from the early marketing based on extensive market analysis to today's one-to-one marketing, there has been a great progress. Through one-to-one marketing, you can give customers a better experience. Enterprises' services to customers will also become more and more professional. The development of customer relationship management is becoming more and more perfect, and it has also injected new vitality into the field of customer data analysis.

Some studies have pointed out that a repurchase of an old customer will bring more than double the profit of the enterprise than a new customer. If the number of old customers increases by one-tenth, then the profit of the enterprise will increase by 50%. Therefore, cultivating loyal customers can bring higher profits and lower costs to enterprises, and give enterprises a competitive advantage in sustainable profitability. According to statistics, the internationally successful customer relationship management system can bring 6% annual turnover growth for enterprises. At the same time, it will increase basic service fees for enterprises by about 10%. There are not many excellent companies that do maintenance of old customers. Here we have to mention Haidilao. Haidilao will treat different customers in different ways and truly satisfy every customer. For example, when you go to eat hot pot, you line up outside and it is very hot. At this time, the customer will bring you a drink. If the girl has long shawl hair, the hair will often fall off when eating hot pot. At this time, the customer will provide you with a rubber band very sweetly, and it must be pink. For example, when you eat hot pot, you especially like fish tofu. If the clerk finds this, he will definitely bring you a fish tofu when you finish your meal. If you come to eat hot pot on your birthday, the staff will definitely send you a special dessert or a small surprise to express their blessings to you. So how does this one-to-one service work? This is also the reason why Haidilao is difficult to replicate. Every clerk in this company is seriously discovering and straddling this personalized service. They will accurately segment each customer. For each customer, a unique service is given, so that the customer feels very caring. Haidilao has done one-to-one marketing to the extreme. Therefore, enterprises are becoming more and more humanized, and enterprise managers are paying more and more attention to the human factor and sticking to the principle of putting people first. Successful companies must have a loyal customer base. This means that customers will continue to choose the services of the company's products, which is the key to a company's success.

We need to analyze customers from two aspects: customer value cycle and customer group classification. First of all, we need to do our best to get more customers, and we have to find

customers selectively. Choose as many customers as possible that are of high value to the enterprise, as this can save costs for the enterprise. Secondly, we need to enter the customer retention phase. We want to retain every new customer as much as possible. By understanding all the information of customers, customers can enjoy better service. Finally, we need to retain customers and provide one-to-one targeted service to customers who want to leave, so as to retain old customers[6]. Through customer group classification, we can stabilize valuable customers, convert low-value customers, and then eliminate valueless customers.

There are three main architectural models of customer relationship management systems, namely centralized, C / S mode and B / S mode.

3. Data Mining Technology Analysis

Data mining is an interdisciplinary subject that combines many aspects of theory. For example, databases, artificial intelligence, machine learning and statistics and other disciplines. The meaning of data mining is to find out the internal relationship between these data. Then predict and guide future trends to help people make better decisions. Data mining technology itself is the core of knowledge discovery. Data mining needs to sort out hidden valuable knowledge from a large amount of data. When applied to the enterprise, it is to analyze the data of the enterprise, discover hidden business laws, and then further model it. Then the application in the customer relationship management system is to mine out a part of information that is valuable to the enterprise from a lot of customer information and a large amount of data. So that companies can better understand customers, and also provide information technology support for future decisions[7].

The main application of data mining technology is the application in customer relationship management system. Through data mining technology, customer relationship management system from the original simple query statistics and other functions, can now find some potential associations through the computer, which can provide decision support for enterprises. Through customer relationship management based on data mining, we analyze customer relationships, analyze customer data through data mining technology, and discover potential customer relationships[8]. So that the enterprise can provide the target customer with more accurate services that satisfy the customer, and at the same time, the enterprise can make the most appropriate decision. Thereby increasing the profits of the enterprise, and reducing the operating costs of the enterprise, thereby improving the market competitiveness of the enterprise.

