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Generic Information System for Chain Stores based on Borland C++ Builder

Changyu Liu [1, 3], Juntao Xiong [1, *] and Bin Lu [2]

[1] *College of Mathematics and Informatics, South China Agricultural University, Guangzhou 510642, China*
[2] *School of Computer Science, Wuyi University, Jiangmen 529020, China*
[3] *School of Computer Science and Engineering, South China University of Technology, Guangzhou 510006, China*

*yezhich@gmail.com, *xiongjt2340@163.com (corresponding author), lbscut@gmail.com*

Abstract

With the rapid growth of global economy, chain stores are springing up all over the world and have dominated more and more service markets, e.g., retail and dining. Accordingly, chain businesses have been one of the fastest growing industries since the beginning of this century. However, there are many bottlenecks for further producing competitive advantages of chain businesses, such as relatively small scales of chain stores, rather weak information awareness of managers, incompetent staffs and diversified business processes of chain stores, by using the traditional manual management. The introduction of chain store information systems, which integrate usually comprehensive information technologies, could provide managers of chain stores with a decision making yet overall management platform. In this paper, we develop a generic yet efficient information system for chain stores using MIDAS based three-tier client-server architecture. Besides, we also illustrate the system from three most principal stages in software engineering, which are system analysis, system design and system implementation.

Keywords*: generic information system, MIDAS, chain stores, chain businesses*

1. Introduction

Chain stores, such as McDonald's, Kentucky Fried Chicken, Pizza Hut, and Starbucks, are retail outlets of a brand that share standardized business methods and central management. Being different from single store, chain stores have dominated the market of many service categories, e.g., retail and dining, around the world. Chain businesses have been one of the fastest growing industries in the national economy since the beginning of the twenty first century. The chain store information system, from the starting point of improving the management efficiency and economic benefits, provides managers with a platform of decision making and overall management by integrating comprehensive technologies, such as database technology and network technology.

With a further rapid development of chain businesses, the traditional manual management has been the bottleneck for producing competitive advantages of chain businesses, requiring urgently a generic yet efficient information system for chain stores, due to following reasons: (1) Although the number of chain stores is very large, their scales are not the case. Hence, information constructions are not necessary for their daily operations. (2) Few managers could realize advantages of the information systems and most staffs of chain stores are incompetent to use information systems. (3) Although there

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are many management information systems available, they do not consider diversified business processes of chain stores and thus not suitable for those chain stores.

Therefore, we developed a generic information system for chain stores by using Borland C++ Builder in this paper. The system adopts MIDAS based three-tier C/S architecture and provides four functional modules. Besides, the paper is organized consecutively as follows. Section 2 outlines the system analysis. Section 3 describes the system design. Section 4 presents the system implementation. Finally, conclusions are discussed in Section 5.

2. System Analysis

System analysis is a problem solving technique that creates desired systems efficiently by identifying goals of a business, which constitutes the fundamental of subsequent system design and system implementation. In this section, we illustrate the system analysis from three aspects, which are requirement analysis, process analysis and use case analysis.

2.1. Requirement Analysis

As one of the most significant stages in system analysis, the requirement analysis involves those tasks to analyze needs of a new product or consider possibly conflicting requirements from various stakeholders, and establishes proper models by bridging the gap between project problems and their solutions. The functional requirement, as one of the most critical components in the requirement analysis, represents user requirements by many system functions. In this paper, we apply the well known client-server model to develop the required generic chain store information system. The logical server is required to provide its potential user, the head office, with global functions to manage its branch stores, such as branch store data maintenance module, branch store member archive management module, branch store staff archive management module, branch store operator management module, and configuration parameter setting module. On the other hand, the application client is required to provide its potential users, branch stores, with local functions such as login module, data setting module, member management module, and cashier work module. In the following, we describe functional modules of the application client in details while ignore functional modules of the logical server due to their simplicities.

(1) The login module. The system should check the verification code, identify roles of input users, consider whether to adopt IP restrictions or dynamic access control, download the latest updated version of the system, and provide different roles with according interfaces.

(2) The data setting module. Providing branch stores with convenient management of cashier work related basic business data, this module could be further subdivided into parameter setting module, staff archive setting module, member grade setting module, consumption content setting module, special discount setting module, and permission setting module. Specifically, for the parameter setting module**,** the system should provide functions for setting cashier fraction mode, payment mode, ticket printing mode, and member password input mode. For the staff archive setting module, the system should provide functions for setting staff ID, staff position, and staff permission. For the member grade setting module, the system should provide functions for setting expiration date, selling price, discount rate, and deduction rate, according to different member grades. For the consumption content setting module, the system should provide functions for creating, reading, updating and deleting of consumption items. For the special discount setting module, the system should provide functions for choosing either discount in percentage mode or discount in amount mode. For the permission setting module, the system should

provide functions for setting specific permissions, such as database CRUD operations, according to their roles.

(3) The member management module. This module is used to manage both member archive records and membership card records. Major functions of the module encompass reading member archive, establishing member archive, modifying member archive, managing membership card, managing subaccount and managing supplementary card.

(4) The cashier work module. As the core component in the generic chain store information system, this module provides functions of issuing bills, pending bills, modifying bills, swiping cards, footing bills, and querying as well as printing bills.

2.2. Data Process Analysis

As another one of the most significant stages in system analysis, the data process analysis (DPA) extracts non-physical components from involved data of the desired system, such as data flow, data transformation, and data storage. Usually, the DPA is used to generate a data flow diagram (DFD) by discovering and solving data flow issues, such as unsmoothed flows, unmatched data and unreasonable data process. The DFD, building in several specified symbols, i.e. external entities, processing procedures, data storage and data flow, is a primary tool to model system logics and a portrayal method to analyze system structures.

