Client Server System for e-Services Access Using Mobile Communications Networks

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Abstract—The client server systems using mobile communications networks for data transmission became very attractive for many economic agents, in the purpose of promoting and offering electronic services to their clients. E-services are suitable for business developing and financial benefits increasing. The products or services can be efficiently delivered to a large number of clients, using mobile Internet access technologies. The clients can have access to e-services, anywhere and anytime, with the support of 3G, GPRS, WLAN, etc., channels bandwidth, data services and protocols. Based on the mobile communications networks evolution and development, a convergence of technological and financial interests of mobile operators, software developers, mobile terminals producers and e-content providers is established. These will lead to a high level of integration of IT&C resources and will facilitate the value added services delivery through the mobile communications networks. In this paper it is presented a client server system, for e-services access, with Smartphones and PDA's mobile software applications, installed on Symbian and Windows Mobile operating systems.

Keywords—Client server system, e-services access, mobile communications, PDA, Smartphone.

I. INTRODUCTION

DATA transmission through mobile networks became very attractive for many economic agents, in business environment, for offering electronic services to their clients. The client server system presented in the paper, offers to the mobile users the GPRS and WLAN access possibility to electronic services, through mobile data terminals like SMARTPHONES and PDA's. As a representative example for business environment, a stock market electronic service, is installed on the server. The client server functionality can be extended for a larger number of informational services and applications: e-commerce, e-banking, e-health, location based services, but also e-government, etc.

An e-service is a software application, whose main component is a data base, which can be accessed by the users via Internet or mobile communication networks. The mobile communications networks give the users the mobility advantage. The 3G networks offer significant channel bandwidth. The software server applications can be hosted at the digital content provider locations.

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II. OBJECTIVES

The objective of the work was to design a client server architecture, using mobile network channels, which would give to the mobile clients the possibility to access information services, through terminals like SMARTPHONE, PDA's or laptops. The electronic service is accessed by the client, using two types of applications:

-socket to socket data transmission applications, suitable for Smartphones and PDA's which have the advantages of high data rates and reduced costs of informational traffic;

-web browsers for 3G mobile terminals or laptops.

The server site provides a stock market transactions electronic service to the users. URL links to other e-services addresses are delivered: e-commerce and mobile positioning. The system user is also provided with downloadable software applications for mobile terminals, ready to be installed in the mobile terminal, like an executable file.

The research and development activities objectives consisted of:

-a client server software structure development, adequate for electronic services access, in the business environment, using mobile communications;

-database software application development, installed on the server, which can store adequate e-content, for various e-services;

-identification of stock market transactions particularities, in order to identify the suitable indices, to deliver real time information, useful for interested parties and brokers.

For Symbian OS Smartphone application developing, the main objectives were to define, implement or generating:

-the header and resources files;

-the application classes/objects source code;

-the project defining, package and the installation file;

-the application compiling and execution on SE P990i emulator.

III. SYSTEM ARCHITECTURE

The general block scheme of the client server system is presented in Fig. 1, where its basic architecture can be seen. This architecture it is adapted for data transmissions using various mobile channels. The laptop is connected at the Internet using modems, through CSD, GPRS and CDMA channels. The connection between the laptop and modems can be made by USB, serial cable or Bluetooth channels. There is available a WLAN interface for wireless Intranet connection.

The database, e-content and suitable software applications of the stock market transaction is installed on the server.

The web server permits a web service interrogation, using the HTTP 1.1. protocol, and the data transmission to the client phone.

The client software applications are resident on laptop, Smartphone or PDA. These terminals allow the user to establish mobile telephony or WLAN connections, and to achieve the TCP/IP transmissions, to access the e-service. Three types of queries are allowed to the client, according to the web service's functions. The user provides the query parameters.

A. Hardware Structure of the System Server

The hardware structure of the server basically consists of:

-An IBM PC compatible computer, Pentium IV, 3 GHz, with Windows XP Professional operating system;

-Internet/Intranet fix IP connection, through a hub, switch, router or gateway, of the economic agent's LAN.

B. Hardware Structure for the System's Mobile Client

The hardware structure of the client basically consists of:

-Laptop, Pentium IV, 3 GHz, with Windows XP Professional operation system.

-Ethernet interfaces, for LAN connections, providing the user with the possibility to compare the cabled and mobile channels access to e-services;

-SE P990i Smartphone, with Symbian v. 9.1. operating system [6];

-QTEK 2020i Personal Digital Assistant, with Windows Mobile 2003 operating system;

-GSM/GPRS data transmission modem, for mobile connection of the laptop to the Internet;

-CDMA modem for Internet mobile access using laptop;

-WLAN and Bluetooth data interfaces.

C. The Server Software Structure and Functions

Several server software modules were developed, for service access using laptop, Smartphones or PDA;

-server software applications, for client connections requests serving and TCP/IP data traffic achieving;

-E-services server applications like: stock market transactions, e-commerce, location based services, etc;

-Server database for e-service information storing.