Data mining technology contains many different types of mining algorithms, including classification algorithms, clustering algorithms, association rules algorithms and so on. In practical applications, the selection and use of specific algorithms are mainly determined by the target of the object in order to achieve predetermined data analysis and mining results.

Data analysis has been applied in many enterprises, and has achieved very good results. For example, the most classic case of data mining, the sales of diapers and beer in supermarkets are surprisingly consistent. This is unreasonable based on subjective speculation, because there is no direct relationship between the two. However, through data mining technology, we discovered a certain relationship between these two things. After investigation and analysis, it turned out that the wife told her husband to buy diapers for the child, but after the husband finished buying, he usually went to buy his favorite beer. And this is also true, because the mother of the child usually tells the father to buy diapers, and at this time they will buy themselves a few bottles of beer to reward themselves after buying. Through data mining technology, we can discover the unexpected association rules in this sense.

Data mining can be used systematically to mine social rules and make predictions. Discovering more social hidden association rules is also the development direction of future data mining. Perhaps in the future, predicting the future development rules of society is not just a dream, and statistics will also be upgraded to big data mining.

4. Design of Shopping Mall CRM based on Data Mining Technology

Over the years, with the rise of e-commerce, the physical industry has become increasingly sluggish. This urgently needs to change the thinking of traditional enterprises. Enterprises need to maintain more customers to create profits for the mall. As a business, shopping malls are actually more concerned about the return of data mining technology. The emergence of customer relationship management can be combined with data mining technology to help enterprises maintain customers. So as to solve the interaction problem between shopping malls and customers. Customer relationship management based on data mining is not just a software, but more like a one-to-one service to customers. So as to provide enterprises with all aspects of customer relationship management solutions. Can help companies better attract customers, and always retain valuable customers. And can help companies quickly identify potential customers and manage customers. It can also scientifically predict the development prospects of customers, thereby maintaining the relationship with customers. Then realize the profit of the enterprise.

The mall customer relationship management system consists of the following three subsystems. Including business operating system, customer cooperation system, data analysis system. Among them, customer operation subsystem and data analysis subsystem are the most important subsystems, including enterprise customer information management and information analysis processing. The design of shopping mall CRM module based on data mining technology is shown in [Fig. 1].

[Fig. 1] Structure of Enterprise Customer Relationship Management System

The business subsystem mainly uses computer technology to manage all aspects of marketing, sales and service. Customer cooperation subsystem Customer information entry, customer information processing, coding management, customer management, supplier management, department management, employee management, product management, partner management. Mainly management of the interaction between the enterprise and the customer. The data analysis subsystem is the most important subsystem in the entire system. If you process and analyze various data, use data mining technology to realize customer relationship management, and then get meaningful information from it.

Today's shopping malls also pay more attention to customers' shopping experience, so they are completely customer-centric in functional design. In the mall CRM system, the customer operation subsystem and the data analysis subsystem are the most important subsystems, including enterprise customer information management and information analysis processing[9]. The functional design analysis of shopping mall CRM based on data mining is mainly divided into 7 parts. The first is the acquisition of new customers. The competition for customer sources is a very important aspect. If you want to acquire new customers, you will generally use regression algorithms and decision tree algorithms in data mining. Predict and analyze consumer behavior to generate prediction and scoring models. The second is customer segmentation. Customer segmentation includes classification based on the customer's natural

