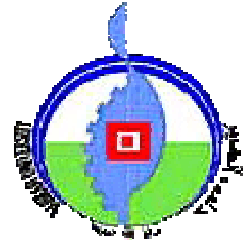


Republic of Iraq

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College of Science



Intranet Based System for Securities Trading

A Thesis

*Submitted to the College of Science, Al_Nahrain University in Partial
Fulfillment of the Requirements for the Degree of Master of Science in
Computer Science*

By

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2009

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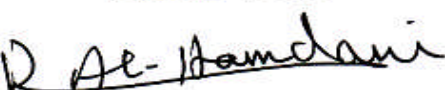
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Abstract

Nowadays the evolution of securities markets using information technology is becoming an important issue because they make exchanges comparable and more integrated. The borders of the market that investors face are blurring. In this way there is an increasing competition among the stock exchanges worldwide and among exchanges and automated trading systems.

Based on previous events, five years from now the business of trading shares will look radically different. Many old stock exchanges will be gone. Hardly a month goes by without any changes in the existing trading systems, or one exchange proposing to merge with another.

Thus, in this project an electronic trading system for Iraq stock exchange is introduced as a step for the exchange to evolve and be able to compete with other stock exchanges around the world.

The system was designed as a network application using web design techniques and protocols which makes it usable on both a local network and on the internet.

When the trading system was designed few issues were addressed to make it practical and relatively secure such as providing easy to understand and use interfaces, putting only necessary details in the pages to ensure fast loading time and providing extra security measures like employing Secure Sockets Layer (SSL) and encryption.

The system responsibilities are: registering brokers, investors and companies as members in the market and managing all aspects of the trading process, it is also the system's responsibility to enforce the stock market's laws

and regulations on all members and trading deals (that happen during the trading sessions).

STS is a real-time trading system, Investor accounts, broker accounts, account status, the trading process and settlements are in real time.

MYSQL Server 6.0 was the chosen Database Management Server (DBMS), Hyper Text Markup Language (HTML) and Personal Home Page (PHP) were chosen as programming languages; JavaScript was used for more interactive interfaces and Apache Server 2 as a network server.

Dedication

To My Beloved Family

Acknowledgment

I would like to express my sincere gratitude and appreciation to my supervisor Dr. Ban N. Dhannoon for her guidance, supervision and untiring efforts during the course of this work.

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Last but never least, tanks to all my family especially my parents, and my friends for their continuous encourgment and support.

List of Abbreviations

ARPANET	Advanced Research Projects Agency Network
ASP	Active Server Pages
ATM	Automated teller machine
B2B	Business to Business
B2C	Business to Consumer
BGP	Border Gateway Protocol
CAN	Campus Area Network
CGI	Common Gateway Interface
CIA triad	Confidentiality, Integrity and Availability triad
DDB	Distributed Database
DDBMS	Distributed Database Management System
E-Commerce	Electronic Commerce
FTP	File Transfer Protocol
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IA	Information assurance
ID	IDentity
IETF	Internet Task Engineering Force
IIS	Internet Information Services
IP	Internet Protocol
ISP	Internet Service Provider
ISX	Iraqi Stock Exchange
LAN	Local Area Network
Mac	Macintosh
MAN	Metropolitan Area Network
NASDAQ	National Association of Securities Dealers Automated Quotation System
NIN	National Identification Number
OSI	Open Systems Interconnection
OTC	Over the Counter

PHP	Personal Home Page or PHP: preprocessor
PIN	Personal Identification Number
SMTP	Simple Mail Transfer Protocol
SQL	Standard Query Language
SSH	Secure Shell
SSL	Secure Sockets Layer
SSO	Single Sign-On
STS	Stock Trading System
TCP/IP	Transfer Control Protocol / Internet Protocol
UNIX	UNiplexed Information and Computing System
URL	Uniform Resource Locators
US	United States
WAN	Wide Area Network
WWW	World Wide Web
XML	eXtended Markup Language

List of algorithms

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Chapter One

General Introduction

1.1 What is E-Commerce?

E-Commerce is the use of the Internet and the Web to transact business. More formally, the digitally enabled commercial transactions between and among organizations and individuals. *Digitally enabled transactions* include all transactions mediated by digital technology. For the most part, this means transactions that occur over the Internet and the Web. *Commercial transactions* involve the exchange of value (e.g., money) across organizational or individual boundaries in return for products and services. Exchange of value is important for understanding the limits of e-commerce. Without an exchange of value, no commerce occurs. [Ray03]

1.2 E-Commerce Features

There are seven features of e-commerce technology that are unique to this medium: [Tur01]

1. Is *ubiquitous*—it is available just about everywhere, at all times, making it possible to shop from your desktop, at home, at work, or even from your car.
2. Has *global reach*, permitting commercial transactions to cross cultural and national boundaries far more conveniently and cost-effectively than is true in traditional commerce.
3. Operates according to *universal standards* shared by all nations around the world. In contrast, most traditional commerce technologies differ from one nation to the next.

4. Provides information *richness*, which refers to the complexity and content of a message. It enables an online merchant to deliver marketing messages with text, video and audio to an audience of millions, in a way not possible with traditional commerce technologies such as radio, television, or magazines.
5. Is *interactive*—it allows for two-way communication between merchant and consumer and enables the merchant to engage a consumer in ways similar to a face-to-face experience, but on a much more massive, global scale.
6. Increases *information density* (the total amount and quality of information available to all market participants). The Internet reduces information collection, storage, processing, and communication costs while increasing the currency, accuracy, and timeliness of information.
7. Permits *personalization* and *customization*. Merchants can target their marketing messages to specific individuals by adjusting the message to a person's name, interests, and past purchases. Because of the increase in information density, a great deal of information about the consumer's past purchases and behavior can be stored and used by online merchants. The result is a level of personalization and customization unthinkable with existing commerce technologies.

1.3 Advantages of E-Commerce

On the web, data is collected electronically rather than manually so less noise is introduced from manual processing, which will increase data security and validity. To understand this point one can compare between e-commerce and the traditional commerce where people buy from real stores and pay physical

money. In traditional commerce, sellers or buyer might cheat , in e-commerce , cheating is less , because as mentioned before , in e-commerce the whole operation will be done electronically so it will be under the control of the system.

[Car01]

Electronic data is rich, containing information on prior purchases activity and detailed demographic data. In addition, some data that previously were very difficult to collect now are accessible easily. For example, electronic commerce systems can record the actions of costumers in the virtual store. Also for electronic commerce systems massive amount of data can be collected inexpensively. The electronic commerce system is easy to implement and evaluate data mining models because the internet already is automated. **[Car01]**

1.4 Types of E-Commerce

There are four generally accepted types of e-commerce: **[Kho06]**

1. Business to Business (B2B): in this type, e-commerce is done between business non-governmental institutions. Example, a company buys from an e-commerce web site for a factory.
2. Business to Consumer (B2C): this is the most common type for internet users. In which individual consumers buy from business e-commerce website. Example, someone buys an item from a business website.
3. Government to Business (G2B): In this type, the government deals with non –governmental institutions. Governmental tenders are a common example where government institutions make tenders for particular items and companies or factories providing these items.

4. Government to Citizens (G2C): this type is similar to B2C type except that the institution is governmental. Example, a governmental factory produces items for consumers.

Securities trading and stock exchange is considered to be B2B e-commerce.

1.5 Stock Exchange

A stock exchange, share market or bourse is a corporation or mutual organization which provides facilities for stock brokers and traders, to trade company stocks and other securities. Stock exchanges also provide facilities for the issue and redemption of securities as well as other financial instruments and capital events including the payment of income and dividends. The securities traded on a stock exchange include: shares issued by companies, unit trusts and other pooled investment products and bonds. [Dia07]

To be able to trade a security on a certain stock exchange, it has to be *listed* there. Usually there is a central location at least for record keeping, but trade is less and less linked to such a physical place, as modern markets are electronic networks, which gives them advantages of speed and cost of transactions. Trade on an exchange is by members only. The initial offering of stocks and bonds to investors is by definition done in the primary market and subsequent trading is done in the secondary market. A stock exchange is often the most important component of a stock market. Supply and demand in stock markets are driven by various factors which, as in all free markets, affect the price of stocks. [Dia07]

1.6 Data Collection

In the course of this work information concerning the stock market and the trading rules were required and the information was obtained by two methods:

1. From interviewing the personals working in the Iraqi stock market about the inner working of the trading process.
2. The Iraqi stock exchange web site was the source for all data needed about the registered brokers and companies.

1.7 Literature Survey

1. "Recommender systems for e-commerce data" [Bas04]

In this M.Sc. Thesis, Basim A. introduces a recommender system is built that uses different recommendation methods to advice a customer the best items that suit his/her interest from a selected site. In a typical recommender system people provide recommendations as input which the system then aggregates and direct to appropriate recipients. Method accuracy depends on several factors, these factors are: the speed of the accuracy which is different from customer to another and the psychological conditions of the recommender system users.

2. "Designing Bidding Strategies for Autonomous Trading Agents" [HE04]

HE M. thesis is concerned with developing bidding strategies for a range of auction contexts. Where it focuses on a number of agents mediated e-commerce settings. In particular, the researcher designs novel strategies for the continuous double auctions, for the international trading agent competition that involves multiple interrelated auctions, and for multiple overlapping English auctions.

All these strategies have been empirically benchmarked against the main other models that have been proposed in the literature and, in all cases; those strategies have been shown to be superior in a wide range of circumstances. Also, define all the models exploited soft computing methods, in particular fuzzy logic and neuro-fuzzy techniques, are used to cope with the significant degrees of uncertainty that exist in on-line auctions and shown as a practical solution method for this class of applications.

3. “Developing and Implementing a User-Centered Intranet: Organizational Culture, Communication and Knowledge Management” [Tho05]

In this thesis, Thorn J. expresses the developing and implementing of a user centered intranet in an organization. This organization has a high rate of change and an entrepreneurial culture which is sometimes chaotic. This challenging environment was a testing ground for the project, which sought to explore a number of propositions affirming the value of user-centered intranets.

- Developing and implementing the intranet encouraged collaboration amongst staff members.
- The intranet became a new channel of communication, which usefully enhanced the staff’s ability to share and find out what others are doing and how to contact them. This led to spin-off organizational improvements such as an improved collaborative reporting system, the restructuring of the organization manual files, and the establishment of a collaboratively-focused full monthly staff meeting. Developing and implementing a user centered intranet was a dynamic way to effect change in the organization and orient it towards a networked organizational model, one which is communication rich, both collaborative and participative.

4. “Using Extranets to Add Value” [Kri06]

Because extranets for B2B information sharing and transaction handling are becoming increasingly common, Krishna K. provides a better understanding on how extranets add value in B2B organizations. B2B systems for electronic commerce are rapidly becoming an essential resource for competitive success. At the same time, the capabilities of such systems are continually evolving. To reach this purpose, the study focused on the types of extranets and their characteristics, the security issues of extranets, as well as the stakeholders served at this level. In order to collect data to be able to answer these research questions, a case study strategy was used, focusing on Ericsson and Volvo in Sweden. Interviews were used as the primary data collection tool. The findings indicate that the type of extranet used depends upon the business model and communication system of the organization.

1.8 Related work:

Below, a brief introduction of two trading system similar to the system proposed in the project.

1.8.1 National Association of Securities Dealers Automated Quotation System – NASDAQ [Bor06]

The NASDAQ Stock Market, Incorporation is the largest electronic stock market in the United States (US), listing more companies and, on average, trading more shares per day than any other US market. The companies that list on NASDAQ operate in diverse industries.

NASDAQ is a dealers’ market, meaning brokers buy and sell stocks through market makers rather than from each other. NASDAQ is a publicly

owned company and trades its shares on its own exchange under the ticker symbol NDAQ.

NASDAQ is an electronic exchange with no physical trading floor. As such, NASDAQ makes all its trades through a computer and telecommunications system.

NASDAQ was developed in 1971 as the first electronic stock exchange in the world. It was created as a means to increase the trading of over-the-counter (OTC) stocks – that is, those stocks that were unable to meet the listing requirements for larger exchanges.

1.8.2. OMX Horizon and Equator

- ***Horizon*** [Tre06]

Horizon is a complete trading system that supports a broad range of cash-based financial instruments.