In order to describe data flows in complex systems, a multitier architecture is always an excellent choice. Firstly, the top tier determines boundaries of the system, such as input and output data flows. Secondly, the middle tiers, locating under the top tier, are decompositions of their upper tiers and abstracts of their lower tiers. Finally, the bottom tier is composed of indecomposable data flows. In this paper, we show in Figure 1 only the top DFD tier of the generic chain store information system.

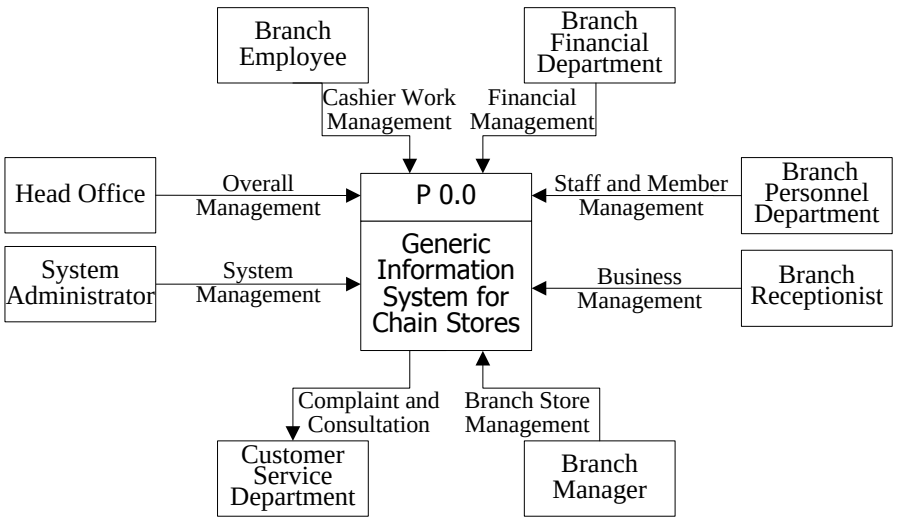


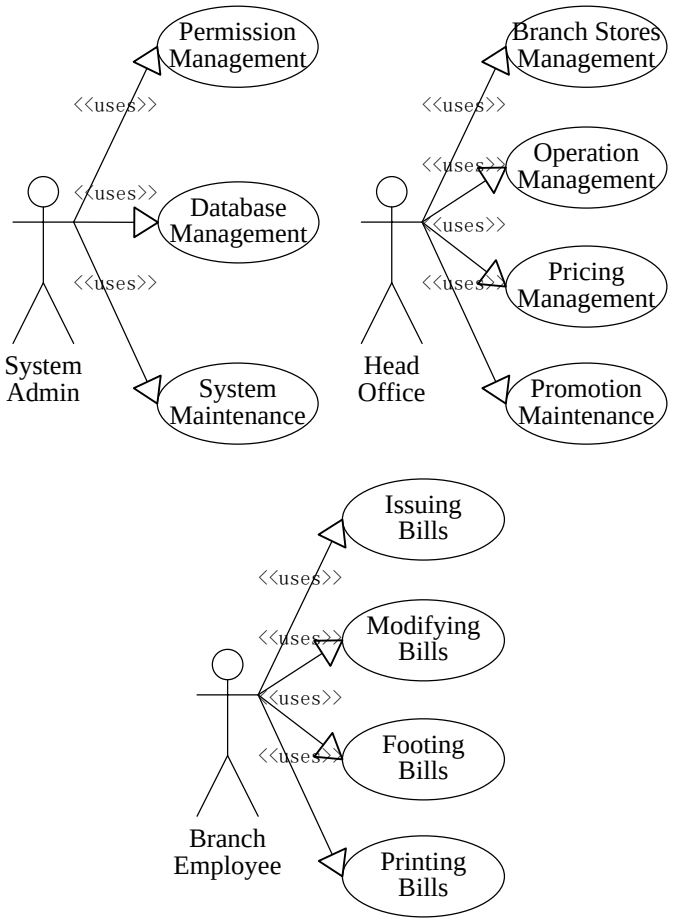
Figure 1. Top DFD tier of the Generic Chain Store Information System

2.3. Use Case Analysis

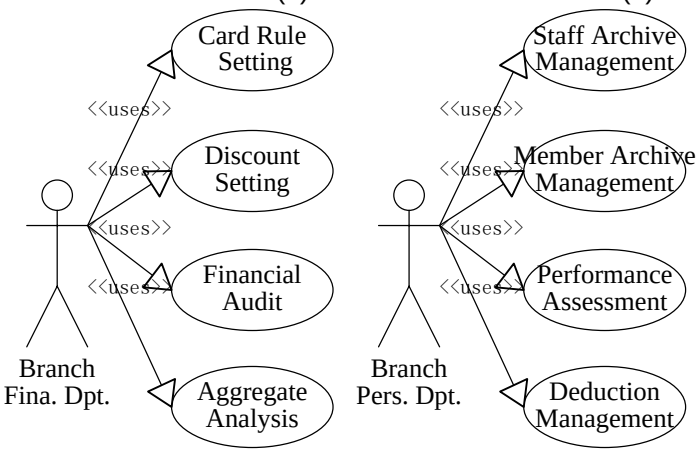
Use case analysis is also a significant stage in system analysis to generate a use case diagram, which is a dynamic view of system functions by external users and is comprised of actors, use cases and their relationships. The actor, either a thing or a person, is an external entity as well a participant and activates the system by inputs. The use case is a set of scenes to describe how actors achieve their goals through the system.