attributes, social attributes, some consumer behaviors and shopping habits. According to the customer's buying habits to provide different personalized services for each customer. This is the basis of what we usually call one-to-one marketing, and also the basis for companies to make decisions about products and services. And such detailed classification can be achieved by the methods of sorting, decision tree and clustering in data mining. The third is cross-selling. Enterprises often increase customer orders through cross-selling. Cross-selling is usually implemented using data mining techniques such as association analysis and sequence analysis. The fourth is personalized marketing services. Precision marketing requires precise marketing based on customer group characteristics, shopping habits, customer value, and customer loyalty. Through the application of data mining, you can analyze the purchase types of customers, and then classify the purchase methods and selected products of different types of customers. And formulate one-to-one marketing services according to the classification results, thereby improving customer satisfaction. The fifth is customer retention and customer churn analysis. For shopping malls, the cost of maintaining old customers or acquiring new customers is low, so we need to protect key customers. At the same time, we should pay attention to the reasons for the loss of customers, monitor and analyze customers, and give customers special care to retain customers. In this process of data mining, we will use rough sets, neural network algorithms and so on. The sixth is customer profitability analysis and prediction. Every industry has its twenty-eighth rule. For example, of all the wealth in the whole society, only 20% of people have 80% of the world's wealth. Then among the customers of an enterprise, usually only 20% of the customers will make 80% of the profits for the enterprise. Find out the customer life cycle model through classification and prediction, so as to predict the profit that customers can bring to the enterprise within a certain period of time. Through data mining technology, analyze the traffic situation of the mall, customers' buying behavior, customers' habits, etc., and discover some regularities to make predictions. Then scientifically formulate corresponding strategies to adapt to the changing customer's actual situation. Keep pace with the market, don't lag behind the market. At the same time, correct assessment can also save a lot of manpower, material resources, and financial resources for the mall, so as to optimize the allocation of resources. The seventh is customer satisfaction analysis. We can find customer purchases, repairs, suggestions, and complaints from the enterprise's data warehouse. We then use data mining technology, and some custom standards and formulas, so that customer satisfaction can be analyzed. Enterprises can easily know why customers are not satisfied, and then companies can make corresponding decisions. So as to make customers more satisfied and increase the profits of the enterprise.

Combine data mining and customer relationship management, and at the same time build a closed system. Enterprises can better coordinate customer relationships, and the efficiency of problem solving will also be improved a lot[10]. The main tasks of data mining are cluster analysis, classification analysis, association analysis, time series analysis, etc. Correlation analysis refers to analyzing things that may happen simultaneously. Mainly to find out the hidden relationship in the data. CRM based on data mining is not just a software, but more like a one-to-one service to customers. So as to provide enterprises with all aspects of customer relationship management solutions. CRM can help companies better attract customers, and always retain valuable customers. And can help companies quickly identify potential customers and manage customers. It can also scientifically predict the development prospects of customers, thereby maintaining the relationship with customers. Then realize the profit of the enterprise.

5. Implementation of Mall CRM based on Data Mining Technology

5.1 Overall Framework of Customer Relationship System

The mall CRM system based on data mining adopts modular design, and modularity is the main feature of the entire system. Considering the needs of modular development and maintenance, the system adopts J2EE architecture and adopts a browser-based B / S system architecture mode. Based on the data mining mall CRM system, the development tool is JBuilderX, the back-end database is Oracle9i, and the application server is specifically implemented using WebLogic8.1. x. The overall architecture pattern is shown in [Fig. 2].

[Fig. 2] Shopping Centre CRM Overall Structure Chart

The mall CRM system based on data mining uses EJB container for data mining. EJB is DataminingEJB, which is a stateful session bean. It mainly includes the following six aspects, namely data selection, customer classification, cross-selling, customer acquisition, customer retention and result output. The design schemes are as follows.

5.1.1 Data Selection DataInput

In the entire database, make a reasonable judgment on the data submitted by the client to find out more complete and consistent data.

5.1.2 Customer Classification Customer Segmentation

According to the different attributes of each customer, customers are divided into different categories according to different classification criteria.

5.1.3 Cross-selling Cross Buying

Through the purchase behavior of customers within a certain period of time, to analyze the impact of a product on other products, whether it is suitable for bundling sales.

5.1.4 Customers Get Customer Obtainer

By analyzing the customer's response to market activities, find some attributes of potential customers.

5.1.5 Customer Retention Customer Retention

Establish a customer classification model with a churn rate, analyze the churn of a customer, and determine how to keep the customer based on its attribute characteristics.