Today's marketplaces need real-time market automation solutions flexible, cost-effective technologies that satisfy and surpass user needs. Horizon has proven to be the right choice for more than two dozen transforming and growing markets around the world.

Horizon's high speed trading engine controls the central order book information, facilitates price negotiation and updates essential market information. Market statistics such as average and closing prices as well as volumes, and index calculations are calculated in real time. Trading results are recorded as they occur in a relational database.

The database provides real-time reporting including trade reporting to clearance and settlement services, historical analysis, and automated

billing. Data vendors and subscribers receive information via market data gateways.

Detailed market views are provided through an interactive streaming mechanism. Horizon also integrates seamlessly with Equator, the clearing and settlement system. This interface provides the ability to pre-validate orders and account holdings, significantly reducing settlement risk and achieving a total market solution.

- ***Equator [Con06]***

Equator is used to clear and settle thousands of trades. This advanced system also powers the national depository of several countries, tracking asset ownership by providing a secure, low risk and efficient clearing, settlement and depository service.

Equator users can define new instruments and corporate actions, as well as set processing rules by using simple operator interfaces. Supervisory staff has access to a range of account and transaction functions to rectify settlement failures or errors. A wide range of reports and audit features provide full traceability. EQUATOR can readily connect to exchange trading systems to provide a Straight-Through Processing (STP) environment and further reduce settlement cycles and risk. When used with the HORIZON exchange trading solution, EQUATOR can provide a tightly coupled environment where sell orders can be validated against depository inventory prior to trading, and credit exposure can be monitored in real time.

1.9 Aim of thesis:

In this project, a relatively secure intranet application model for securities trading is going to be proposed and established. The proposed model will make use of the benefits of the distributed databases architecture and should fulfill all the requirements relevant to trading operation; also, it offers some additional security protections to preserve the confidentiality and integrity of the trading information.

1.10 Thesis outlines:

This is the summary for the contents of the subsequent chapters of this thesis:

- **Chapter Two** (*Theoretical Background*): discusses the concept of internetworks, intranets, web servers and browsers, distributed database system; Also, it discusses information security and encryption methods.
- **Chapter Three** (*The Proposed Stock Trading System (STS)*): A structure of the proposed system is presented. The different parts of STS are explained and a brief explanation of their functions is provided.
- **Chapter Four** (*Interfaces and Evaluation*): this chapter presents STS interfaces and discusses the tests that were run on the system and the security issues concerned.
- **Chapter Five** (*Discussion, Conclusions And Suggestions For Future Work*) : the highlights of STS are presented and lists of conclusions and future work suggestions are included

Chapter Two

Theoretical Background

2.1 Internetwork

Two or more networks or network segments connected using devices that operate at layer 3 (the 'network' layer) of the Open Systems Interconnection (OSI) Basic Reference Model, such as a router. Any interconnection among or between public, private, commercial, industrial, or governmental networks may also be defined as an internetwork. [Pou01]

In modern practice, the interconnected networks use the Internet Protocol (IP). There are at least three variants of internetwork, depending on who administers and who participates in them:

- a) Intranet
- b) Extranet
- c) Internet

Intranets and extranets may or may not have connections to the Internet. If connected to the Internet, the intranet or extranet is normally protected from being accessed from the Internet without proper authorization. The Internet is not considered to be a part of the intranet or extranet, although it may serve as a portal for access to portions of an extranet. [Pou01]

2.1.1 Intranet

An intranet is a set of interconnected networks, using the IP and IP-based tools such as web browsers and File Transfer Protocol (FTP) tools that are under the control of a single administrative entity. That administrative entity closes the

intranet to the rest of the world, and allows only specific users. Most commonly, an intranet is the internal network of a company or other enterprise. **[Opp02]**

2.1.2 Extranet

An extranet is a network or internetwork that is limited in scope to a single organization or entity but which also has limited connections to the networks of one or more other usually, but not necessarily, trusted organizations or entities (e.g. a company's customers may be given access to some part of its intranet creating in this way an extranet, while at the same time the customers may not be considered 'trusted' from a security standpoint). Technically, an extranet may also be categorized as a Campus Area Network (CAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), or other type of network, although, by definition, an extranet cannot consist of a single Local Area Network (LAN); it must have at least one connection with an external network. **[Pou01]**

2.1.3 Internet

A specific internetwork, consisting of a worldwide interconnection of governmental, academic, public, and private networks based upon the Advanced Research Projects Agency Network (ARPANET) developed by ARPA of the United States (U.S.) Department of Defense, also home to the World Wide Web (WWW) and referred to as the 'Internet' with a capital 'I' to distinguish it from other generic internetworks. **[Pou01]**

Participants in the Internet, or their service providers, use IP Addresses obtained from address registries that control assignments. Service providers and

large enterprises also exchange information on the reachability of their address ranges through the Border Gateway Protocol (BGP). [Pou01]

2.2 The Internet versus Intranets

The Internet is a public network. Any user can access the Internet assuming the user has an account with an Internet Service Provider (ISP).

The Internet is a worldwide network, whereas intranets are private and are not necessarily connected to the Web. Intranets are connected to a specific company's network and usually the users are the company's employees. An intranet is separated from the Internet through a firewall (or several firewalls). Intranets usually have higher throughput and performance than the Internet and are usually more secure than the Internet. [Bid04]

The two also have a lot in common. They both use the same network technology, Transfer Control Protocol / Internet Protocol (TCP/IP), and they both use browsers for accessing information. They both use documents in Hyper Text Markup Language (HTML) and eXtended Markup Language (XML) formats and both are capable of carrying documents with multimedia formats. Also, they both use the Java programming (or its derivatives) language for developing applications. [Bid04]

Intranets may or may not use any of the technologies beyond HTML, i.e., Java programming, JavaScript or VBScript, Active X, Dynamic HTML, or XML. One of the advantages of an intranet is that since the organization can control the browser used, it can specify a browser that will support the technologies in use. Beyond Web documents, the organization can also specify the use of the Internet phone, e-mail, video conferencing, and other Web technologies supported by the chosen browser. [Opp02]

Table (2-1) summarizes the similarities and dissimilarities of these two technologies. [Opp02]

Table (2.1) The similarities and differences between the internet and intranet

Key features	Internet	Intranet
Users	Anybody	Employees only
Graphical Scope	Unlimited	Limited to unlimited
Speed	Lower than that of Intranet	Higher of that in Internet
Security	Lower than that of Intranet	Higher of that in Internet
Technology Used	TCP/IP	TCP/IP
Document Format	HTML	HTML
Multimedia Capability	Could be lower than that of an Intranet	Could be higher of that in Internet

2.3 Advantages of Intranets [Cal02]

1. *Productivity:* Intranets can help users to locate and view information faster and use applications relevant to their roles and responsibilities. With the help of a web browser interface, users can access data held in any database the organization wants to make available, anytime and - subject to security provisions - from anywhere within the company workstations, increasing employees' ability to perform their jobs faster, more accurately, and with confidence that they have the right information. It also helps to improve the services provided to the users.
2. *Time:* With intranets, organizations can make more information available to employees on a "pull" basis (i.e.: employees can link to relevant

information at a time which suits them) rather than being deluged indiscriminately by emails.

3. *Communication:* Intranets can serve as powerful tools for communication within an organization, vertically and horizontally.
4. Web publishing allows 'cumbersome' corporate knowledge to be maintained and easily accessed throughout the company using hypermedia and Web technologies. Examples include: employee manuals, benefits documents, company policies, business standards, newsfeeds, and even training. Because each business unit can update the online copy of a document, the most recent version is always available to employees using the intranet.
5. *Business operations and management:* Intranets are also being used as a platform for developing and deploying applications to support business operations and decisions across the internetworked enterprise.
6. *Cost-effective:* Users can view information and data via web-browser rather than maintaining physical documents such as procedure manuals, internal phone list and requisition forms.
7. *Promote common corporate culture:* Every user is viewing the same information within the Intranet.
8. *Enhance Collaboration:* With information easily accessible by all authorized users, teamwork is enabled.
9. *Cross-platform Capability:* Standards-compliant web browsers are available for Windows, Mac, and UNIX.

2.4 The Importunes of an Intranet for a Business engaging in E-Commerce

An intranet aids in the management of internal corporate information that may be interconnected with a company's e-commerce transactions (or transactions conducted outside the intranet). In as much as the intranet allows for the instantaneous flow of internal information, vital information is simultaneously processed and matched with data flowing from external e-commerce transactions, allowing for the efficient and effective integration of the corporation's organizational processes. In this context, corporate functions, decisions and processes involving e-commerce activities are more coherent and organized. [Kho06]

The proliferation of intranets has caused a shift from a hierarchical command-and control organization to an information-based organization. This shift has implications for managerial responsibilities, communication and information flows, and workgroup structures. [Ada03]

2.5 Web Browsers

Web browsers enable users to access content published on Web servers that reside on the Internet or corporate intranets. Web browsers request and receive content hosted on Web servers using Hypertext Transfer Protocol (HTTP), the standard application layer protocol for the World Wide Web. [Bid04]

Such content can be static, meaning it consists of text files formatted using (HTML) or the content can be dynamic, meaning it is generated on demand using server-side or client-side scripting technologies such as Microsoft Active Server Pages (ASP) and JavaScript. [Bid04]

Web browsers typically include features that make “browsing” (locating and accessing resources on) the Web simple, such as: [Tul02]

- a) Toolbar buttons for navigating forward and backward through the tree of previously displayed pages, for stopping the download process, and for manually refreshing a page that loaded incompletely.
- b) Lists of favorites or bookmarks that store Uniform Resource Locators (URLs) of frequently accessed sites as well as tools for organizing and accessing those URLs.
- c) Options for specifying a default home page from which to begin browsing, a default search engine for searching the Web, and other default browsing options.
- d) Security options for handling such concerns as whether to allow scripts, ActiveX components, or Java applets to run on the browser.
- e) Facilities for displaying a page’s underlying source code or HTML and even for editing and publishing Web content.
- f) Integration with other Internet software such as mail, news, or chat applications. Some Web browsers are packaged as stand-alone applications, while others are part of an overall suite of Internet tools that are integrated at various levels.

2.6 Web Servers [Tul02]

Web servers enable the publishing content on the Internet or on corporate intranets. Web servers host Web pages and other content that can be delivered using HTTP to Web browsers and other clients.

The first Web servers were originally developed for the UNiplexed Information and Computing System (UNIX) platform and were used for

publishing static Web content consisting of text files formatted using HTML. To enhance static Web pages, dynamic features such as forms were later added using scripts written in interpretive languages such as Perl that ran within the UNIX Common Gateway Interface (CGI) execution environment.

Other technologies developed later for delivering dynamic Web content include Java applets, ActiveX controls, Microsoft (ASP) server-side scripting, and many others.

2.7 Distributed Database

A database is a collection of data that is stored and maintained at one central location. A database is controlled by a database management system. The user interacts with the database management system in order to utilize the database and transform data into information. [Mit05]

The development in computer networking technology and database system technology resulted in the development of distributed database in the mid 1970s, it was felt that many applications would be distributed in the future and therefore the database had to be distributed also.

A distributed database system includes a distributed database (DDB), a distributed database management system (DDBMS) and a network for interconnections. [Kos02]

A distributed database is a collection of data that belong logically to the same system but are spread over the sites of a computer network. This definition emphasizes two equally important aspects of a distributed database [Cer85]:

- a. Distribution: the data are not resident at the same site, so that DDB can be distinguished from a single centralized database.

- b. Logical correlation: the data have some properties which tie them together, so that DDB can be distinguished from a set of local databases or files which are resident at different sites of a computer network.

2.8 Information Assurance (IA) [Tul02]

Information assurance is the process of protecting and defending information systems and infrastructures against attack. *Assurance* means confidence that the security features of a product or system fulfill their stated aims, and information assurance provides policies and procedures for developing, testing, and implementing information products in a secure fashion.

Information assurance focuses on five elements of information security:

- a) Authentication.
- b) Availability.
- c) Confidentiality.
- d) Integrity.
- e) Non repudiation.