At the server side, for the client access using mobile terminals, the following functions are implemented:

-"listening" to the client connections requests, at the suitable logic port;

-allowing the Request Identifier to the client request;

-displaying in a GUI of the dynamic IP client address, the client query and transmitted data, server name and IP;

-the message "Connection closed" is displayed, when this event is performed by the client.

The stock market transactions e-service is implemented based on a suitable WEB service. This is efficient especially for client access using Smartphones and PDA's.

The client software applications are available on the server, for downloading and installing in the adequate mobile terminals of the user: Smartphones and PDA.

D. The Mobile Client Software Structure and Functions

The software structure of the mobile client, for e-service access using laptop, Smarphones and PDA's consists of:

-interfaces for GPRS and CDMA mobile networks attaching, [4];

-data transmission software modules, using TCP/IP;

-database query transmission, to the server.

At the client side, the events are happening as it follows:

-the IP address of the server computer is introduced in the suitable text field, followed by the Connect command;

-if the connection is accepted by the server, the client is notified by a suitable message on the GUI;

-the requested information is received from the server and displayed in the adequate text field;

-the events that take place during the data traffic, are displayed at the bases of the GUI: ex. received data, transmitted data etc.

For e-services user access using Smartphones and PDA's, the WEB service functions were included in suitable software modules, developed for these types of terminals.

IV. TECHNOLOGY DESCRIPTION

A. Server Application Development

In the following will be presented the technology used for server and mobile client applications development. In order to implement and publish the e-service site on Internet, the HTTP application server IIS 5.1 was used, and a DNS installed on a server of the local network. The site development was realized using the HTML language, including the Get, Head, Post, Push, Put and Patch functions, for data transfer. The database was developed using PhpMyAdmin on a MySQL server, which stores the data in tables. PhpMyAdmin achieves the graphical interface of MySQL, performing the database administration, which otherwise would be done in a MSDOS window or using the MySQL Administrator.

B. The Client Software Applications for Sony Ericsson P990i Development Tools

The client server system can use various mobile telephony terminals. Adequate tools must be used to develop client applications, according to the SDK GUI platform and the operating system of the mobile phone [1].

In case of SE P990i Smartphone, the following tools, installed on a Windows XP OS PC were used, [2]:

-the UIQ 3.0 SDK GUI platform, for Symbian v9.1, [3];

-the CodeWarrior Professional 3.1 IDE, based on C++ language, for object oriented programming, compatible with UIQ 3.0 SDK;

-ActiveSync utility software, for transferring the SIS file, from PC in the Smartphone internal or card memory, through USB cable or Bluetooth connection.

The UIQ 3.0 SDK software design components are:

-a phone emulator, compatible with Windows OS PC;

-header files and libraries for running the application on emulator and on the real ARM processor;

-specific documentation and Symbian OS libraries [6].

Symbian OS has a flexible architecture, which permit different platforms launching as UIQ 3.0, for Sony Ericsson mobile phones, and Series 60, Series 80 for Nokia terminals.

The Smartphone emulator configuration is made using the UiqEnv utility software, or by SDK Configurator. The user sets the communication ports and the graphical user interface.

The Smartphone client application is based on three main UIQ 3.0 defined software objects, which offer information about the data base query status and allows user interaction with the device and query results displaying: respectively a CEikLabel, CEikEdwin, Ceikedwin type objects. The identifiers of these objects are EmobaccessInfo, EmobaccessSymbol, EmobaccessContent.

The resource files of the Symbian OS defines the application behavior on the Smartphone. They have the extensions .rss, .rls, .ra, and will be binary processed by the compiler. The compiled version is loaded in Smartphone, along with the application executable file.

The CodeWarrior IDE for Symbian OS contains suitable compilers for the phone emulator, as well as for real processors designed files. Special debug commands for emulators and hardware, for OEM version case, are also included. The WINSCW and GCC-E compilers were used for UREL type build targets [5].

C. The Client Software Applications for QTEK 2020i PDA

In order to develop client applications and WEB service interfaces for QTEK 2020i, PDA, Phone Edition, running Windows for Mobile 2003, the following tools were used: .NET Compact Framework SDK libraries, MS Visual Studio 2005 IDE, installed on Windows XP Professional. Active Sync 4.0 or later, for PC connection.

V. SOFTWARE DEVELOPING

A. Server Software Application Development

The server database was created in the following steps:

-starting the IIS service on the Windows XP OS PC.

-in PhpMyAdmin folder, the index.php file was opened in a web browser;

-logging as a "root" user and suitable password, for security reasons, to access the application main interface;

-defining a new database using Create new Menu.

In the server application, the database contains one table, with the corresponding fields. The information insertion is made by accessing the Insert tab. The scripts are embedded in a php type file and can be accessed directly on the site, as web pages. The database contains several societies, currently listed at the stock's first category. The database is accessed through PHP scripts, containing the SQL queries. The PHP scripts reside on the same server as the database does, and they are appealed directly using the DNS address of the site, through a web browser. The call has the following general form http://localhost/query.php? parameter=value. The WEB browser is available on the laptop, and also on Smartphone and PDA. For Smartphone and PDA, dedicated client software was also developed. These applications achieve direct database queries, without using a WEB browser.