5.1.6 Result Output Result Output

Pass the results of data mining back to the client. Including customer information data and marketing promotions data and customer transaction data.

5.2 Application Process of Customer Relationship Management under Data Mining

To apply data mining technology in customer relationship management, we must first determine the business goals that the company hopes to achieve. According to these, data collection and preprocessing are carried out. Then form a preliminary data cognition and understand the distribution of data, and then you can build a data prediction model. Only in

this way can the data mining technology play a corresponding role in the customer relationship management system, and can it help enterprises solve the practical problems existing in enterprises[11].

The business-focused data mining process starts with data, and secondly defines data based on understanding, then applies data mining to form a knowledge representation, and then applies it to the enterprise. Research results in business-focused data mining should be practical, and it is best to express the results of knowledge discovery in simple language, which is easier for users to understand. Only in this way can the hidden information behind big data be discovered to make predictions. Then solve the problems to be solved in the enterprise, and then help the enterprise achieve the expected goals.

Data mining mainly through modeling, select a reasonable model, you can draw the correct conclusion. The data mining process is divided into the following steps. First, select the data, then data preprocessing, then data mining, then pattern evaluation, and finally knowledge representation. The data pre-processing includes data cleaning, data integration, data selection and data conversion[12].

The mode evaluation of data mining is not to verify the correctness of a certain mode, but to find the model in the database and analyze it automatically. It is essentially an inductive process. The purpose of data analysis in customer relationship management is to discover hidden information in the data[13-15]. With the changing business needs of enterprises, the continuous updating of customer data, and the optimization of technology development systems, it is necessary to constantly adjust the established data model and to repeatedly carry out data mining to adapt to the requirements of enterprises[16][17]. In summary, the pattern evaluation process of data mining is shown in [Fig. 3].

[Fig. 3] Data Mining Model Evaluation

Finally, the results obtained by data mining are fed back to the user, and presented in a more intuitive and easy-to-understand way[18][19]. Or as new data stored in the database to prepare for future data mining. Therefore, the flow of the entire data mining process is shown in [Fig. 4].

[Fig. 4] Data Mining Process

5.3 Algorithm Design in Customer Relationship Management

The decision tree algorithm is used for customer classification in customer relationship management. To classify customers, we must choose a target variable. Through the theory of marketing, customer purchasing power is very important, and it has a great influence on the mall's marketing strategy[20]. Therefore, the target variable is the customer purchasing power. The purchasing power of customers is divided into three types: high purchasing power, general purchasing power and low purchasing power. We define customers according to attributes such as age, gender, occupation, family status, etc., so as to correspond to customer purchasing power. Then make a customer information table arranged in order according to customer information, as shown in [Table 1].

Establish different attribute lists according to each field in the customer information table, and pre-sort. For example, in the age attribute list, it is sorted by age from oldest to youngest. Then find the best split point of each node in the decision tree. Through calculation, 27 is the best split point of the age attribute, divide the age attribute list into two parts, and then use

the MDL algorithm to trim the decision tree, thereby generating a relatively accurate decision tree, as shown in [Fig. 5].

[Table 1] Customer Information Form

Customer ID	Age	Gender	Income	Family Status	Occupational Category	Purchasing Power
ID9004510	18	Male	25000	general	1	Low
ID9004511	22	Female	10500	difference	3	Low
ID9004512	27	Male	88000	good	1	High
ID9004513	16	Male	25000	difference	3	Low
ID9004514	27	Female	50000	general	2	High

[Fig. 5] Customer Classification Decision Tree

In the management of shopping malls, an important indicator is the ability to acquire new customers. Establish a customer classification model through data mining to identify potential customer groups. Customer response behavior is used as the target variable, and data in marketing activities as input variables. Based on the customer's promotional activities and the customer's behavioral classification model, we can analyze the people who are interested in the promotional activities of these products, and carry out targeted promotional activities according to the attributes of these people[21]. To classify customers through data mining, we must first establish a classification model based on customer response behavior. Because it is to find new customers, so it is also different in the data processing although the customers are also classified. To select data in a targeted manner, as shown in [Table 2].