Of these five elements, three of them (confidentiality, integrity, and availability) are often viewed as core elements of information security. [Tul02]

2.8.1 Identification and Authentication

Identification is the act of a user professing an identity to a system, usually in the form of a login Identity (ID). Identification establishes user accountability for his or her actions on the system. *Authentication* is verification that the user's claimed identity is valid, and it is usually implemented through a user password at login time. [Fun05]

Authentication is provided through a variety of means from secret passwords to using biometric characteristics. In general, authentication is accomplished by testing one or more of the following items: [Col05]

- a) Something you know, such as a personal identification number (PIN) or password; this factor is known as Type 1 authentication.
- b) Something you have, such as an Automated teller machine (ATM) card or smart card; this factor is known as Type 2 authentication.
- c) Something you are (physically), such as a fingerprint or retina scan; this factor is known as Type 3 authentication.

Obviously, using more than one factor adds additional credence to the authentication process. For example, *two-factor authentication* refers to using two of the three factors, such as a PIN number (something you know) in conjunction with an ATM card (something you have).

After authentication, a user is granted rights and permissions to access certain computer resources and information. This allocation is known as *authorization* of the user. [Col05]

2.8.2 Identification and Authentication techniques

The most common authentication and authorization techniques used now are:

1. Passwords [Col05]

Passwords are, by far, the most popular factor used for authentication. Therefore, protecting passwords from compromise and unauthorized use is crucial. Similar to a one-time pad in cryptography, a *one-time password* provides the highest level of password security. Because a new password is required every

time a user logs on to the network, an attacker cannot use a previously compromised password. [Col05]

A password that changes frequently is called a *dynamic password*. A password that is the same for each login is called a *static password*. An organization can require that passwords change monthly, quarterly, or at other intervals, depending on the sensitivity of the protected information and the password's frequency of use. [Col05]

In some instances, a passphrase can be used instead of a password. A *passphrase* is a sequence of characters that is usually longer than the allotted number of characters for a password. The passphrase is converted into a virtual password by the system.

Passwords can be generated automatically by credit card-sized memory cards, smart cards, or devices resembling small calculators. Some of these devices are referred to as *tokens*. These password generators are Type 2 devices, something you have. [Col05]

2. Biometrics

Biometrics is defined as an automated means of identifying or authenticating the identity of a living person based on physiological or behavioral characteristics.

Biometrics is a Type 3 authentication mechanism because it is based on what a person "is." Biometrics is useful in both identification and authentication modes. [Col05]

For identification, biometrics is applied as a *one-to-many* search of an individual's characteristics from a database of stored characteristics of a large population. An example of a one-to-many search is trying to match a suspect's

fingerprints to a database of fingerprints of people living in the United States. Conversely, authentication in biometrics is a *one-to-one* search to verify a claim to an identity made by a person. An example of this mode is matching an employee's fingerprints against the previously registered fingerprints in a database of the company's employees. [Fun05]

3. Single Sign-On

In *Single Sign-On (SSO)*, a user provides one ID and password per work session and is automatically logged on to all the required network resources and applications.

Without SSO, a user normally must enter multiple passwords to access different network resources. In applying SSO, passwords should be transmitted or stored in encrypted form for security purposes. With SSO, network administration is simplified, a stronger password can be used, and resources can be accessed in less time. [Col05]

4. Kerberos

Kerberos is named after a three-headed dog that guards the entrance to the underworld in Greek mythology. Kerberos is based on symmetric key cryptography and was developed under Project Athena at the Massachusetts Institute of Technology.

It is a trusted, third-party authentication protocol that authenticates clients to other entities on a network and provides secure means for these clients to access resources on the network. [Col05]

2.8.3 Availability

For any information system to serve its purpose, the information must be available when it is needed. This means that the computing systems used to store and process the information, the security controls used to protect it, and the communication channels used to access it must be functioning correctly.

High availability systems aim to remain available at all times, preventing service disruptions due to power outages, hardware failures, and system upgrades. Ensuring availability also involves preventing denial-of-service attacks. [Tul02]

2.8.4 Integrity

Integrity means accuracy and completeness of a received message or retrieved file. It is an essential aspect of information security and together with confidentiality and availability; it forms the “CIA triad.” An information system that protects the integrity of data and ensures that it has not been modified in transit (for messages) or during storage (for files). It is essential that intruders not be able to intercept and substitute legitimate data with false or forged data. Integrity of data can also be damaged accidentally by electrical discharges or natural disaster. [Tul02]

Physically securing storage systems and ensuring redundancy can protect the integrity of stored data. Protecting the integrity of transmitted information requires physical protection of transmission media, encryption of information so it can't be read or modified, and the use of checksums to detect when data has been modified. [Col05]

2.8.5 Confidentiality

It is a security concept that implies safety from interception, viewing, or copying. Confidentiality is an important element in the secure transmission of electronic information. On both wired and wireless networks, an attacker might try to eaves-drop to capture passwords or sensitive business information such as credit card numbers. [Tul02]

To prevent eavesdropping from being effective, communications can be encrypted using Data Encryption to ensure confidentiality. In addition, communications can be digitally signed to ensure their integrity—that is, to ensure that the information has not been tampered with during transit. [Tul02]

2.8.6 Non-repudiation

Non-repudiation is the concept of ensuring that a contract, especially one agreed to via the Internet, cannot later be denied by one of the parties involved.

In regard to digital security, non-repudiation means that it can be verified that the sender and the recipient were, in fact, the parties who claimed to send or receive the message, respectively. In other words, non-repudiation of *origin* proves that data has been sent, and non-repudiation of *delivery* proves it has been received. [Fun05]

2.9 The client/server model

The fundamental design for most network-based applications, particularly those on the Internet, is the client/server model. The names client and server are also commonly used to categorize computers on a network based on their functionality.

Initiation occurs when the user enters a URL (for example, www.google.com) into the client browser. The client indicates what is needed

wants from the server by sending a GET request. The server that maintains all of the information responds back to the client with a PUT method containing the requested data. [Col05]

This client/server relationship can be seen in other common Internet activities such as e-mail. Just as the post office stores and processes physical mail, e-mail is first stored in an electronic mailbox managed by a mail server. E-mail clients, such as Eudora or Outlook Express, send requests to the mail server using a specified protocol. The mail server processes this request and forwards e-mail to a client where it can be viewed and processed by the user. [Col05]

In the client/server model, an application is split into a front-end client component and a back-end server component.

The front-end client part of the application runs on a workstation and receives data that is input by the user. The client component prepares the data for the server by preprocessing it in some fashion, and then sends the processed information to the server, usually in the form of a request for some service. The back-end server component receives the client's request, processes it, and returns information to the client. The client receives the information returned from the server and presents it to the user through its user interface. [Tul02]

Usually most of the processing is done at the back end (server end) where database servers, messaging servers, file servers, and other resources are located.

An example of a simple client/server application is a Web application that is designed for Microsoft Internet Information Services (IIS) using a combination of server-side (ASP) programming and client-side scripting. The ASP scripts run on the Web server, while the client-side scripts run on the client Web browser. [Tul02]

2.10 Secure Sockets Layer/ Transport Layer Security

The Secure Sockets Layer (SSL) was an initiation by the Internet Task Engineering Force (IETF) during the 1990s aimed at securing Web transactions for commerce and financial organizations.

SSL works between the application and transport layers of the network protocol stack to ensure security of applications on the transport layer. SSL's basic aim is to provide authentication and integrity negotiation between applications involved. The negotiations can be used to decide on encryption algorithms to be used for the oncoming data exchange between the two parties. Today, most of the Web browsers, such as the Internet Explorer and Netscape Navigator, come with built-in SSL support that makes it quite transparent to the end user. [Bar01]

The SSL operating environment is represented in Figure 2-1.

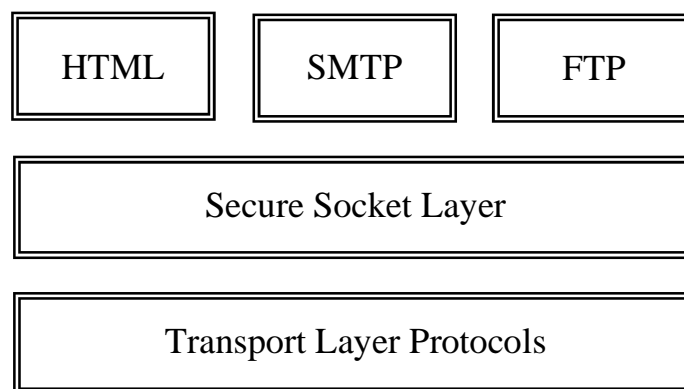


Figure (2.1) functional layout of SSL [Bar01]

The most important feature is that it shields the operation of the underlying security functionalities of Web browsers from the users. Thus, the Secure Shell (SSH) technology, a program that allows a user to log into another

computer remotely across the Internet, while maintaining complete security is able to add advanced security features to the Web browsers. [Col05]

SSL relies on public key cryptography for mutual authentication, confidentiality, data integrity, and so on, on these Web browsers. The system provides for high-end security into the Web browsers for very little incremental cost. This leads to highly scalable architectures in Web browsers and applicability in financial transactions where mutual authentication and confidentiality services are provided. Most financial transactions require protection between the servers and the users when credit card purchases are made using online Web browsers. The servers require the verification of the user when remote users download proprietary and confidential information from an organization's server. [Ste00]

2.11 Encryption

Encryption (sometimes called enciphering) transforms original information, called plaintext or clear text, into transformed information, called cipher text, code text, or simply cipher, which usually has the appearance of random, unintelligible data. The transformed information, in its encrypted form, is called the cryptogram. [Leh06]

When encryption is used to send messages, it is reversible. After transmission, when the information has reached its destination, the inverse operation (decryption, sometimes called deciphering) transforms the cipher text back to the original plaintext. There are cases in which encryption is one way only. [Leh06]

Most encryption techniques use rather simple mathematical formulas that are applied a number of times in different combinations. Most also use a secret

value called a key to encrypt and decrypt the text. The key is a kind of password, usually known only to the sender and the recipient of encrypted information. The encryption algorithm mathematically applies the key, which is usually a long string of numbers, to the information being encrypted or decrypted

The type of encryption algorithm, the secrecy of the key, and a number of other characteristics together form what's called the strength of the encryption; cryptographic strength determines how hard it is to break an encrypted message [Bel08].

PHP supports a number of encryption algorithms such as blowfish, Twofish, DES, saferplus, enigma, serpent, etc. The Twofish algorithm was chosen as the encryption algorithm for this project.

Twofish Algorithm

Twofish is a symmetric key block cipher with a block size of 128 bits and key sizes up to 256 bits. It was one of the five finalists of the Advanced Encryption Standard contest, but was not selected for standardization. Twofish is related to the earlier block cipher Blowfish.

The Twofish cipher has not been patented and the reference implementation has been placed in the public domain. As a result, the Twofish algorithm is free for anyone to use without any restrictions whatsoever. However, Twofish has seen less widespread usage than Blowfish, which has been available for a longer period of time [Sch99].

2.12 PHP Characteristics

1. **PHP Is Free** (as in Money)
2. **PHP Is Free** (as in Speech): As an open source project, PHP makes its innards available for anyone to inspect.

3. **PHP Is Cross-Platform:** It can be used with a web server computer that runs Windows, Mac OS X, Linux, Solaris, and many other versions of UNIX.
4. **PHP Is Widely Used:** As of March 2004, PHP is installed on more than 15 million different web sites, from countless tiny personal home pages to giants like Yahoo!. There are many books, magazines, and web sites devoted to teaching PHP and exploring what you can do with it. There are companies that provide support and training for PHP.
5. **PHP Hides Its Complexity:** PHP can be used to build powerful e-commerce engines that handle millions of customers. It can also be used to build a small site that automatically maintains links to a changing list of articles or press releases. When using PHP for a simpler project, it doesn't get in the way with concerns that are only relevant in a massive system. When advanced features such as caching, custom libraries, or dynamic image generation are needed, they are available.
6. **PHP Is Built for Web Programming:** Unlike most other programming languages, PHP was created from the ground up for generating web pages. This means that common web programming tasks, such as accessing form submissions and talking to a database, are often easier in PHP. PHP comes with the capability to format HTML, manipulate dates and times, and manage web cookies — tasks that are often available only as add-on libraries in other programming languages. **[Sk104]**

2.13 What is MySQL?

MySQL, the most popular Open Source Standard Query Language (SQL) database management system, is developed, distributed, and supported by MySQL AB.