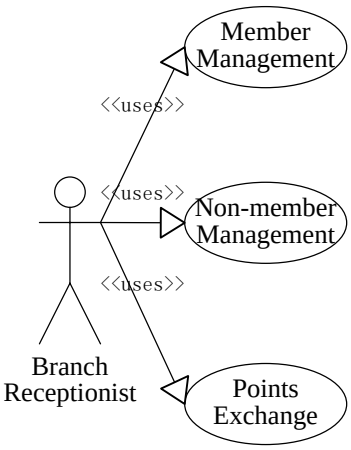
Functional requirements, rather than implementation details, of the system can be displayed vividly through the use case diagram. Furthermore, functional behaviors of systems, subsystems or classes are modeled by visualization technologies, so that both

system users and developers can understand thoroughly those elements. Eight roles, i.e. system administrator, head office, branch employee, branch financial department, branch personnel department, branch receptionist, branch manager, and customer service department, are involved in the generic chain store information system. Figure 2 shows intuitively functional system requirements by according eight use case diagrams.

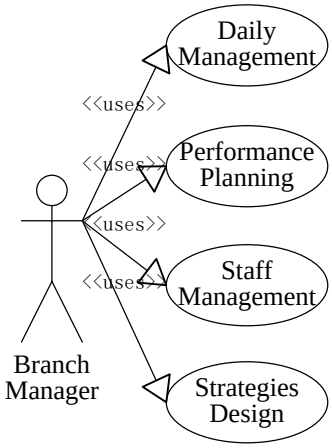


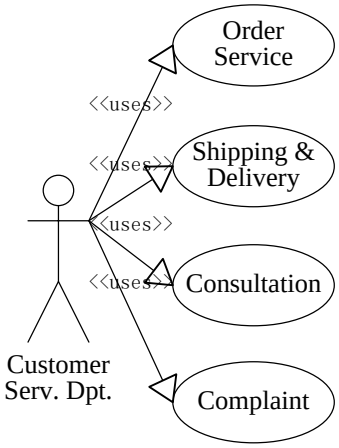
(1) System administrator (2) Head office (3) Branch employee





(4) Branch financial depart. (5) Branch personnel depart. (6) Branch receptionist





(7) Branch manager (8) Customer service depart.

Figure 2. System Use Case Diagrams

3. System Design

System design, in software engineering, is the process to satisfy system requirements by defining the architecture, components, modules, interfaces and the database. In this section, we illustrate three aspects, namely the architecture, modules and the database.

3.1. Design of the Architecture and Modules

Architecture design, as the most significant stage in system design, is usually performed after the system analysis. In this paper, we adopt the multi-tier distributed application services suite (MIDAS) based three-tier C/S architecture of the Boland C++ Builder, as shown in Figure 3, which are the application client tier, the logical server tier, and the database tier.

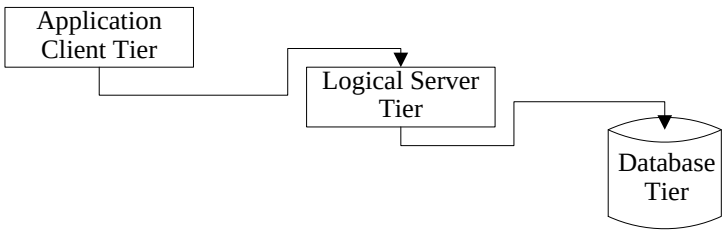


Figure 3. MIDAS based Three-tier C/S Architecture

Modules design, as another one of the most significant stages in system design, subdivides a system into smaller modules which can be created and used independently in different systems. According to the requirement analysis and the MIDAS based three-tier C/S architecture, our system modules and sub-modules, as shown in Figure 4, are derived from the logical server module and the application client module.

