RESEARCH AND IMPLEMENTATION OF CAMPUS CARD DATA ANALYSIS SYSTEM

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Abstract: The campus smart card system is one important basic part of campus information constructions. It is one of projects which most represent campus information construction effects and can promote school's management and service level. The campus smart card system is integrated by two major categories of subsystems, they are consumption and authentication. These systems accumulated a flood of card records during the past years. This article describes the research work about campus card system data mining carried by Beijing Jiaotong University. The researchers developed a data analysis system, which they called student behavior analysis system. The article lay emphasis on the design of the System framework，and technical methods of implementation. At last, application cases are given.

1 PREFACE

The campus smart card system is one important basic part of campus information constructions. It is one of projects which most represent campus information construction effects and can promote school's management and service level. Campus smart card system is an integrated information system, use smart cards as a carrier, set two major categories of consumption and identification functions in it.

At present, many colleges and universities have campus card system construction or in progress, the main business subsystem, including food consumption, library, medical treatment, computer room management, meeting attendance, electronic package of counter, building access control, vehicle management, etc.

So many applications accumulated a flood of data. Case Study of Beijing Jiaotong University, campus card system put into use for six years, credit card records of the system are up to 500 million. If we can convert data into information for school leadership and administrative departments to support decision-making, we will greatly promote the level of school's information management. Depend upon the former study on data mining, the project team has developed a campus card data analysis system, and achieved a very good practical effects.

2 ARCHITECTURE OF THE DATA ANALYSIS SYSTEM

The architecture of data analysis system is divided into data analysis & processing module and data statistics & querying module.

2.1 Network Structure

Our campus smart card system uses a private dedicated network, which is isolated to campus public network by a physical firewall. As shown in Figure 1, data analysis and processing module work on a server located in smart card private network. Data statistics and querying module work on another server located in campus public network. After data processing, data will be transferred from the backup

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database B to the database C, which is running on server C located in the campus public network. At last, completion of data published online in the campus network.

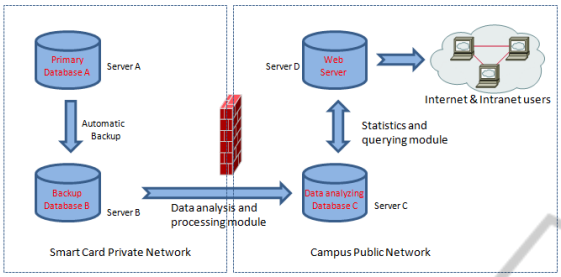


Figure 1: Architecture of the data analysis system.

2.2 Data Analysis & Processing Module

Our campus card system have two database, primary database A and backup database B, they are both Oracle9i database running on two SUN V880 Server. At 4 o'clock every morning, data file will be thoroughly copied from primary database A to the backup server B. Data analysis database C is also an Oracle9i database, but it is running on Linux platform. Data analysis and processing module runs regularly every day on the server C as a service to capture data from backup server B to database C. But the capture from B to C is different from the simple copy from A to B, because the process of data analysis needs induction, split and merge.

2.3 Data Statistics & Querying Module

Statistics and querying module uses B/S three-tier architecture. The bottom layer is an Oracle9i database, where processed campus card data is stored in it. The middle layer is a web server, running IIS and .Net framework 2.0. The top layer is the user's browser come from the clients located in the campus public network. Our system does not design user management, but use of the school uniform integrated management information system to complete the portal and access control.

3 IMPLEMENTATION OF DATA ANALYSIS SYSTEM

3.1 Difficulties in Implementation the System

The campus card system has up to 500 million data records. In such a large database, in order to analyzing, querying, statistics and calculating, efficiency is the primary consideration, and is very difficult to achieve. So we use a variety of measures to optimize the execute speed.