[Table 2] Customer Reflection Behavior Table

No.	Age	Gender	Occupation	Product	Understanding	Reaction Behavior
100001	19	Female	Staff	Community A	brought before	1
100002	24	Female	student	Community A	heard about it	3
100005	17	Male	student	Community B	do not know	1
100007	34	Female	Doctors	Community B	heard about it	2
100009	27	Female	engineer	Community C	heard about it	2
100021	31	Male	teacher	Community C	do not know	1
100026	44	Female	accounting	Community B	heard about it	4
100031	26	Male	programmer	Community C	do not know	5

In the mall, the profits of a small number of customers are neutralized by the losses of a small number of customers. So, definitely

To maintain those truly valuable customers. So it must be achieved through data mining technology. The best customer retention strategy is to build a simple customer classification decision tree with a churn rate. According to the attributes of different customers such as service type and gender and credibility. Each leaf node represents a customer category of different value. For example, the first leaf node represents a female customer, and the churn rate is 0.1. The second leaf node represents a male client and the churn rate is 0.8. The third leaf node represents general customers, and the churn rate is 0.2. The fourth leaf node represents loyal customers, and the customer churn rate is 0.5.

The algorithm of the best customer retention strategy can calculate the node that can bring the highest net profit to the mall. Finding the best node is the best strategy for the customer to maintain[22].

5.4 Comparison between Mall CRM based on Data Mining Technology and Traditional Enterprise Management

Traditional enterprise management can realize data entry, query, and statistics through the database, but the relationships that exist in the data cannot be discovered. Therefore, we cannot predict the future development. Now, with the advent of the information age, there is more data. Many very important hidden information in huge data. People hope to carry out advanced analysis and processing on these data information. Data mining technology itself is the core of knowledge discovery. Data mining technology will be in the era of big data. The customer relationship management system based on data mining technology is currently a relatively advanced customer management system. It has more advantages than traditional

enterprise management.

The customer management system based on data mining makes the enterprise and each customer a learning relationship. Every time an enterprise interacts with a customer, it can enable the enterprise to learn more about the customer. At the same time, the customer management system is a centralized management of all data. When designing a system, all data have internal connections and laws. In this way, a high degree of data sharing can be achieved, and the system integration is also very high, so there is also good continuity between each module.

The customer management system based on data mining also integrates the interactive channels between enterprises and customers. Such as phone calls, face-to-face conversations, faxes, emails, web page visits, etc. All these data are centralized in the background database of the customer management system. Every customer has a complete and consistent data. With such a database, enterprises can better perform data mining and information processing.

As the needs of users are becoming more and more diverse, they are becoming more and more varied. No matter which system can meet all customer needs. The customer management system based on data mining has a standard external interface, which is very easy to expand. In the later stage, it can be perfected according to the needs of customers to ensure that they can obtain as much data as possible and provide customers with better quality services.

6. Conclusion

This article combines data mining technology with shopping mall CRM to analyze customers and provide data processing methods. Taking mall customer relationship management system as an example, customer classification, cross-selling, customer acquisition and customer retention are realized in the data mining module. The SPRINT classification algorithm is used in customer classification, which improves the accuracy of customer classification, so that the relevant decisions of the mall can be made more credible. The algorithm of the best customer retention strategy is adopted in customer retention to help the mall make decisions, so as better to retain customers and maximize the profit of the mall.

Through the application of data mining technology in the customer relationship management system of the mall, the mall can track and analyze the customers and gain a deeper understanding of the customers. In this way, the mall can make corresponding decisions, which can provide customers with one-to-one personalized services. With high-quality service, it can attract more new customers and maintain old customers. In order to reduce costs and increase

profits for the mall, the operation of the mall is getting better and better.

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