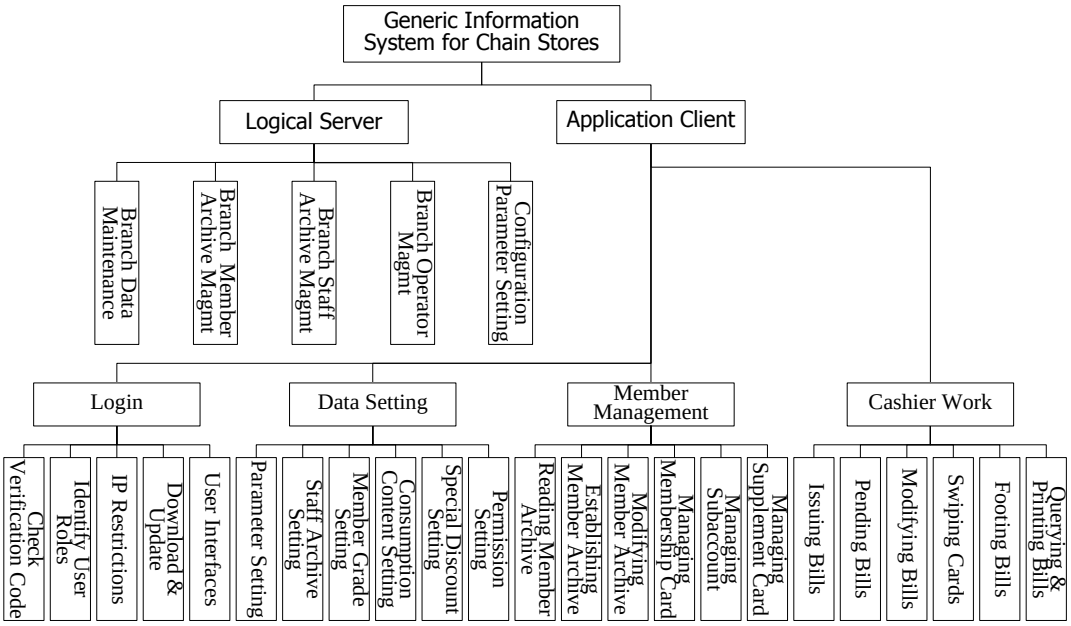


Figure 4. Functional Modules of the System

3.2. Database Design

Database design is also a key stage in system design. In this paper, we adopt the entity-relationship (ER) model based relational database as the base of the system, as shown in Figure 3, to organize data into tables of rows and columns. Advantages of the relational model, such as high structured data, minimum redundancy, independence of procedures from data and easy expandability, lead to the fact that it becomes soon the dominated database.

An ER model is a data model for describing a business process in ER diagrams by entities which may have various properties and their relationships of dependencies and requirements, where an ER diagram describe the real world based on the initial conceptual model in database design. In this paper, we consider related 11 entities and draw one ER diagrams, as shown in Figures 5, by using the Powerdesigner, one common tool for database design, according to the previous requirement analysis. Those entities include the permission management table PERMISSION__GIS4CS, the role management table ROLE__GIS4CS, the user archive table USER__GIS4CS, the membership archive table MEMBER__GIS4CS, the parameter setting table PARA_SET__GIS4CS, the chain store archive table CHAIN_STORE__GIS4CS, the overall consumption table OVRL_CONSUMPT__GIS4CS, the recharge record table RECHAR_RECORD__GIS4CS, the membership level table MEMBER_LEVEL__GIS4CS, the item commodity table ITEM_COMMODT__GIS4CS, and the special discount table SPECL_DISCOUNT__GIS4CS.

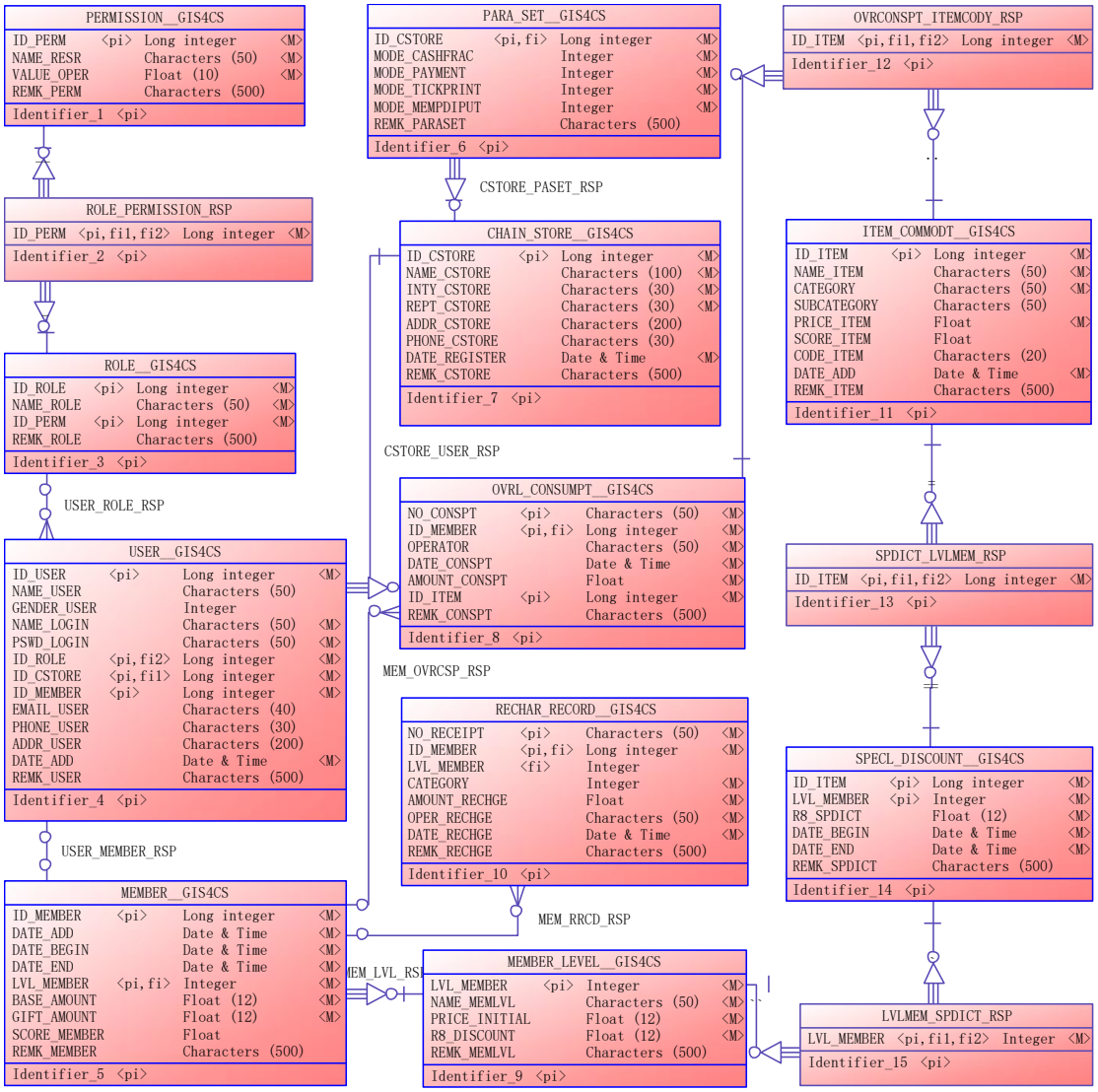


Figure 5. ER Diagram of the Generic Information System

4. System Implementation

System implementation is the construction of the new system according to system analysis and system design. In this section, we describe exhaustively how we realize the logical server and application client of the required generic chain store information system.