3.1.1 Optimizing Data Sources

In order not to affect the normal operation of the campus card system, we do not run data collecting, analyzing and processing program on the primary server A, but from the campus card backup server B, instead. Card runtime data will be backed up to the backup server on every morning at 4 am. Then data processing system begin to run at 8 am to capture data from the backup database, data are also analyzed and summarized at the same time. The average collected records daily are 130,000, spend about 2 hours. Therefore, the data analysis system own all data created before 4 am this morning, though it is not real time system, yet for the statistics and query purpose, the lag day is perfectly acceptable.

3.1.2 Optimizing the Database

In order to improve access efficiency, we created the index on the database, and appropriate citations to some of the redundant data and reduce the associated table to optimize access efficiency. At the same time, we created a number of tables, in which results are saved while statistic procedures execute in the background periodically. The user programs access statistics results directly, so as to achieve optimization.

3.1.3 Optimizing Algorithm

We optimize the raw data for three times.

Firstly, we removed credit card records belonging to the temporary staff outside, because the original campus card database records include all user records, not only students and teachers. Leaving only the card records of formal teachers and students is necessary.

Secondly, we classified food and beverage consumption data, building access data, shower data, medical data and other types of data when they are extracted from the database B. Here is an explanation of how we optimize food and beverage consumption data.

- Step 1, we summarize the meals. In each meal period, if one student credit card more than

once on different POS machines, we treat multiple records as one meal, add the several costs, and merged into one meal.

- Step 2, we add up each student's cost and times monthly with breakfast, lunch and dinner, so that a statistical chart will come into being faster.
- Step 3，we insert warning data into the table monthly, rather than calculate each time, thus improve access efficiency.

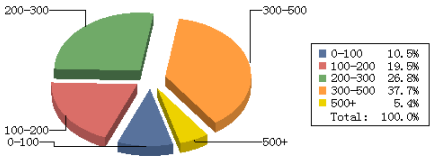
4 CASE PRESENTATION

4.1 Student Behavior Analysis System

We developed this system is to enable those teachers who is responsible for student management can keep track of dynamic information. For example, students who have meal more than 70 times per month, but monthly cost less than 150 Yuan RMB, etc.

4.1.1 Statistics and Query Function

One can select specific groups, such as a particular college, a grade or a period number of students, query and statistics the recharge records, consumer records, eating records, computer room records, medical records, access records, and draw the appropriate cake Chart, histogram. As shown in Figure 2.



Monthly consumption	Total consumption	consumption%	Number of Students	Number%	
0-100	￥95,551.48	10.52%	20214	86.34%	View Details
100-200	￥177,136.56	19.51%	1209	5.16%	View Details
200-300	￥243,648.97	26.84%	979	4.18%	View Details
300-500	￥342,093.39	37.68%	923	3.94%	View Details
500+	￥49,432.02	5.44%	87	.37%	View Details

Figure 2: Interface of statistical and query function.

4.1.2 Alert Function

Analyze each type of behavior, based on statistical theory, set alerts threshold and save the results of data analysis into the table. Such as, students who come back dormitory too late more than 7 times a month; students who eat more than 60 times a month but the total cost is less than 100 Yuan RMB; students who spend more than 300 hours a month on internet, etc. These information need to be saved into the question table, and take the initiative to push a window to student management workers when they log on, or the messages are sent to the manager's mobile phone.

4.2 Decision Support System

Beijing Jiaotong University have five student canteens, a foreign student canteen and a staff canteen. Last year, in order to build a new student activity center, university had to place a student canteen for demolition and reconstruction. However, removal of the old dining hall, and rebuild a new canteen will spend about 2 years. During the 2 years, students will have a significant impact on crowded dining, especially in the peak dinner time. How to open the canteen windows scientifically, adjust the service time of the canteens is the urgent task which placed in front of school leaders. To this end, the project team submitted canteen statistics data weekly to the school leadership and logistics management. Here are a few sample charts.

