# Design and Implementation of Online Stock Trading System

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***Abstract*—A solution about building a real-time online stock trading system is given by using the technologies of Ajax, Struts and Hibernate framework. It uses B/S browser, application server, database server three-layer architecture configured into presentation layer, business logic layer, persistence layer three-way architecture according to MVC. And it is implemented by using Struts framework with all data stored in Oracle database; the data persistence layer is realized by using Hibernate3 framework; client-side validation of form and real-time stock information's updating automatically are implemented by using Ajax technology; it is JMS that keeps the communication among the different modules, such as stock data acquisition module and analog transaction module. The test results show that this system has the characteristics of good real-time and safety, runs stably and reliably, so it verifies the validity of the solution.**

***Key words-online stock exchange; real-time stock information; Ajax; Struts; Hibernate***

## I. INTRODUCTION

Nowdays more and more people buy and sell their stock on the internet all over the world. Markets of online transaction have already been more popular overseas, such as the QFII (Qualified Foreign Institutional Investors) client online trading platform launched by Bank of America and Merrill Lynch. However, the stock market trend, real-time and automatic real-time updating are not satisfied with the user's requirements. Although some individual sites achieve that the trend of the stock market updates automatically in real-time, its interface is not easy to use and comfortable as the C/S structure software. For these reasons, this paper researches the design and implementation of the online stock trading system based on B/S structure.

Based on Struts, Hibernate framework and Ajax technology, the online stock trading system is designed and implemented. It should have the following functions: user register and login, browsing market trend and real-time stock information, viewing personal account information and transaction records, operating stock during 24 hours, etc.

The loading demand, real-time demand and safety demand are briefly discussed for the limit length of this paper. The system could register tens of thousands of users and could guarantee that at least 20 customers can operate online stock trading at the same time. And this system should be highly real-time. For stock trading, all kinds of the transaction type operations require the system respond within 3 seconds; In addition, the safety demand of the system should be considered.

## II. SYSTEM DESIGN

The overall system design approach is based on MVC three-layer structure [1]: presentation layer, business logic layer, persistence layer. It is divided into business logic layer and the database persistence layer in data acquisition and simulation trading module in the background of the system. Communication among various systems is achieved by JMS, where MVC three-layer structure uses Struts framework to achieve [2], data persistence layer uses Hibernate3 framework to achieve [3], the client authentication of the form and the stock real-time information's updating automatically uses Ajax (Asynchronous JavaScript and XML) technology [4] and data is stored in Oracle database.

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*A System architecture design*

1. System network topology structure

As shown in Figure1, the network topology of the system is divided into three levels based on different into3 levels based

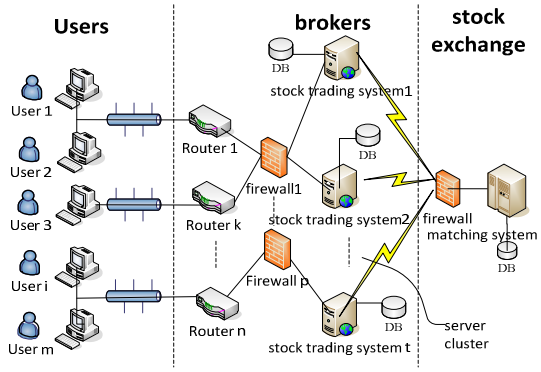


Figure1. Network topology structure of the system

on different transaction execution process: users, brokers and Stock Exchange. Users connect to the internet by using PC to access the online stock brokerage system, which sends the order information downloaded by users to the Stock Exchange, the Matching System of which finishes the real-time stock trading which best matches with the user's requirement accordance to the entrusted information and returns the transaction results to the brokerage.

In order to meet the needs of system performance, stock trading system is set up in the server, and it should set up server cluster, using multiple servers to avoid network congestion caused by excessive users.

Meanwhile, in order to meet the needs of security, the firewall should be set between the communication link and for sensitive information, it should be sent encrypted.

2. System architecture

As shown in Figure 2, online stock trading system is mainly divided into two major parts: the foreground web site and the background simulation system. In the foreground web site, browsing stock trends, seeing profit and loss position and commission of user functions are realized. And background simulation system is mainly divided into data acquisition and transaction processing.

The data acquisition module is one of the background modules of the system, which provide data source support for the system.