4.1. Logical Server

4.1.1. An Overview: Database server, especially for SQL server of management systems, which is exposed to external network, is vulnerable to secure attack. A feasible approach is to use a logical server as an agent to connect indirectly the application client with the database server through specified communication protocol.

Borland C++ Builder provides MIDAS based applications with a mechanism supported by MIDAS.DLL for exchanging database records among clients and servers. There are three protocols used in MIDAS communications, namely DCOM, TCP/IP sockets and HTTP, which correspond successively to Borland C++ Builder controls of TDCOMConnection, TSocketConnection and TWebConnection. In this paper, we combine TDCOMConnection control and the Borland Socket Server for data communications.

4.1.2. Create a Logical Server: In order to support three-tier MIDAS architecture, both Remote Data Module and TDataSetProvider control are required to be added into the general new project. Besides, the client needs to initialize the database service agent scktsrvr.exe before connecting the server database. Then, a new logical server can be created by steps of:

(1) Create a new project called pChainStoreLogSer in Borland C++ Builder. Then, click File|New on the main menu to open a New Items dialog box and create a Remote Data Module called CSLogicalServer from the Multitier page of the dialog box.

(2) Add one TADOConnection control called acCSLogSer to the Remote Data Module for connecting to the SQL server database and set its attribute by

acCSLogSer->ConnectionString = "Provider= SQLOLEDB.1;Password=test;"
+ "User ID= test;Data Source=.\SQLEXPRESS;Persist Security Info=False";

(3) Add several TADOQuery controls called aqCSLogSer_i to the Remote Data Module according to the requirement analysis and set their attributes by

aqCSLogSer_i->Connection = acCSLogSer;

(4) For each aqCSLogSer_i, add one TDataSetProvider control called dspCSLogSer_i to the Remote Data Module which is used to process client requests and encapsulate communication data, and set their attributes by

dspCSLogSer_i->DataSet = aqCSLogSer_i;
dspCSLogSer_i->OnDataRequest = dspCSLogSer_iDataRequest;
dspCSLogSer_i->AfterApplyUpdates = dspCSLogSer_iAfterApplyUpdates ;

(5) Write codes to achieve required functions, such as event handling, service logic handling, data integrity check and data security check in the logic server. Then, save, compile and register the MIDAS based logic server.

4.1.3. Key Algorithms: Since we have created a logical server and arranged required controls in the last section, we can then write two types of codes, which are event codes for forms or controls and publically called business logic codes. Different from application client, the logic server focuses more on business logic codes to provide functions of database connection, login verification and business logics of clients based on MIDAS communication mechanism. Business logic codes are realized through the OnDataRequest event of the TDataSetProvider control, as shown in Algorithm 1, where pReso->Strings[0].ToInt() determines which business logic is called, case 1 refers to the login function, case 2 refers to the user update function, case 3 executes SQL sentences, and default is for other situations.

Algorithm 1: The data request event dspCSLogSer_iDataRequest.

Input: TObject *Sender, OleVariant &Input;
Output: OleVariant strReturn.

```
1:  AnsiString strRequest, strReturn;
2:  TStringList *pReso = new TStringList();
3:  strRequest = (AnsiString) Input;
4:  pReso->Text = StringReplace(strRequest,"/","\r\n",TReplaceFlags()<<rfReplaceAll);
5:  switch pReso->Strings[0].ToInt()
6:  |   case 1: strReturn = UserLogin(pReso->Strings[1], …); break;
7:  |   case 2: strReturn = UserUpdate(pReso->Strings[1], …); break;
8:  |   case 3: ((TDataSetProvider *)Sender)->DataSet->Filter = pReso->Strings[1];
9:  |           strReturn = ((TDataSetProvider *)Sender)->Data; break;
10: |   default: strReturn = "Error !"; break;
```



```
11:  end
12:  delete pReso;
13:  return strReturn.
```

4.2. Application Client

4.2.1. Create an Application Client: Accordingly, a MIDAS based application client can be created by steps of:

(1) Create a new project called pChainStoreAppCli in the Borland C++ Builder integrated development environment by click the menu File|New|Application.

(2) Add one TDCOMConnection control called dcCSAppCli into the new project to connect to the Remote Data Module CSLogicalServer of the logical server for providing client users with database connection services, and set its attribute by

dcCSAppCli ->ServerName = "pChainStoreLogSer.CSLogicalServer";

(3) Add TClientDataSet controls called cdsCSAppCli_i to the new project. Note that the control cdsCSAppCli_i in the application client corresponds one-to-one to the control dspCSLogSer_i in the logical server. Furthermore, we set their attributes by

cdsCSAppCli_i->ProviderName = "dspCSLogSer_i";

cdsCSAppCli_i->RemoteServer = dcCSAppCli;

(4) For each cdsCSAppCli_i, add one TDataSource control called dsCSAppCli_i to the new project and set its attribute by dsCSAppCli_i ->DataSet = cdsCSAppCli_i;

(5) Create forms for four required functional modules, i.e., the login module, the data setting module, the member management module, and the cashier work module, in the new project. Then, arrange reasonable controls and write according codes in those forms.

4.2.2. The Login Module: The login module provides all users of the system, including head office employees and branch store employees, with login check services and assigns relevant permissions to verified users. Figure 6 shows the flowchart of the login module.