- MySQL is a database management system.
- MySQL is a relational database management system.
- MySQL software is Open Source.

MySQL Server was originally developed to handle large databases much faster than existing solutions and has been successfully used in highly demanding production environments for several years

MySQL Server works in client/server or embedded systems.

The MySQL Database Software is a client/server system that consists of a multi-threaded SQL server that supports different backends, several different client programs and libraries, administrative tools, and a wide range of application programming interfaces (APIs).

- A large amount of contributed MySQL software is available.

[Wid02]

Chapter Three

The Proposed Stock Trading System

3.1 Introduction:

The Stock Trading System (STS) manages the Stock Market's basic activities starting from companies, investors and brokers' registration, to the trading process and making reports at the end of each trading session, it also provides information about the brokers, enlisted companies and the investors to authorized users.

The first step to enter the system is by registering as an STS user. The accessibility to the different parts of the system differs according to the type of the user, it varies between the ability to control the system (the administrator), the mere ability to view information provided by the system or the capability to participate in stock trading.

The trading process is where the actual trading occurs and thus it is the most important part of the system, it includes two stages:

- a. First stage includes selling and purchasing of stocks within the two hour trading session.
- b. Second stage is the producing the session's report which makes the final statistics of the trading session.

Security is an integral part of STS, it is ensured in term of authentication and authorization (identifying the different types of users and their privileges within the system). Integrity (the data is not getting changed or corrupted) and confidentiality.

MYSQL Server 6.0 was the chosen Database Management Server (DBMS), HTML and PHP were chosen as programming languages, JavaScript

was used for more interactive interfaces and Apache Server (2.2.6) as a network server.

3.2 System Architecture

STS is designed in Client/Server model, as shown in figure (3.1), it includes a number of computers; three of which are specified as stock market database server, the Stock Market's server, two bank servers; and other computers used are clients (users), each one of the market's three servers can also be considered as a client of the other two.

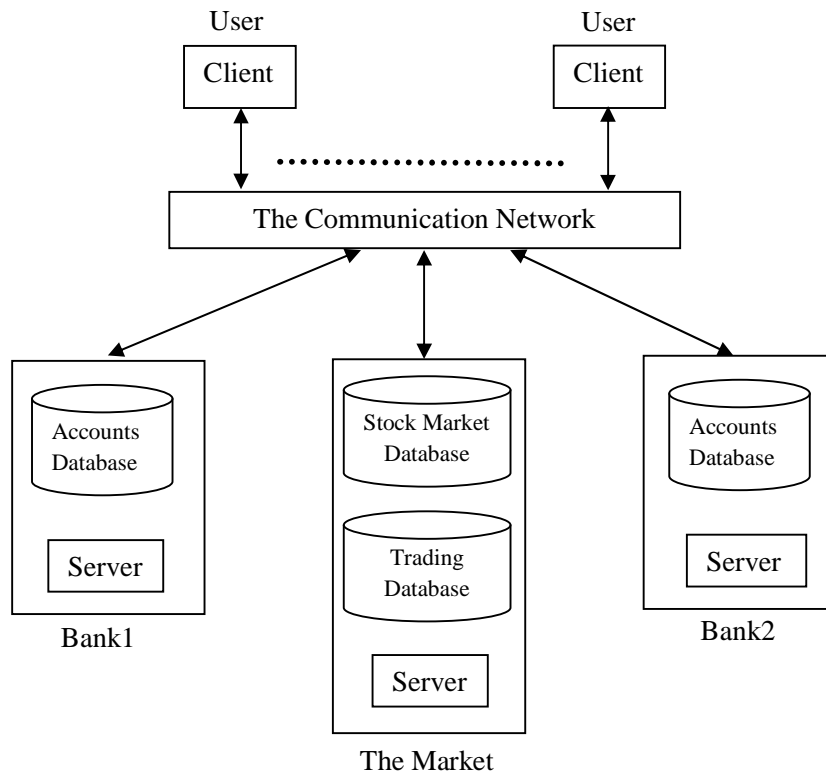


Fig 3.1 System Architecture

3.3 Users in STS

There are four types of users in STS each have their own privileges:

a) Administrator: Is a person that represents the stock market, he has the ability to control most of the system and intervene in the trading when an illegal action had taken place. The administrator has a special user interface (a control panel) that no other user can have access to.

This type of user does not have the right to participate in the trading process but he is the one responsible for starting and ending the trading session.

b) Broker: A stock broker is a qualified and regulated professional who buys and sells shares and other securities through the market on behalf of investors.

In STS, a broker type user can view the data regarding the investors he represents and he is the only type of users in the system that can actually participate in the trading process.

c) Investor: This user has a restricted access to the system; he can only view the information regarding his account and observes the trading session.

d) Company: Is a user with a very limited access; it can view only the names and shares of investors who own the companies stocks.

In addition, all users have the ability to view the detailed information about the enlisted companies.

3.4 The Distributed Databases in STS

The system utilizes four databases; two of them belong to the market while the other two to the associated banks.

These databases are:

a) Stock-Market Database

This database includes six tables; three (*investor, broker, company*) stores the information obtained when registering investors, brokers and companies. The fourth table is the *shares* which contains a list of companies' shares and their owners.

The *users* table includes the Identification numbers, passwords, and membership type of all users in the system. While the sixth table, the *logins* table, is used to keep track of users' logins to the system by recording the ID number, time, user IP and session ID for every login.

For the Stock-Market's database, it can be noticed:

- i. The tables in this database are updated when a new user registers to the system or by the administrator if the data provided by the user changes.
- ii. This database provides information about the brokers, investors, companies and the shares.
- iii. At the start of each trading session, the data required for the session is copied from this database.
- iv. The contents of the Stock Market's database are updated at the end of every trading session.

b) The Trading Database

This database contains all data concerning the trading process, it includes six tables:

- i. *Investor-information table* which contains information obtained from both Stock Market database and the Banks' databases. This information (investor name, broker_NIN, account no., balance) is necessary for the trading process.
- ii. *The shares table*, this table is copied directly from the Stock Market's shares table for easier and faster access during the session.
- iii. *Offers table*, it is used to store all offers made during the session. This table must be empty at the beginning of the session.
- iv. *The Trading-Session table*, if a deal is made during the trading session its details are stored in this table.
- v. *Trading-information table* contains the final result of the session obtained from the make report module.
- vi. The last table is the *previous-sessions table* that contains the dates, time and other information of previous sessions.

c) The Banks' Databases

These two databases are identical in structure and each belongs to a different bank, they provide accounts details of investors and brokers.

There is one table in the bank's database available to the system; it includes accounts information of STS users (such as account numbers, names, balances etc.).

3.5 STS Design

The proposed stock trading system includes four major modules (registration, login, the trading process and obtaining information), as shown in figure (3.2), each has its own set of algorithms, and every one of these modules will be explained in details in the following subsections.

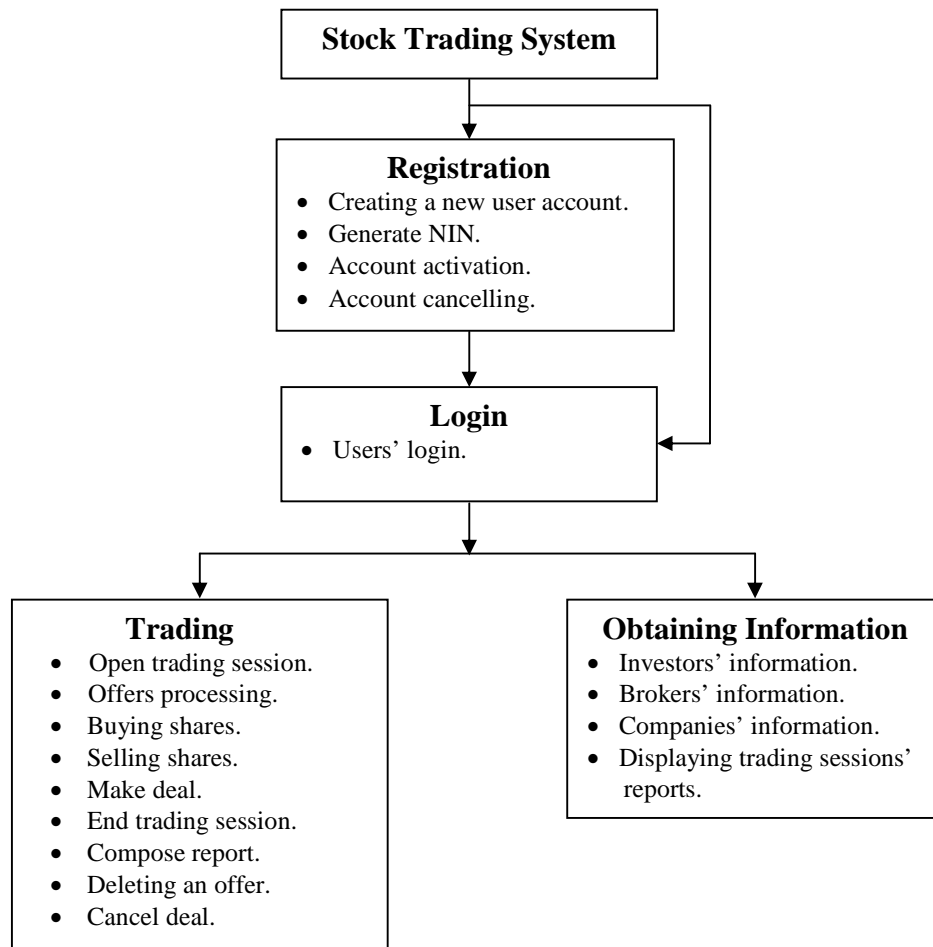


Figure (3.2) The proposed STS

3.5.1 Registration

A user can register to the system as one of three user types (broker, investor or company), the user has to fill in a form with the necessary information and then submit it to the system. The information will be validated and if it is approved then the registration is successful, otherwise the form will be redisplayed again with a list of all errors. Table (3.1) contains of all errors that might appear during the system's operations, while algorithm (3.1) describes the general process of registering a new user.

Table (3.1) Messages in STS

Number	Message
1	الرجاء ملء جميع الحقول التي بعدها اشارة *
2	كلمتا السر لا تتطابقان
3	لقد قمت بالتسجيل مسبقا بهذه المعلومات.
4	شكرا لتسجيلك في سوق العراق للاوراق المالية .. تفعيل حسابك قد يستغرق عدة ايام ... الرجاء الانتظار.
5	لقد سجلت دخولك مسبقا .
6	الرقم غير صحيح.. حاول مجدداً.
7	الرقم التعريفي او كلمة السر خطأ.
8	لا يوجد مستخدم بهذه المعلومات .. تأكد من المعلومات التي ادخلتها و تذكر يجب ان تكون سجلت عضوية في السوق قبل محاولة الدخول.
9	لم يتم تفعيل حسابك بعد.. العملية قد تستغرق عدة ايام.
10	حصل خطأ اثناء العملية .. لم يتم فتح جلسة التداول.
11	الرصيد في الحساب المصرفي للمستثمر لا يغطي تكاليف العرض.
12	المستثمر لا يملك الاسهم المطلوبة لتغطية العرض .
13	حصل خطأ عند التنفيذ .. الرجاء المحاولة مرة ثانية.
14	تمت العملية بنجاح.

Algorithm (3.1) Create New User Account

Goal: To make a new user account with an inactive status.

Input: The user's registration information (name, phone, email, address, etc.)

Step1: Display the form to be filled by the user.

Step2: If any of the required fields is not set **then**
Display message (1).

Step3: If the password<> confirm password **then**
Display message (2).

Step4: If there is a user with the exact same information **then**
Display message (3).

Else

Call Generate-NIN algorithm (3.2),
Insert the user's information into the appropriate table (broker,
investor or company),
Set the user status into inactive,
Display message (4).

Step5: return.

3.5.1.1 The National Identification Number (NIN)

A national identification number is used by the governments of many countries as a means of tracking their citizens, permanent residents, and temporary residents for the purposes of work, taxation, government benefits, health care, and other governmentally-related functions. Sometimes, the number will appear on an identity card issued by a country.