4.2.1 Comparison Charts of Each Canteen

According to the Chinese students' consumption data, we conducted a statistical analysis separately, according to No.1 canteen, No.2 canteen and No.4 canteen. Our statistics date is from March 6 to 12 (except Saturday and Sunday), every five minutes as a number of sampling points. According to statistics, the time period as the abscissa, number of meals eaten within five minutes as the vertical axis, make the daily meals curve. We draw the dinner curve five days on a chart, respectively, in different colours for different date. As shown in Figure 3 to Figure 5.

Through analysis, We can see, from March 6 to 12, the maximum number of breakfast appears in No.2 canteen, the peak number is 225 times every five minutes and the peak time is 7:40. The maximum number of lunch appears in No.1 canteen, the peak number is 229 every five minutes and the peak time is 12:20. The maximum number of dinner appears in canteen No.1, the peak number is 214 every five minutes and the peak times is 18:15.

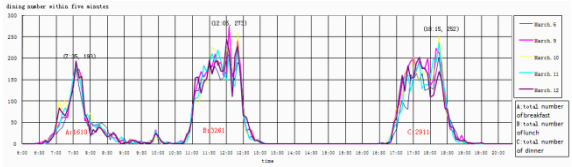


Figure 3: Analysis of dining number of canteen No.1 in March 6 to 12.

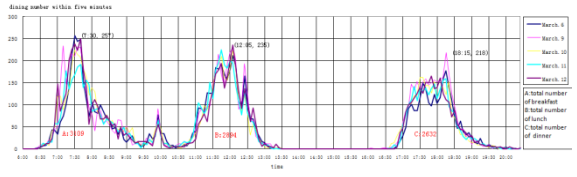


Figure 4: Analysis of dining number of canteen No.2 in March 6 to 12.

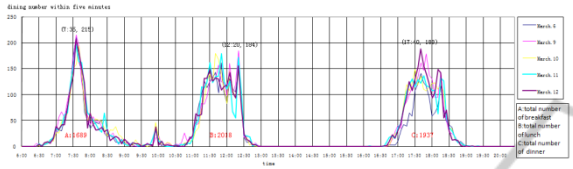


Figure 5: Analysis of dining number of canteen No.4 in March 6 to 12.

4.2.2 Comparing the Number of Meals of Each Canteen

Project team choose two periods of time, February 23 to 27 and March 6 to 12, calculate the average number of diner, draw a curve about the three canteens on a chart. As shown in Figure 6 to Figure 7. It can be seen that, in March No.2 canteen decrease in the number of diners, while No.1 canteen increase the number of diners. We can draw a conclusion: some students diverted to No.1 canteen.

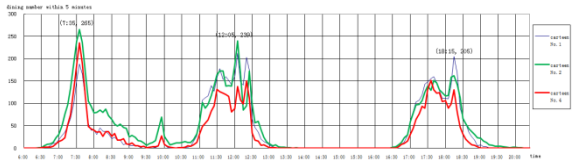


Figure 6: Analysis of dining number of three canteens in Feb 23-27.

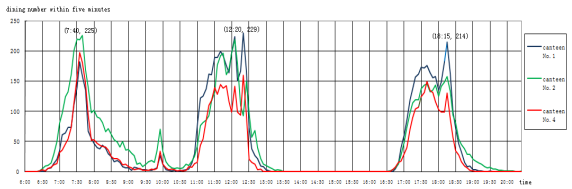


Figure 7: Analysis of dining number of three canteens in Mar 6-12.

5 CONCLUSIONS

In the past two years, through the application of card system data mining, all departments enjoy the benefits more efficient and more scientific when they make management and service-related decisions involved in teachers and students. In addition to campus card system, there are many other management information systems. Development and utilization of the information should be the focus of information technology research in future. Managements will also benefit from the use of information.

REFERENCES

Decai Wang, Yongli Zhang. 2008. *Campus card system construction need to look at the overall situation*, China Education Network.

Linfeng Jiang. 2006. *Construction of Science and Technology for the digital card,* China Education Network.