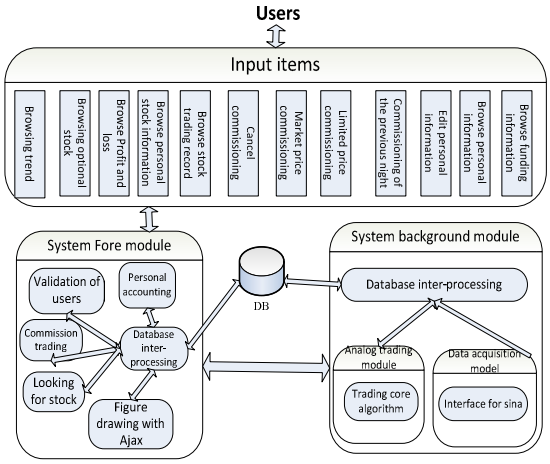


Figure 2. System architecture diagram

The transaction processing module reads the user's orders information from the database, sorts the buy orders and sells orders in accordance with the matching algorithm, and then deals the orders eligible, including dealing with personal accounts, exchange of information processing, etc., and last returns the outcome of the transaction information to brokerage.

*B Database design: E-R diagram*

In Figure 3, Database E-R diagram clearly shows the links between tables, such as Table USERS, user table that records the user's account number, password and other important information; Table STOCKINFO, stock information table that record the code-named, names, status and other information; HOLD is the user position table, which contacts USERS through a foreign key USERNUM and links with STOCKINFO through taking STOCKID as the a foreign key. SELFSTOCK is the self optional table that connects USER through a foreign key USERNUM and Connects STOCKINFO through STOCKID.

*C System security design*

1. Network architecture design

The network architecture design of online stock trading system is shown as the network topology of the network architecture in Figure 1, including the following components: 1) router; 2) a two-tier firewall (one layer is in front of the web server, the other on the stock exchange; Web Server is mainly used in transmitting and load

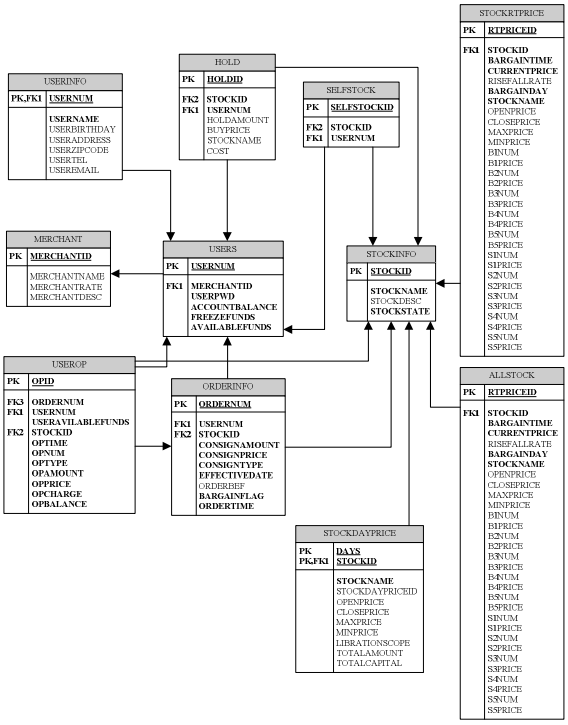


Figure 3. Database E-R diagram

balancing, which can be instead by load balancers); 3) more than one PC sever used as application server, which increases linearly with the load increases; 4) 2 Hot Standby Minicomputers used as database server and back up database server of the online trading system.

2. The safety design of data transmission

(1) Follow the PKI system, which ensures the security of the information system and verifies the identity of the digital certificate holder through using public key technology and digital certificates;

(2) Use HTTPS protocol, which must be used to visit the online trading system. The protocol uses the international commonly used protocol SSL to transact the transmission data encrypted. For the encryption strength, DES 128 bit symmetric encryption, which is able to protect the security of data transmission and could be anti-wiretapping, anti-counterfeit, tamper-resistant and anti-denied, is far more powerful than 40-bit symmetric encryption. Then the information of customers can be fully encrypted transmitted. The web server protected by SSL can become safer.

Meantime, the following factors are considered: Preventing duplication of submission of the page; Encryption of sensitive data; Session limit; The key page without calling back; Random verification code; Logging tools; SMS Tips (Landing, transaction, modifying personal information etc. can be informed by sending SMS.)