The ways in which such a system is implemented is dependent on the country, but in most cases, a citizen is issued a number at birth or when they

reach a legal age (typically the age of 18). Non-citizens are issued such numbers when they enter the country.

In STS, NIN was adapted as a form of identification for the Iraqi Stock exchange members. NIN is simulated such that every type of user has a special format for their NIN. For brokers, the broker NIN is a three digit number and every broker company has a domain of ten numbers which are the NIN their brokers will register under, an example, if the brokers company's domain is 030 then brokers under this company will have NIN of one of the following (030, 031, 032... 039).

As for companies the NIN is a four digit number, every company has only one identification number, example (1020, 1030 ...).

The investors in STS have a fourteen digit identification number; the investors NIN consist of several parts as shown in the example:

$$\begin{array}{cccccccccccccc} \underline{0} & \underline{8} & \underline{0} & \underline{2} & \underline{0} & \underline{4} & \underline{0} & \underline{1} & \underline{1} & \underline{2} & \underline{3} & \underline{4} & \underline{5} & \underline{6} \\ \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & \uparrow & \uparrow & \uparrow & \underbrace{\hspace{3em}} \\ \mathbf{1} & \mathbf{2} & \mathbf{3} & \mathbf{4} & \mathbf{5} & \mathbf{6} \end{array}$$

- 1- Represent the year the NIN was issued, i.e. 08 stands for 2008.
- 2- The broker NIN.
- 3- A number used to describe the investor whether he is a minor (0), incompetent (1), normal person (2), a company (3), a group (4) or the government (5), etc.
- 4- Indicates whether the investor is an Iraqi (0) or a foreigner (1).
- 5- Represent the sex of the investor (0 for male and 1 for female).
- 6- The investor's serial number in the market.

The administrator also has a NIN to log in to the system. Algorithm (3.2) describes how the NIN is generated in STS:

Algorithm (3.2) Generate NIN
<p>Goal: Generate a valid NIN for new users. Input: User –Type: broker, investor or company. Company-name: the brokers company name if exists. (Optional) Broker-NIN. (Optional) Competence: investors competence takes the value (0... 6). (Optional) Nationality: Iraqi or foreigner (0 or 1). (Optional) Sex: investor sex (0 or 1). (Optional)</p>
<p>Step1: <i>if (user-type = broker) then</i> Check if there is no company name then //registering a new broker company From Brokers table retrieve the domain of the last registered company, Return (domain+10). Else // the broker company is registered in STS Retrieve the NIN of the last broker that registered under the company name received, Return (NIN+1).</p>
<p>Step2: <i>if (user-type = company) then</i> Retrieve the NIN of the last registered company, Return (NIN + 1).</p>
<p>Step3: <i>if (user-type = investor) then</i> Year = the year without century. Retrieve the NIN of the last registered investor, New-NIN=the last six digits of the retrieved NIN Return (the concatenation of Year, Broker-NIN, Competence, Nationality, sex and New-NIN+1)</p>

3.5.1.2 Account Activation

Account activation is the administrator responsibility , a list of all new accounts (inactive) are displayed, the administrator then can view the submitted information of the new users and then either activate the account (Algorithm 3.3), or cancel the registration (Algorithm 3.4).

Algorithm (3.3) Account Activation

Goal: make the new user's account active.

Input: NIN: the user's NIN.

Step1: sent an email to the user with the NIN, password and activation link.

Step2: return.

Algorithm (3.4) Account Cancelling

Goal: delete the new user's registration.

Input: NIN: the user's NIN.

Step1: Delete the information of the user with user-NIN=NIN from users table,
Delete the information of the user with user-NIN=NIN from the appropriate
(broker, investor or company table).

Step2: return.

3.5.2 The Users Login

In order to access any page in STS the users must login to the system first, they have to enter their NIN and password in a form and also type the displayed verification code (Image Verification generates tests that allow the system to determine whether it is dealing with a human or with a program pretending to be human. Tests are designed in such a way that they can be easily passed by most humans, but cannot be passed by current computer programs. A test is pretty simple: the user is required to type a sequence of characters (letters, digits or both) that is displayed to him or her as an obscured, distorted image on the screen while the disguised code cannot be read by a computer program; it is easily read by a human. As a result, only human beings are allowed to submit forms), If the user could not provide correct information for three times his account will be suspended and he won't be able to access the system for fifteen minutes. Algorithm (3.5) shows the process of users' login.

Algorithm (3.5) Users Login

Goal: Login STS users.

Input: NIN: the user's NIN.

Pass: the user's password.

Code: the value entered by user.

Image-Code: the value displayed to the user.

Step1: define counter=0. //how many times the user has tried to login

Step2: ask the user for his NIN, password and the code.

Step3: if the user already logged in then

Display message (5).

Step4: if Counter > 3 then

Suspend the user's account for 15 minutes.

Step5: if Code <> Image-Code then

Display message (6),

Counter =Counter+1,

Go to Step2

Step6: if NIN="" or pass="" then

Display message (7),
Counter =Counter+1,
Go to step2.

Step7: from users table select the record with the provided NIN and password,

If there is no result display message (8),
Counter =Counter+1,
Go to Step2.

Else if the user's account is active then

- Insert the user's information into the logins table,
- Generate a new session for the user.

Else

- Display message (9)

Step9: return.

3.5.3 The Trading Process Modules

The trading process modules are the modules controlling the trading session, they include the algorithms to open and close the session, the administrator monitoring and the algorithms that manages the trading of stocks.

3.5.3.1 The Trading Session Start Module

This module is responsible for starting the session as well as retrieving all the data needed for the trading from the banks databases and the stock market's database; it only works in certain days on a certain time (specified by the Stock Markets administration).

It also stores the previous session's report in a file and deletes all record from the offers, Trading_Session and Trading_Info tables.

Algorithm (3.6) Open Session

Goal: start the trading session.

Input: Session-Status= False, //a Boolean flag (true or false) to indicate the session status (true for open session or false for closed session).

Step1: define errors=False. // a Boolean flag

Step2: from the banks databases retrieve the account number and balance for all investors,
If it failed set errors=True,
Go to step11.

Step3: from the stock market's database retrieve the name and NIN for all investors,
If it failed **then** set errors= True and Go to step11.

Step4: Insert the information retrieved to the investors-info table,
If it failed **then** set errors= True and Go to step11.

Step5: Copy the contents of the shares table from the stock-market database to the trading database,
If it failed **then** set errors= True and Go to step11.

Step6: store the content of the trading_info table in a file.
If it failed **then** set errors= True and Go to step11.

Step7: delete all records from the offers table.
If it failed **then** set errors= True and Go to step11.

Step8: delete all records from the trading_session table.
If it failed **then** set errors= True and Go to step11.

Step9: delete all records from the trading_info table.
If it failed **then** set errors= True and Go to step11.

Step10: insert the date, opening time and session status in to the Previous_Sessions table.
If it failed **then** set errors= True.

Step11: if (errors) **then**
 Display message (10).
Else
 Session-Status = True.

Step12: return

3.5.3.2 The Offers Processing Modules

This module takes the order presented by brokers and checks them for validity then execute the offer (if a match is available) or store it in the Offers table.

Algorithm (3.7) offers processing

Goal: execute or store new offers.

Input: Offer-type: sell or buy.

Step1: if (offer-type = buy) then
 Call Buying_Offers (algorithm 3.7).
 Else // if offer-type=sell
 Call Selling_Offers (algorithm 3.8).

Step2: return.

Algorithm (3.8) Buying_Offers

Goal: validate and execute buying offers.

Input: buyer_NIN.

 Broker-NIN.

 Shares: number of shares to be bought or sold.

 Share-price: the proposed price for a single share.

 Company: the company name.

 Offer-type: sell or buy.

 Retail: a Boolean flag to indicate if the offer must be executed as whole or if can be partitioned.

Step1: total-price= shares * share-price.

Step2: Retrieve the balance for the buyer from the Investor_Info table.

Step3: If ($balance \geq total-price$) **then**

- Retrieve all selling offers for the specified company with
Share-price \leq price,
- Sort results according to the time they occurred from oldest to newest.
- Within the sort results, sort according to share price from lowest to highest,
- **For** each one of the selected offers

If ($shares = offer-shares$) **then**

- Call **make-deal** (algorithm 3.9)
- **Exit For Loop.**

Else if ($shares < offer-shares$) **then**

If ($offer-Retail = 1$) **then**

- Call **make-deal** (algorithm 3.9),
- Update the offer information in Offers table set:
 $New-Shares = offer-shares - shares,$
- $Shares = 0.$
- **Exit For Loop.**

Else if ($shares > offer's\ shares$) **then**

If ($Retail = 1$) **then**

- Call **make-deal** (algorithm 3.9).
- $Shares = shares - offer-shares.$

Else // the balance does not cover the offer

Display message (11).

Step4: if ($shares > 0$) **then** //not all wanted shares were bought

Store the offer information in Offers table.

Step5: return.

Algorithm (3.9) Selling_Offers

Goal: validate and execute selling offers.

Input: Seller_NIN.

Broker-NIN.

Shares: number of shares to be bought or sold.

Share-price: the proposed price for a single share.

Company: the company name.

Offer-type: sell or buy.

Retail: a Boolean flag to indicate if the offer must be executed as whole or if can be partitioned.

Step1: total-price= shares * share-price.

Step2: Retrieve the number of shares owned by seller for the specified Company, call it seller-shares.

Step3: **If** (seller-shares >= shares) **then**

- Retrieve all buying offers for the specified company with Share-price >= price,
- Sort results according to the time they occurred from oldest to newest.
- Within the sort results, sort according to share price from highest to lowest.

• **For** each of the retrieved offers

If (shares= the offer- shares) **then**

- **Call make-deal** (algorithm 3.9).
- **Exit For Loop.**

Else if (shares < offer- shares) **then**

If (offer-Retail =1) **then**

- **Call make-deal** (algorithm 3.9),
- Update the offer in Offers table set:
New-Shares= offer shares – shares,
- Shares=0.
- **Exit Loop.**

Else if (shares >offer's shares) **then**

If (Retail) **then**

- **Call make-deal** (algorithm 3.9).
- Shares=shares – offer-shares.

Else // if investor shares does not cover the offer

Display message (12).

Step4: **if** (shares>0) **then** Store the offer information in Offers table.

Step5: **return.**

Algorithm (3.10) Make Deal

Goal: execute a deal.

Input: Broker-NIN.

Buyer-NIN: the NIN of the investor buying the shares.

Seller-NIN: the NIN of the investor selling the shares.

No-Shares: number of shares in the offer.

Share-price: the price for a single share.

Total-price: total price for the offer.

Company: the company the shares in the deal belong to.

Step1: //exchange shares ownership

In shares table,

If the buyer already owns shares in the company **then**

Set shares=shares +No-shares.

Else

Insert new record to shares table with the buyer-NIN, bought shares and Company NIN.

Step2: Set shares =shares- No-Shares

// for the seller.

Step3:// store the new deal

Insert the deals details (buyer-NIN, seller-NIN, No-shares, share-price, total-price, broker-NIN, date and time) in to the trading session table.

Step4 in Offers table, set offer status to “executed”.

Step5: // make money transfer

For the buyer, set balance = balance – total-price.

For the seller, set balance = balance + total-price.

Step6: if any of the above failed **then**

Display message (13).

Else

Display message (14).

Step7: Return.

3.5.3.3 The End Session Module

This module is responsible for ending the trading session and updating the stock market's database and the banks databases with the results of the trading session.

Algorithm (3.11) End Session
Goal: close the trading session. Input: Session-Status: a Boolean flag (true or false) to indicate the session status (on or off).
Step1: Session-Status = False. Step2: Replace the records in the stock-market's shares table with the new information that resulted from the trading session. Step3: Update the balance for investors in the banks' databases with the new information that resulted from the trading session. Step4: Return.

3.5.3.4 The Compose-Report Module

This module makes the necessary calculation that are required to compose the report of the trading session, it works throughout the session putting the results in the Trading _Info table until the session is closed. Then, it will be called for the last time to produce the final report.

Algorithm (3.11) shows the compose report module.

Algorithm (3.12) Compose Report

Goal: compose the trading session's report.