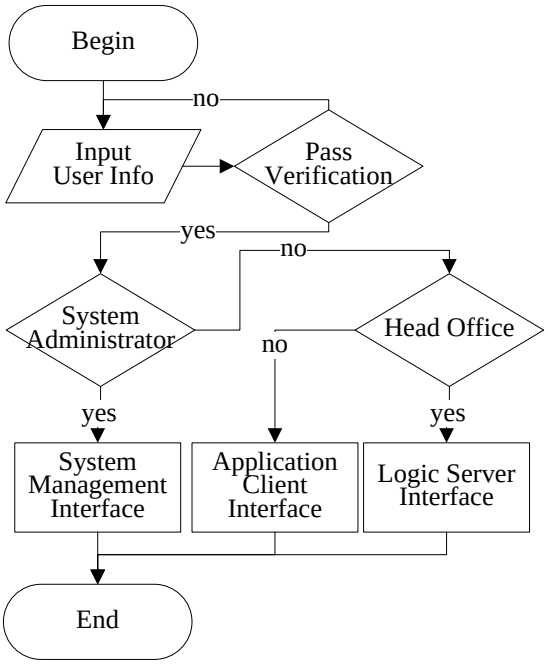
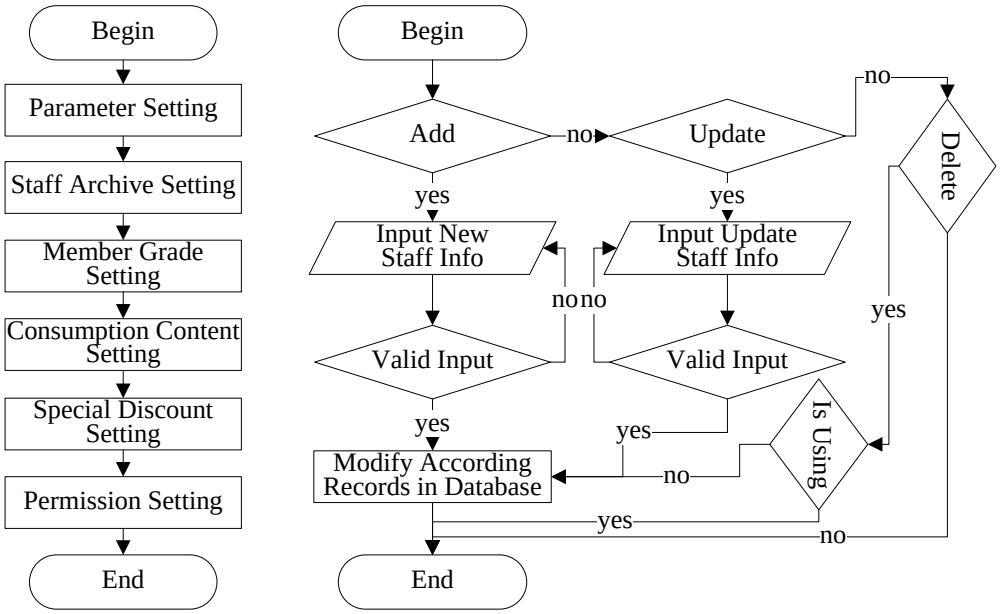


Figure 6. The Flowchart of the Login Module

Double click on the client application ChainStoreAppCli.exe to open the login dialog. Before click the login button, users are required to select types of servers to be connected, input both their ID and passwords. Figure 7 shows the interface of the login module.

Figure 7. The Interface of the Login Module

4.2.3. The Data Setting Module: As mentioned before, the data setting module involves following sub-modules, namely parameter setting module, staff archive setting module, member grade setting module, consumption content setting module, special discount setting module, and permission setting module. In this section, we take the parameter setting module and the staff archive setting module for example to illustrate how this module is implemented. Figure 8 shows those two sub-flowcharts of the data setting module.



a) Parameter setting b) Staff archive setting

Figure 8. The Flowchart of the Data Setting Module

Accordingly, we show the interface for the two sub-modules of the data setting module in Figure 9, where in the parameter setting module the system should provide functions for setting cashier fraction mode, payment mode, ticket printing mode, as well as member

password input mode, and in the staff archive setting module the system should provide functions for setting user ID, chain store ID, role ID, etc.