### *D View stock quotes module design*

The module provides the ordinary users to view the market, stocks and optional stocks(login required) quotes, that is users can query market as well as stock before landing and can visit the optional stock by new functional provided by the system after landing.

Update of the real-time data: Ajax technology is used to send a new request regularly to the background, and the background system reads out the latest stock information data from database, and then it returns to the page level through Ajax technology. At last, the page updates the data in the page with the latest data.

Real-time stock quotes updating in the picture: The background system reads out the up-to-date stock information from the database through sending new requests to the background by using AJAX technology, and then uses JFreeChart components to paint the share data as a time-sharing plan [5], day K Line. In order to ensure that the storage load of the server is not too large, the latest picture will be automatically covered the former picture. So the foreground just does a simple local refresh without modifying the whole image, and the operation of covering picture is done at the background. After the picture has been updated, it needs to add a time parameter after the picture link address to make the browser take it as a new request which will update picture. Its sequence diagram of real-time update is shown in Figure 4.

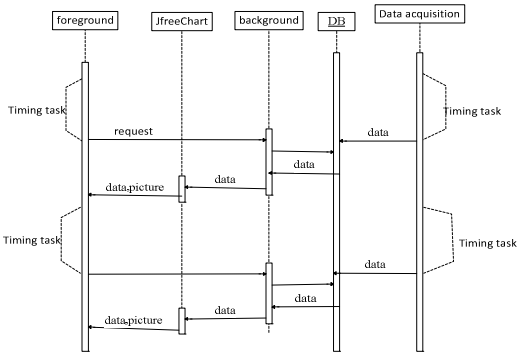


Figure 4. Sequence diagram of real-time update

### E Simulation trading module design

This module is one of the background modules of the system, which simulates the transaction commission.

The background reads the open order in the life time from the database. Purchasing orders form priority queues appointed first by price priority, followed by time priority, and then by the commissioned volume priority. And then according to the matching algorithms of buying and selling, the module can deal with the commission that can be transaction, and then set the transaction information back to the broker. At the same time, the system modifies the funds, position status, transaction records, order information and other related information of the users that transact successfully. The broker updates the latest price and trading volume information, and finally stores the information into the database.

## III. SYSTEM IMPLEMENTATION

### A. System development framework and environment

The system is built in MVC three-layer structure. In data acquisition and analog transaction module of the background, the system is divided into business logic layer and database persistence layer. The various systems communicate with each other by using JMS, in which MVC three-layer structure uses Struts, and data persistence layer uses Hibernate [6].

MyEclipse 6.5 is used as the software development platform. First, the system uses MyEclipse to create a new web project StockOnline, and add support of Struts and Hibernate according to the previous system design. And then, the system carries out procedures in accordance with the design chart; data acquisition and analog transaction is implemented by using JAVA to write console.

Power Design 12 is used to establish a physical model and conceptual model of the database, and use software to check while the physical model and conceptual model is correct and reasonable.

Install Oracle 9i server, and use Oracle 9i to generate a STOCK table space, and then create the appropriate users and set up a user name and password. Then, use Poser Designer 12 to generate the corresponding database automatically.

Install JDK5 or later version and configure the environment variables. Install Tomcat6.0 whose default port is 8080. For Oracle also needs to use 8080 port, change Tomcat's port, such as 7070.

### B. Test summary

*1) Real-time system testing:* The system real-time meets the needs of rapid logic updating requirements, and meets the needs in the need analysis.

*2) System pressure testing:* System can carry at least 20 individuals landing and commission trading at the same time, which meets the needs in the need analysis.

*3) Functional testing:* The system almost meets all the functional requirements in the need analysis.

And the system has been fully achieved. The test results indicate the feasibility and effectiveness of this scheme. (Due to the length limitation, this paper omits Commission modular design, Data acquisition module design, design diagrams and the all interfaces completed, but you can send us email for them).

## IV. SUMMARY

This paper designs and realizes a real-time online stock trading system, which merges Struts, Hibernate, Ajax and log management programming techniques. It achieves a MVC three-tier architecture online stock trading system foreground based on B/S structure, which could show real-time stock quotes and trading commission. The system uses JAVA language to carry out a system background that could attain stock information from the Web and simulate transaction and realizes the system testing. From the test analysis, we could see that the system can run correctly, operate simply and be safe, which meets the needs of the system.

## V. REFERENCE


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