Input: All data in Trading-Session table.

Step1: Select the NIN for all companies participating in the trading session from the Trading_Session table

Step1: for each company

- calculate
 - No-Of-Deals=the number of all executed deals for the company.
 - Total-Price=the sum of prices for all executed deals.
 - Total-Shares=the sum of all shares traded in the session for the company.
 - Price-Average=the average for share prices for all executed deals.
 - Highest-Price=the highest share price in all executed deals.
 - Lowest-Price= the lowest share price in all executed deals.
 - Trading-Size= (total-shares*total-price)/1000000 // in millions
 - Opening-Price=the share price of the first executed deal.
 - Closing-Price= the share price of the last executed deal.
 - Last-Selling-Offer-Price= the share price of the last selling offer.
 - Last-Buying-Offer-Price= the share price of the last buying offer.
- From the previous trading session report, retrieve the Closing Price for the company.
- Insert all the data in to the Trading-Info table.

Step2: Return.

3.5.3.5 Trading Session Monitoring

The administrator can see all the offers made during the trading session (executed or not) and can delete any of them if they violated the market's regulations.

If the offer is not executed then it is only deleted from the offers table with no consequences while if it was executed then the whole process must be reversed and all the deal must be undone.

Algorithm (3.12) shows how the offer is deleted in both cases:

Algorithm (3.13) Deleting an offer

Goal: delete an offer or undo a deal.

Input: the offer's number.

Step1: retrieve the offer's details.

Step2: if the (offer status = executed) then

Call Cancel_Deal (algorithm 3.13).

Else

Delete the offer from offers table.

Step3: return.

Algorithm (3.13) describes the steps necessary to undo unexecuted deal.

Algorithm (3.14) Cancel_Deal

Goal: undo a deal.

Input: Broker-NIN.

Buyer-NIN: the NIN of the investor buying the shares.

Seller-NIN: the NIN of the investor selling the shares.

No-Shares: number of shares in the offer.

Share-price: the price agreed upon.

Total-price: total price for the offer.

Company: the company the shares in the deal belong to.

Step1: //return shares to the seller
Set shares =shares- No-Shares, for the buyer.

Step2: *If the seller does not own any more shares in the company then*
Insert new record to shares table with the seller-NIN, shares and Company.

Else
Set shares=shares +No-shares.

Step3:// delete the deal
Delete the deal from the trading session table.

Step4 Delete the offer from the Offers table.

Step5: // make the money transfer
For the buyer, set balance = balance + total-price.
For the seller, set balance = balance - total-price.

Step6: *if any of the above failed then*
Display message (13).

Step8: Return.

3.5.4 Obtaining information

In addition to the above, STS provide the users with the ability to view brokers, investors and companies' information, although what they can view differs according to the user privileges.

While brokers' information is open for all users, the investors' is not; An investor can only view his own account information as well as additional data from his bank account, any broker can view the information regarding the investors he is representing while a company type user can only have the names and shares number for investors owning shares in the company.

The administrator can view some parts from the investor account such as his NIN, broker's name, broker's company and registration date.

Companies' information is also open but an additional list of all stock owners and how much they own is added if the user is company.

There are three modules for providing the information mentioned above as well as a module that displays the trading report.

Algorithm (3.14) describes the module that retrieves investors' information:

Algorithm (3.15) Investors' Information

Goal: obtain the investor's information.

Input: User-Type.

Step1: *if* (user-type= broker) **then**

Retrieve the (name, the broker's authorization date, the authorization period, balance in the bank and the shares and company names)for all investors the broker is representing,
Display the information.

Else if (user-type=investor) **then**

Retrieve all investor information from his account in the stock market database,
Retrieve the bank information (balance) from the bank database,
Display the information.

Else if (user-type=company) **then**

Retrieve the names and shares of all stock holders for the company,
Display the information.

Else // the user is the administrator

Retrieve NIN, broker name, broker company and registration date for all registered investors,
Display the information.

Step2: return.

Algorithm (3.15) shows the module that retrieves brokers' information.

Algorithm (3.16) brokers' Information
Goal: obtain the brokers' information. Input: the broker's NIN.
Step1: Retrieve all brokers' (name, company, phone, email, establish date and executive director) from their accounts in the Stock Market database, Step2: Display the information. Step3: return.

Algorithm (3.16) shows the module that retrieves companies' information.

Algorithm (3.17) the company's Information
Goal: obtain the company's information. Input: User-Type. Company's NIN.
Step1: Retrieve the company's (name, address, phone, cell phone, email, executive director, capital, listing date and capital at listing) from its account in the stock market database, Step2: Display the information. Step3: if User-Type= company then Retrieve the names and shares of all share owners in the company, Display the information. Step4: return

Algorithm (3.17) shows the module responsible for displaying the trading session's report, every trading session's report is saved in a file with the date and time of the session; this file is retrieved when that report is asked for by a user.

Algorithm (3.18) the trading session report

Goal: display the report of any session report.

Input: Trading Session date.

Step1: retrieve the file with the specified date.

Step2: read the information from the file,
Display them in a table structure.

Step3: return

Chapter Four

STS Interfaces and Evaluation

4.1 STS Interfaces

STS interfaces are designed as web pages using HTML, JavaScript and PHP and they can be viewed using web browsers.

Those pages can be classified into public pages, which can be viewed by anyone visiting the system, and users' pages that can only be viewed by registered users. The public pages in STS are:

4.1.1 The Home Page

It contains information about the Iraqi Stock Exchange such as its goals and rules, see figure (4.1), and also includes a menu to navigate through the system, see figure (4.2).

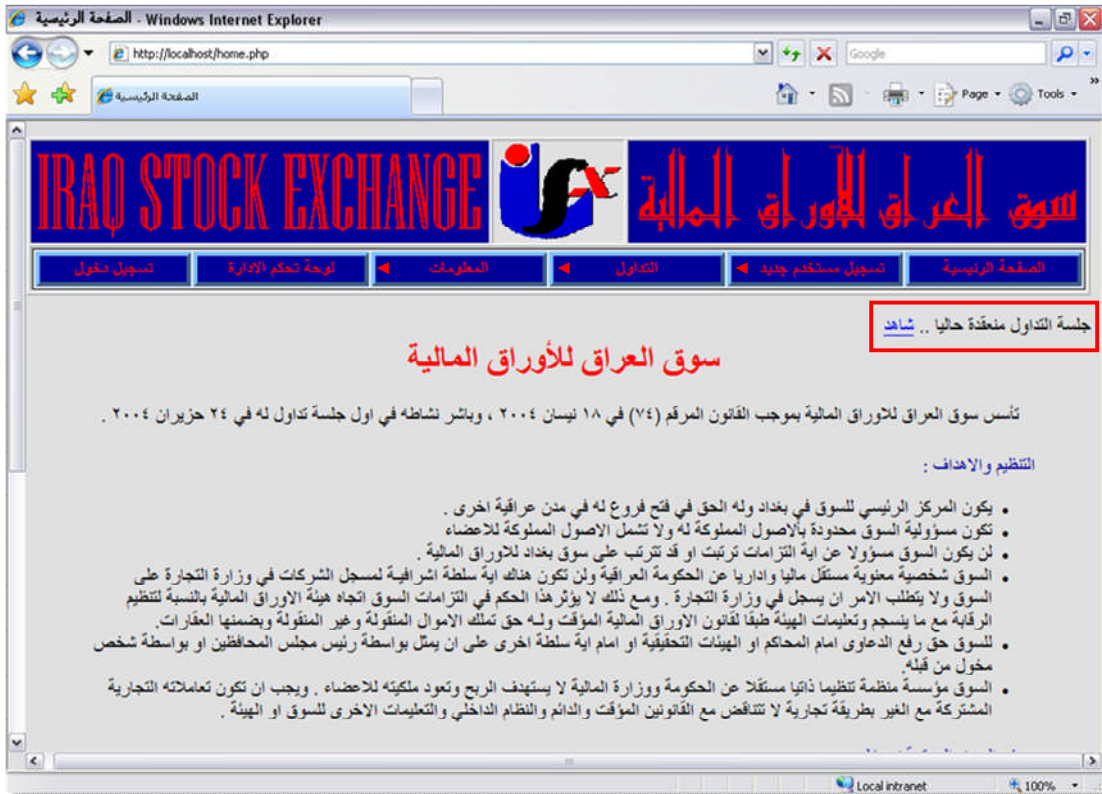


Figure (4.1) STS home page



Figure (4.2) STS Menu

4.1.2 The Trading Sessions' Progress Report

If the trading session is open, a link to this page is displayed on top of the home page. This page displays a table, figure (4.3), which contains basic information about the deals made throughout the trading session; it starts empty and it is updated every thirty second.

عدد العقود المنفذة	سعر الممهم لآخر عقد منفذ (دينار)	اثنى سعر للمهم (دينار)	اعلى سعر للمهم (دينار)	سعر الإغلاق للجملة المسليقة (دينار)	سعر الأفتتاح (دينار)	عدد الاسهم المتداولة	الشركة
٦	١,٤٠٠	١,٤٠٠	١,٤٥٠	١,٢٠٠	١,٤٠٠	٨٢٧٣٤٨٧	مصرف الاقتصاد للاستثمار والتمويل
٩	٣,١٥٠	٣,٠٥٠	٣,١٥٠	٣,٠٥٠	٢,٠٠٠	٢٢٨٧٥٢٢١	مصرف كردستان الدولي للاستثمار والتنمية
١٢	٠,٩٠٠	٠,٨٥٠	٠,٩٠٠	٠,٨٠٠	٠,٨٥٠	٦٤٢٩٢٣٦٨	الاهلية للانتاج الزراعي(مساهمة خاصة)
٣٣	٢,٧٥٠	٢,٥٠٠	٢,٧٥٠	٢,٦٠٠	٢,٥٠٠	٧٥٨٣٤١٨٩	دار السلام للتأمين
٦	١,١٠٠	١,٠٥٠	١,١٠٠	١,٠٠٠	١,٠٥٠	٧٣٣٥٠٤٨	الشرق الاوسط لاتنتاج وتسويق الاسماك (خاصة)
١	٣,٦٠٠	٣,٦٠٠	٣,٦٠٠	٣,٥٠٠	٣,٦٠٠	٤٨٣٣٩٨	العراقية لاتنتاج وتسويق اللحوم والمحاصيل الحقلية
٤	١,٢٥٠	١,٢٥٠	١,٣٠٠	١,٢٠٠	١,٣٠٠	٨٥٧٩١٦٧	مصرف دار السلام للاستثمار
٢٠	١,٥٠٠	١,٤٠٠	١,٥٠٠	١,٤٠٠	١,٤٠٠	٥٨٣٠٥٠٠٠	العراقية لنقل العنوتجات النفطية واليضع
٣	١,١٠٠	١,٠٥٠	١,١٠٠	١,١٠٠	١,٠٥٠	١٨٧٥٠٠٠	مصرف الوركاء
٢	٣,٨٥٠	٣,٨٠٠	٣,٨٥٠	٣,٨٠٠	٣,٨٠٠	١٩٠٠٠٠٠٠	مصرف الشمال
٣	١,٤٥٠	١,٤٠٠	١,٤٥٠	١,٣٠٠	١,٤٠٠	١١٩٦٢٥٥	مصرف كردستان
٥	١,١٠٠	١,١٠٠	١,١٠٠	١,١٠٠	١,١٠٠	٢٦٨٠٤٩١٣	مصرف الشور الدولي للاستثمار
٥	٢,٨٥٠	٢,٨٥٠	٢,٨٥٠	٢,٨٠٠	٢,٨٥٠	٢٢٩٥٥٦٨	المعمورة العفارية

Figure (4.3) session progress report

4.1.3 The Registration Forms

In order to access the other private parts of the system the visitor must first register as one of three types of users known to the system (broker, investor or a company); three forms are supplied by the system for that purpose.

Figure (4.4) shows the brokers registration form.