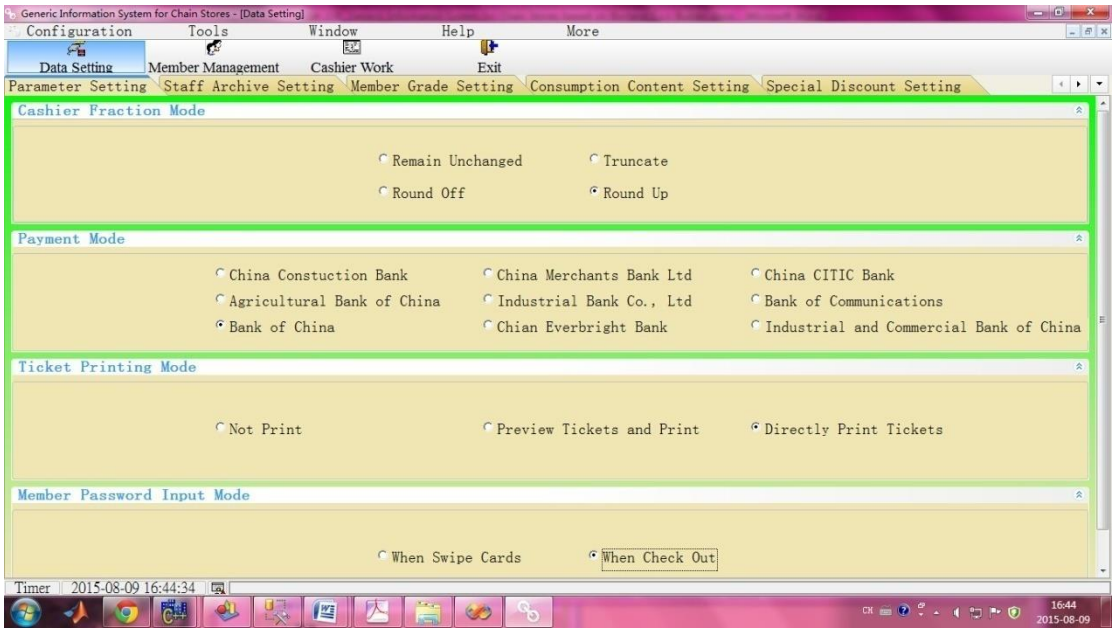


Figure 9. The Interface of the Data Setting Module

4.2.4. The Member Management Module: The module encompasses a variety of member management related functions, such as reading member archive, establishing member archive, modifying member archive, managing membership card, managing subaccount and managing supplementary card. Figure 10 shows the flowchart of the member management module.

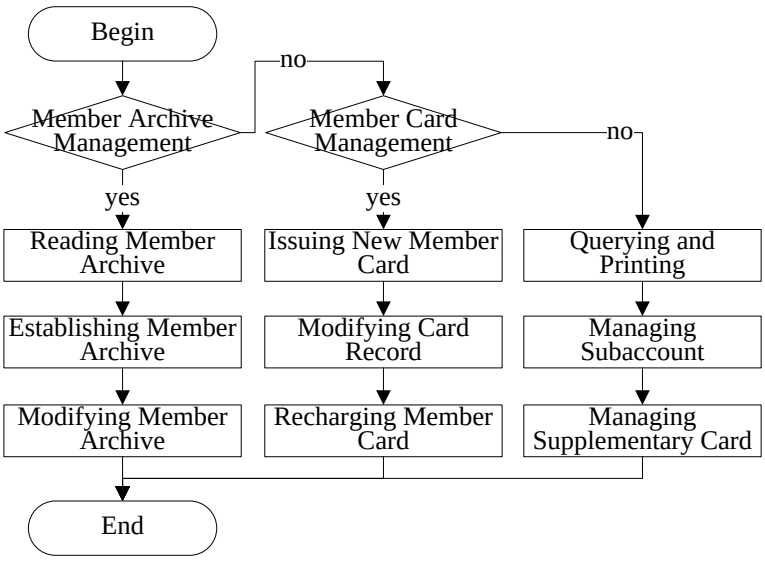


Figure 10. The Flowchart of the Member Management Module

Figure 11 shows the interface of in the member management module by two functions, i.e., establishing member archive and managing membership card, as they are two principal functions yet the bases of the module.

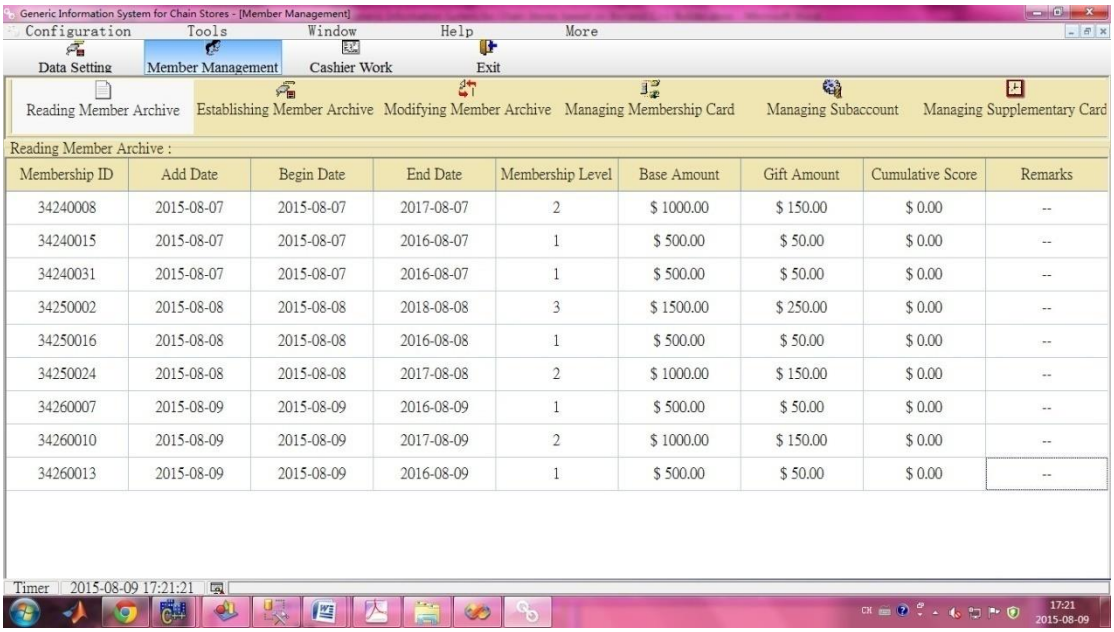


Figure 11. The Interface of the Member Management Module

4.2.5. The Cashier Work Module: In the generic information system for chain stores, the cashier work module is the core of the system, consisting of many sub-modules, such as issuing bills, pending bills, modifying bills, swiping cards, footing bills, and querying as well as printing bills. Figure 12 shows the overall flowchart of the cashier work module.