الحقول التي بعدها علامة * مطلوبة:

أسم الوسيط:

شركة الوساطة:

الهاتف:

البريد الإلكتروني:

أسم المدير المفوض:

رأس المال:

تاريخ التأسيس:

اليوم الشهر السنة

رقم السجل التجاري:

أسم المصرف:

كلمة السر:

رقم الحساب:

أعد ادخال كلمة السر:

تسجيل

Figure (4.4) the broker's registration form

The visitor must fill in the form for the type of membership they desire and submit it to the system to be validated. If one or more errors in the information were found then the form will be redisplayed with a list of all errors for the user to be corrected, as shown in figure (4.5)

الرجاء تصحيح الأخطاء التالية

- رقم الهاتف غير صحيح
- البريد الإلكتروني الذي ادخلته غير صحيح.. البريد يجب ان يأخذ الشكل user@mailserver.com
- أدخل قيمة رأس المال رقماً.
- رقم السجل التجاري غير صحيح.
- رقم الحساب غير صحيح.
- كلمة السر يجب ان لا تقل عن ٨ رموز ولا تزيد عن ١٦.

الحقول التي بعدها علامة * مطلوبة:

شركة الوساطة*: شركة الفوز

الهاتف*: [Yellow box]

البريد الإلكتروني*: [Yellow box]

أسم المدير المفوض*: احمد خضر خلف

رأس المال*: ١٥٠٠٠٠

تاريخ التأسيس*: 2007 4 29

رقم السجل التجاري*: [Yellow box]

اسم الوسيط*: محمد احمد خضر

Figure (4.5) the broker's registration form with the errors list

4.1.4 The Login Page

Registered users must login to the system to get permission to access private pages; this page appears to anyone trying to view these pages and is not identified by the system as a user.

To login, the user must fill the form in figure (4.6) with the NIN (received from the market's administration through email when his account activated) and his password. He also must enter the image verification code displayed by the system, the information is then checked, and if errors occurred an error message is displayed, and the user must retry to login again. If login succeeded he will be directed back to the home page where he can access any part of the system he wants according to his privileges.

Figure (4.6) STS login form

All other pages are limited to registered users only, their contents may differ according to the user’s membership type and privileges, these pages are:

4.1.5 The Trading Page

This page consists of three parts; the companies list, the offers details and a form for adding new offers. The trade page is shown in figure (4.7) as it appears for brokers.

نوع العرض	الاسهم	سعر السهم	الوسيط	الوقت
بيع	٢٠٠٠٠	٣,٠٠٠	شركة الفوز	١٠:٠٢:٣٠
شراء	١٠٠٠٠٠٠	٢,٠٠٠	شركة الحياة	١٠:١٤:٠٣
شراء	٦٠٠٠٠٠	١,٠٠٠	شركة الحياة	١١:١٠:٣٨
شراء	٣٠٠٠٠٠	١,٥٠٠	شركة الحياة	١١:٢٩:١٨

Figure (4.7) the trading page

The companies list, (the table at the right side in figure (4.7)), is a table that consist of three columns the first is the names of all enlisted companies that are allowed to participate in the session, the second is the share closing price of the companies from the previous trading session while the third is the number of waiting offers.

The second part includes a table, the middle table in figure (4.7), which contains the details of all waiting orders for a specific company; the user can choose a company from the companies list and view its orders.

The third part is a form used to add a new offer as seen in figure (4.8), it only appears when the user is a broker, because only brokers are allowed to participate in trading sessions while all others can only observe.

The broker must fill-in the form to submit an offer to the system and that offer will then be processed, it will either be executed (if a match is found in the waiting offers) or added to the waiting offers.

The screenshot shows a form for adding new offers. It contains several fields and controls:

- 1:** A dropdown menu for selecting a company, with the text 'شركة الفوز' (Company Al-Foz) visible.
- 2:** A dropdown menu for selecting an investor, with 'مستثمر 1' (Investor 1) selected.
- 3:** A text input field for the company name, with 'الاخاء للانفتاح الزراعي (مساهمة خاصة)' (Al-Akhaw for Agricultural Opening (Special Contribution)) as a placeholder.
- 4:** A dropdown menu for selecting a share type, with 'الأسمم' (Shares) selected.
- 5:** A dropdown menu for selecting an offer type, with 'شراء' (Buy) selected.
- 6:** A text input field for the price, labeled 'السعر:' (Price).
- 7:** A checkbox labeled 'بالتجزئة' (In lots).
- 8:** A button labeled 'أضف العرض' (Add Offer).

Figure (4.8) the form to add new offers

The form's contents are:

1. The broker's company name.
2. A list of all investors registered with the broker.

3. A list of all companies that are allowed to participate in the session.
4. The share price.
5. The number of shares.
6. The operation type (buy or sell).
7. Retail.
8. The offer submit button.

If the user is not a broker the page will be displayed as shown in figure (4.9)



Figure (4.9) The trading page as it appears for users other than brokers

4.1.6 The Information Pages

Three pages in STS site contain information about the system users and since most of the information provided at the registration can be shared, these pages are accessible to all users although its contents may differ, for example the brokers information can be viewed by all users, while an investor's personal data is only available for the investor himself.

The brokers information is the same for all users, see figure (4.10).



شركة الوساطة	رقم الهاتف	البريد الإلكتروني	المدير المفوض	تاريخ التأسيس	رأس المال (مليون دينار)
شركة المتحدة	7188809	almutahida_broker@yahoo.com	فرمان خزان حسن	2006/3/5	20
شركة اطلس	7190057	atlaco_alatlas@yahoo.com	سامي حمودي محمد	2001/3/26	100
شركة الامان	7191313	aman_iraqicom@yahoo.com	عمار اكرم صالح	1977/5/15	20
شركة الاهلي المتحدة	7170057	commerce.iraq@ahliunited.com	مها ندمان نوري	1998/3/10	100
شركة البركة	7172008	albaraka310@yahoo.com	عماد شاكر عبد الجبار	1987/3/7	50
شركة الجوهرة	7182002	jawharabrokerage@yahoo.com	علي جمال امين	1992/4/26	20
شركة الربيع	7180696	info@rabeesecurities.com	نه وشروان كمال بابان	1999/3/21	50
شركة الشمال	7187880	alshimal_broker_co@yahoo.com	علي عبد الحسين علي	2008/1/1	20
شركة الفرح	2967066	farroha2004@yahoo.com	فرح احمد خصص	2000/8/10	100
شركة الفوز	7706810	alfawz_co@yahoo.com	احمد وليد احمد	1982/10/24	100
شركة الكرمل	7193476	info@sizr-karmal.com	وسيم بوحدنا الجزراوي	2007/2/2	250
شركة الكساب	7400284	alkassabcompany@yahoo.com	فائق نعيم عبد الكريم	1989/2/16	100
شركة الوفاء	7190718	thabet_1969@yahoo.com	ثابت عبد المنعم	1983/8/10	20
شركة بابل	8169331	hatham_saman2005@yahoo.com	هيثم نافع الياصر	2000/9/17	50

Figure (4.10) The brokers' information

The investors' information page differs for each type of user. The administrator will see the names, broker's company, broker name and registration date for all investors as shown in figure (4.11). The investor type users can view all information regarding their account, see figure (4.12), the brokers can view information they need such as the investor's account balance and the shares he owns, as shown in figure (4.13), a company type user will have a list of all investors that own shares in the company and the number of share that they own, see figure (4.14).



اسم المستثمر	شركة الوساطة	الوسيط	تاريخ التسجيل
مستثمر 1	شركة الفوز	احمد وليد احمد	2008/11/12
مستثمر 2	شركة الحياة	طالب عباس الطباطبائي	1999/5/22
مستثمر 3	شركة الحياة	طالب عباس الطباطبائي	2003/3/3
مستثمر 4	شركة العراق	محي عباس فليح	2000/8/5
مستثمر 5	شركة الوفاء	احمد وليد احمد	2001/12/21
مستثمر 6	شركة العراق	محي عباس فليح	1998/2/15

Figure (4.11) the investors' information page as it appears to the administrator

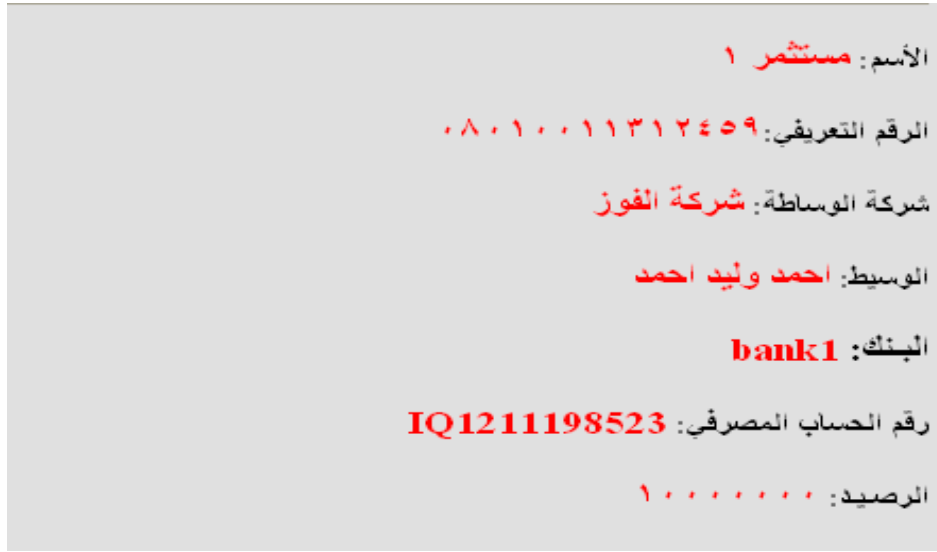


Figure (4.12) The investors' information page as it appears an investor

شركة الفوز

الرقم	اسم المستثمر	تاريخ التحويل	فترة التحويل	الرصيد
١	مستثمر ١	٢٠٠٨/١/١	٢٠٠٩/٦/١	١٠٠٠٠٠٠٠
٢	مستثمر ٢	٢٠٠٨/٢/٣	٢٠٠٩/٨/٣	٢٠٠٠٠٠٠٠
٣	مستثمر ٣	٢٠٠٤/٣/٢٢	٢٠٠٩/١١/١	٩٠٠٠٠٠٠٠
٤	مستثمر ٧	٢٠٠٧/١/١	٢٠٠٩/١٠/١	٨٠٠٠٠٠٠٠

Figure (4.13) The investors' information page as it appears to brokers

دار السلام للتأمين

اسم المستثمر	الأسهم
مستثمر ٣	١٢٠٠٠٠٠
مستثمر ٢	٦٠٠٠٠
مستثمر ١	١٠٠٠٠٠
مستثمر ٦	١٥٠٠٠٠

Figure (4.14) The investors' information page as it appears to companies

The companies' information is also shared by all users, figure (4.15).



Figure (4.15) The companies' information page

4.1.7 The Administrator's Control Panel

This page can only be viewed by the administrator, using the control panel the administrator can open, monitor and close the trading sessions, view the information for new registered users and all suspended accounts so that he can activate or reactivate them.

It also contains links to the other parts of the system so that he will not need the site menu to reach any page. The administrator's control panel is shown in figure (4.16).



Figure (4.16) The administrator's control panel

The button to open the trading session remains inactive until the time to open the session by the market's rules, it will also be inactive when the session is already open. The opposite happens with the session close button as it stays inactive unless the session is open.

4.1.8 Session Monitoring Page

This page contains a table with all orders made in the session whether they were executed or not, see figure (4.17), it can be accessed from the control panel so it is available only to the administrator. It provides all details regarding the offers and the administrator can delete any offer from the list even if a deal was made for the offer (in that case the deal will be canceled).

نوع العرض	الشركة	عدد الاسهم	سعر السهم الواحد	وقت اضافة العرض	حالة العرض
شراء	مصرف الاقتصاد للاستثمار والتمويل	١٠٠٠٠	١,٤٠٠	١٠:٠٤:٢٣	منفذ
بيع	مصرف كردستان الدولي للاستثمار والتنمية	١٥٠٠٠	٢,١٠٠	١٠:٠٥:٤٤	غير منفذ
شراء	الاطية للانتاج الزراعي (مساهمة خاصة)	٢٠٠٠٠	٠,٨٥٠	١٠:٠٩:٢٢	منفذ
شراء	الاطية للانتاج الزراعي (مساهمة خاصة)	٣٠٠٠٠٠	٠,٩٠٠	١٠:٠٩:٣٥	منفذ
بيع	الاطية للانتاج الزراعي (مساهمة خاصة)	١٠٠٠٠٠٠	٠,٨٥٠	١٠:١١:٠٣	منفذ
شراء	الحراية لانتاج وتسويق اللحوم والمحاصيل الحظية	٤٥٠٠٠	٣,٦٠٠	١٠:١٢:١٦	غير منفذ
بيع	الحراية لانتاج وتسويق اللحوم والمحاصيل الحظية	٦٠٠٠٠٠	٣,٥٠٠	١٠:١٦:٢١	غير منفذ
بيع	نبنوى للصناعات الغذائية	٢٥٠٠٠٠	١,٤٥٠	١٠:١٧:٤٣	منفذ
بيع	الهلال الصناعية	٣٠٠٠٠٠٠	٠,٧٠٠	١٠:٢١:٥٤	منفذ
شراء	الهلال الصناعية	١٠٠٠٠٠٠	٠,٧٠٠	١٠:٢٢:٣١	غير منفذ
شراء	مصرف اشور الدولي للاستثمار	٨٠٠٠٠	١,١٠٠	١٠:٢٣:١٢	منفذ
بيع	المعمورة العقارية	٦٥٠٠٠٠	٢,٨٥٠	١٠:٢٦:٠٩	غير منفذ
بيع	المنتجات النفطية والفضائح	١٦٠٠٠٠	٠,٨٠٠	١٠:٢٨:٤٢	منفذ

Figure (4.17) The session monitoring page

4.1.9 Trading Session Reports

In this page, see figure (4.18) , the users can view the reports of all previous trading sessions, on the right side of this page, a list of the sessions' dates are displayed so that the user can choose a specific session and see its report. If the trading session is not open, any user trying to access the trading page will be automatically directed to this page and the report for the latest session will be displayed to the user.

الشركة	الاسهم	حجم التداول (مليون دينار)	سعر الافتتاح	سعر الاغلاق	معدل السعر الحالي	معدل السعر السابق	اعلى سعر نفذ	اقل سعر نفذ	سعر آخر طلب شراء	سعر آخر عرض بيع	عدد العقود المنفذة
مصرف الاقتصاد للاستثمار والتمويل	٨٢٧٣٤٨٧	١١٧٢٣٨٨٢	١,٤٠٠	١,٤٠٠	١,٤٠٠	١,٤٠٠	١,٤٥٠	١,٤٠٠	١,٤٠٠	١,٤٥٠	٦
مصرف كردستان الدولي للاستثمار والتنمية	٢٢٨٧٥٢٢١	٧٠٧٠٥٩٧٦	٢,٠٠٠	٢,١٥٠	٢,١٥٠	٢,١٥٠	٢,١٥٠	٢,٠٥٠	٢,٠٠٠	٢,٢٠٠	٩
الاهلية للإنتاج الزراعي (مساهمة خاصة)	٦٤٢٩٢٣٦٨	٥٧٤١٣١٣١	٠,٨٥٠	٠,٩٠٠	٠,٩٠٠	٠,٨٥٠	٠,٩٠٠	٠,٨٥٠	٠,٨٥٠	٠,٩٥٠	١٢
دار السلام للتأمين	٧٥٨٢٤١٨٩	١٩٤٦٤٨١٣٤	٢,٥٠٠	٢,٧٥٠	٢,٧٥٠	٢,٤٥٠	٢,٥٥٠	٢,٧٥٠	٢,٧٠٠	٢,٧٥٠	٢٣
الشرق الأوسط للإنتاج وتسويق الاسماك (خاصة)	٧٣٥٠٤٨	٧٧٠٦٨٠٠	١,٠٥٠	١,١٠٠	١,١٠٠	١,٠٥٠	١,٠٥٠	١,٠٥٠	١,٠٥٠	١,١٠٠	٦
العراقية للإنتاج وتسويق اللحوم	٤٨٣٣٩٨	١٧٤٠٢٣٣	٢,٦٠٠	٢,٦٠٠	٢,٦٠٠	٢,٦٠٠	٢,٦٠٠	٢,٦٠٠	٢,٥٠٠	٢,٥٠٠	١

Figure (4.18) the trading reports page

4.2 STS Evaluation

The most important problems that may arise in systems like STS are slow load, and response time and weak security. Thus STS was tested for both issues and the results are discussed below.

4.2.1 Speed

In respect to speed, the load time for the different pages was calculated on both a local network and the internet.

A star network consisting of ten computers was used to test the system to find out how fast is the pages loading process and how long the server takes to respond. On the internet the system was hosted on a free server and then the load time was calculated.

The speed was recorded in three types of connection rates, a LAN (up to 10 mbps), a modem or dial up access (56 kbps or less) and T1 connection (1.44 mbps) where T1 lines are a popular leased line option for businesses connecting to the Internet and for Internet Service Providers (ISPs) connecting to the Internet, table (4.1) shows the result for the load time test.

Table (4.1) The load test results

<i>The page name</i>	<i>Size (bytes)</i>	<i>Page Load time (second)</i>		
		<i>LAN</i>	<i>Modem</i>	<i>T1</i>
Brokers' information, fig (4.10)	16459	Less than 1	7.79	1.18
Home, fig (4.1)	23791	Less than 1	9.25	1.22
Login, fig (4.6)	12088	Less than 1	7.12	1.36
The administrator's control panel, fig (4.16)	24576	Less than 1	3.53	1.21
Trade page, fig (4.7)	14249	Less than 1	7.35	1.17
Session monitoring, fig (4.17)	15343	Less than 1	7.57	1.17

4.2.2 Security

The information security elements and how they were handled in STS were evaluated, and the results are listed below:

a) Authentication and Authorization

- i. The passwords are encrypted using a one way encryption combined with a unique salt key (a string added to the password before the hash function) to prevent password exposure.
- ii. The salt key along with other system passwords and data are stored in an encrypted file outside the root folder.

- iii. To prevent an attacker from stealing a legitimate user's session to obtain access to the system, a new session ID is generated whenever the user's privileges changes (such as when the user logs in to the system). Also the IP address and browser information of the user are stored with other login information, whenever the user tries to access private pages, his information are compared with the stored data to ensure that it is not someone else using the same session.
- iv. In order to prevent brute force attacks the users are limited to only three login failures before the account is suspended.

b) Information integrity

Information integrity in STS is ensured by filtering both the input and the output to and from the system, and also encrypting the most sensitive data in the database. This approach also prevents SQL injection and cross site scripting attacks.

c) Confidentiality

Confidentiality is very important aspect in STS as the system has four type of users each with their own privileges, STS checks the user's security level (according to his membership type) every time a request for information is made to make sure that only the legitimate user gets access to the data.

4.3 Discussion

STS was designed as an application for the Iraqi Stock Exchange, its main functions are registering new users (brokers, investors and companies), trading stocks and providing information about the markets members and trading sessions.

The system uses a standard identification system called NIN that uses specially formatted numbers as a user ID rather than using the user's name or letting the users choose their own ID which may cause inconvenience.

Regarding the trading process, STS follows the Iraqi stock exchange rules and limitations and stops any action violating them.

STS has a central control represented by the system administrator. The administrator is responsible for checking the information provided by users to register a new account and can either accept them as members or cancel the registration, also he is responsible for reactivating a suspended account (accounts can be suspended if the user violated the market's regulations).

Opening, ending and monitoring the trading session is also a responsibility of the administrator, he has the ability to cancel any offer or deal made during the session from the start of the session until the next session begins.

STS provides information to its users, this information can be about the members, trading sessions or the market's news. The users can view the information according to their privileges because some of the data is not accessible to all members.

STS was designed with easy to use interfaces that loads fast whether the system is working in a local network or on the internet, which makes them practical and easy to navigate through.

STS takes security very seriously thus it implements a number of security measures to protect its users and the information within the system, such measures are the use of SSL to secure the traffic to and from the system, encrypting sensitive data in the database and filtering all input and output.

Chapter Five

Conclusions and Future Work

5.1 Conclusions

1. Putting the market's information in more than one database increases the system's security.
2. Implementing the system as an intranet provides more security and privacy to its members.
3. STS is a real-time trading system, it takes the brokers orders, check them and then execute the orders all in real time. Also, the settlements are done immediately without wait.
4. Checking the security level (membership type) of a user whenever information is requested from the system is used as a method to ensure confidentiality.
5. The system is practical and easy to use because it was designed with clear and friendly user interfaces, and the load time for them is relatively fast so they do not make the user wait for too long to view any page.
6. The use of SSL and database encryption along with the filtering of both input and output in the system provides higher security while not affecting the users or the different functions of the system.

5.2 Future Work

1. Since business and financial systems require high security, some additional measures such as encrypting the contents of databases can be applied to raise the security of STS.
2. Additional functions such as trading statistics and graphs can be added to the system.
3. Implementing a mail server to facilitate communication between the administration and STS members.
4. Dividing the administrator's responsibilities among several parties to distribute the load of work.
5. Using a backup system to support the existing one in case there was a crash or heavy load.

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الخلاصة

ان التطور والتحول الحاصل في اسواق الاوراق المالية هذه الايام اصبح مسألة مهمة جدا لانه يجعل هذه الاسواق اكثر تشابهاً وتكاملاً وان حدود السوق التي تواجه المستثمرين تصبح اقل وضوحاً يوماً بعد يوم. لهذا السبب هناك تصاعد في المنافسة بين اسواق الاسهم في العالم كله، وكذلك بين الاسواق وانظمة التجارة الالكترونية.

استناداً الى احداث سابقة، بعد خمس سنوات من الآن فإن تجارة الأسهم ستتغير تغيراً جذرياً، العديد من البورصات القديمة ستزول ولا يكاد يمر شهر دون أي تغيير في النظم التجارية القائمة أو اقتراح احدها الاندماج مع آخر.

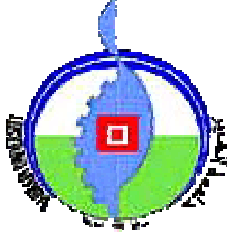
ولهذا، في هذا المشروع تم اقتراح نظام تبادل الاسهم الإلكتروني لسوق العراق للأوراق المالية كخطوة اولى لتطوير السوق وجعله قادرا على خوض غمار المنافسة مع اسواق الأسهم في العالم اجمع. النظام صمم كتطبيق شبكة بأستخدام تقنيات تصميم الشبكات وبروتوكولاتها مما يجعله قابلاً للأستخدام في الشبكات المحلية وعلى شبكة الانترنت.

عندما صمم نظام التجارة الإلكتروني تم أخذ بعض الأمور بعين الاعتبار لجعله عملياً و آمناً نسبياً مثل توفير واجهات مستخدم سهلة الفهم والأستعمال، وضع التفاصيل اللازمة فقط في الواجهات لضمان سرعة التحميل و توفير اجراءات امنية اضافية مثل استخدام (طبقة المقابس الآمنة)

مسؤوليات النظام المقترح هي : تسجيل الوسطاء والمستثمرين والشركات كأعضاء في السوق وادارة جميع جوانب العملية التجارية. وهو ايضا مسؤول عن تطبيق قوانين السوق وانظمتها على جميع الاعضاء وعلى الصفقات التجارية التي تتم اثناء جلسات التداول.

النظام هو نظام تجاري في الوقت الحقيقي، حسابات المستثمرين، حسابات الوسطاء، عملية التداول و عملية التسويات كلها تجري في الوقت الحقيقي.

خادم ماي اس كيو ال أختير ليكون خادم ادارة قواعد البيانات، لغة أتش تي أم أل و بي أتش بي استخدمت لتصميم النظام والواجهات، الجافا سكريبت وظفت لتصميم واجهات أكثر تفاعلية و اختير خادم أباتش ٢ كخادم للشبكة.



جمهورية العراق
وزارة التعليم العالي والبحث العلمي
جامعة النهرين
كلية العلوم

نظام قائم على الشبكة الداخلية لتداول

الاوراق المالية

رسالة مقدمة الى كلية العلوم، جامعة النهرين كجزء من متطلبات نيل شهادة الماجستير
في علوم الحاسوب

من قبل

حنين احمد خضر

(بكالوريوس ٢٠٠٦)

المشرفة

د.بان نديم خنون