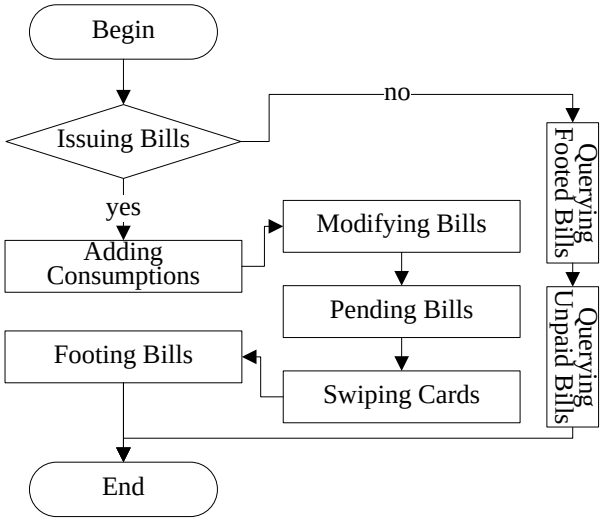


Figure 12. The Flowchart of the Cashier Work Module

Among these sub-modules, both issuing bills and footing bills are critical to the processing of particular businesses. The issuing bills sub-module generates new bills for customers to consume in branch stores and delete all other uncompleted operations. The footing bills sub-module calculates total customer expenses, checks if their balances are enough for current consumptions and prints according receipts. Figure 13 shows the interface of the cashier work module.

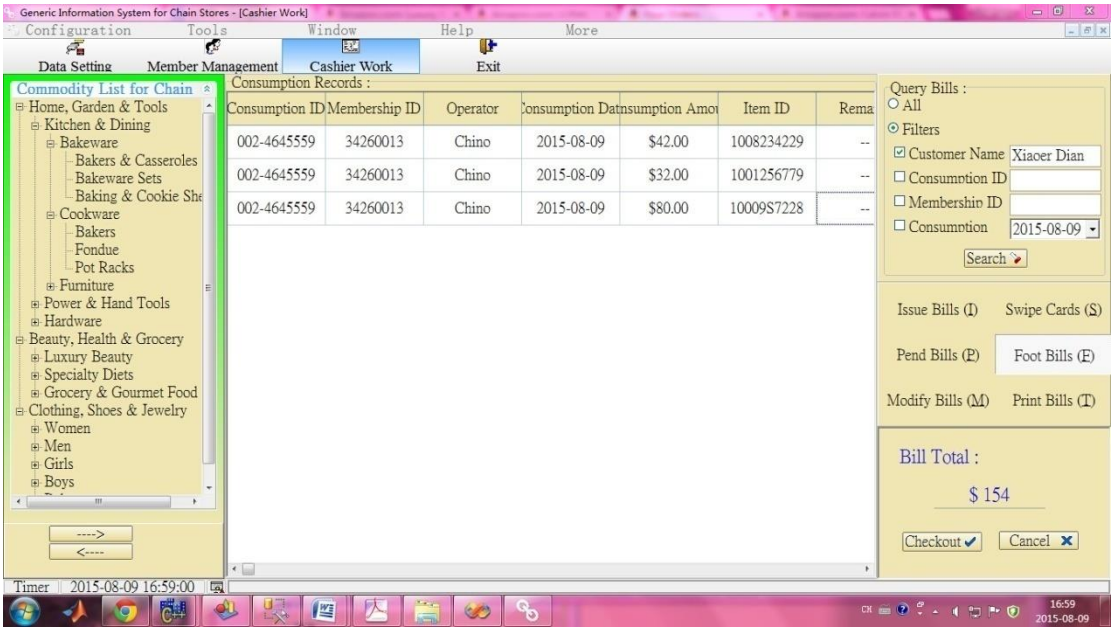


Figure 13. The Interface of the Cashier Work Module

5. Conclusion

In this paper, we adopted the MIDAS based three-tier C/S architecture to develop a generic information system for chain stores by using the Borland C++ Builder programming tool and the SQL Server database. We illustrated the system from three aspects, which are the system analysis, the system design and the system implementation, and four functional modules, which are the login module, the data setting module, the member management module and the cashier work module. However, efficient management of chain stores is a complex social issue and business requirements of diversified chain stores are very comprehensive, which can't be solved only from the technical aspect. In the near future, we would like to integrate first the three-tier B/S architecture in the whole generic system and then the decision support module in the logic server.

Acknowledgments

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Authors

Changyu Liu, he received the PhD degree from South China University of Technology in 2015. He is currently a lecturer at South China Agricultural University. He was a visiting scholar at the School of Computer Science, Carnegie Mellon University, from September 2012 to October 2013, advised by Dr. Alex Hauptmann. Then, he worked with Prof. Mohamed Abdel-Mottaleb and Prof. Mei-Ling Shyu at the Department of Electrical and Computer Engineering, University of Miami, from October 2013 to

September 2014. His research interests include computer vision and machine learning.

Juntao Xiong, he received his doctorate degree in South China Agricultural University in 2012. He has been working in this school from 2007. He is currently an associate professor at South China Agricultural University. He was a visiting scholar at the Graduate of Agricultural, Kyoto University, from February 2015 to February 2016, and worked with Prof. Naoshi Kondo. His research interests include machine vision and image processing.

Bin Lu, he is currently a lecturer in the School of Computer Science at Wuyi University. He received his Ph.D. degree in 2013 from South China University of Technology. He is a reviewer of the Journal of Yangtze River Scientific Research Institute since 2010. His main research interests include complex network and machine learning.