B. Client Software Application Development

The necessary classes, in minimal configuration, used for developing the client application for Smartphone, are:

-Application View which instantiates the main window and acts as a container for other application objects;

-Application UI which instantiates the view of the application and manipulates the commands sent by objects;

-Application Document which handle the application data content;

-Application is the main class of the application, and has the role to start the application by the Application Document class instantiation; also, it sets the UID (universal unique identifier, necessary for each application).

Besides these classes, there were also used Internet access and WEB server communications classes, defined in the HTTPEventHandler.h and HTTPClient.h header files.

The client server system allows the access to electronic services links, provided by third party suppliers, in the Services links section of the site.

The client software application diagram is presented in the Fig. 9. In the application main screen the user specifies the server IP address and logical port, for connection. After the connection is established, the query data is inserted in an input box. If the connection is stable, the data are transmitted to the server. After receiving the information stream, the client may close the connection.

VI. RESULTS

The system client software applications functionality was tested as it is presented in the following.

A. Stock Market Exchange E-Service Access Using a Laptop, on Mobile Communications Channels

The system database was accesed through web browser by: URL http://localhost/phpmyadmin/index.php;

The username and password, for login was introduced, to access the Database screen. It displays the service database, associated to the project: transactions_summaries (1). It stores the listed companies quotations, which can be observed through the Browse command.

The company stock exchange information is available to the service client through the next steps:

-open the browser and enter the link URL: http://localhost/query3.php ? symbol= ATB;

-the browser retrieves the information for ATB (in Romanian, this stands for Antibiotics Iasi Company);

The list of companies whose quotation variation is under the maxim threshold "x" is obtained by:

-open the browser and enter http://localhost/

query1.php?above=x; the companies are displayed in the browser.

The list of companies whose quotation variation is above the minim threshold "y" can be obtained by:

-open the browser and enter the address http://localhost/query2.php?sub=y; the companies are displayed in the browser.

B. Stock Market Exchange E- Service Access, using the SE P990i Smartphone

The access client applications were developed using php query functions or WEB services. A query function realizes the following steps:

-connect to the MySQL server, using login and password;

-connect to the MySQL transactions database;

-take over the query parameter, provided by the user;

-select the database information according to the symbol, and transmit it to the client browser.

The main client application GUI window for SE P990i mobile phone is opened by the Smartphone commands: Main Menu – Tools – Mobacces. The client user must perform then the following tasks:

-obtain the stock exchange information following application GUI: Main Menu – Info Companies;

-in the Company field, the symbol of the company is introduced, than the commands Done and Go are clicked;

-the Ready window displays the connection status: Connecting, Connected, Data received, Transaction Success; in the Fig. 2. The client software application running on P990i emulator is presented.

-display the requested company information, Fig. 3.

The list of companies whose quotation variation is under the maxim threshold "x" is obtained by the commands:

-in the main screen, select Menu – Maxim Threshold;

-place the cursor in Threshold Maxim window, the virtual keyboard become active and the desired maximum value can be typed, for example "1"; than press Done and Go;

-in the informational field, the companies that had a quotation variation under the introduced value, are displayed, see Fig. 4.

The list of companies whose quotation variation is above the minim threshold, for ex. "0" can be obtained by the commands:

-in the main screen, select Menu – Minimum Threshold;

-place the cursor in Minim Threshold window, as a result, the virtual keyboard is active, and the maximum value, for example "0", can be typed; than press Done and Go;

-in the information box the companies that had an index variation above the introduced value are displayed.

-in the information box the companies that had an index variation above the introduced value are displayed.

C. Stock Market Exchange E- Service Access, Using the PDA Terminal QTEK 2020i.

PHP scripts based client application was developed also for PDA terminal, QTEK 2020, using GET functions in the HTTP/1.1. protocol. The data transmission is achieved by socket programming objects in the TCP/IP protocol, Fig. 5. The maximum quotation threshold related companies list are displayed on the PDA screen, Fig. 6.

Another stock market exchange client application, using a WEB service was developed. The data is transmitted using GET, POST and SOAP protocol, at 80 logic port. The WEB service generates an XML answer file. In Fig. 7 is presented the main PDA's GUI, displaying several stock market indices, provided to the user. The Exchange Statistics parameters, volume, values, ordered by market types are presented in the Fig. 8.

Based on these client applications, the user can efficiently decide to sell or buy shares, having the advantage of the terminal mobility. This will increase his financial benefits.

Fig. 2 Client software application running on the SE P990i emulator
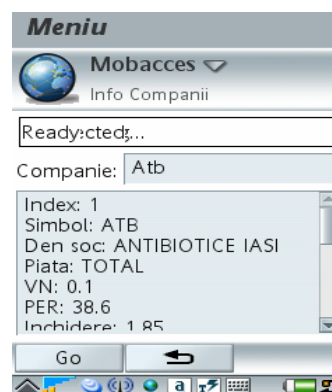

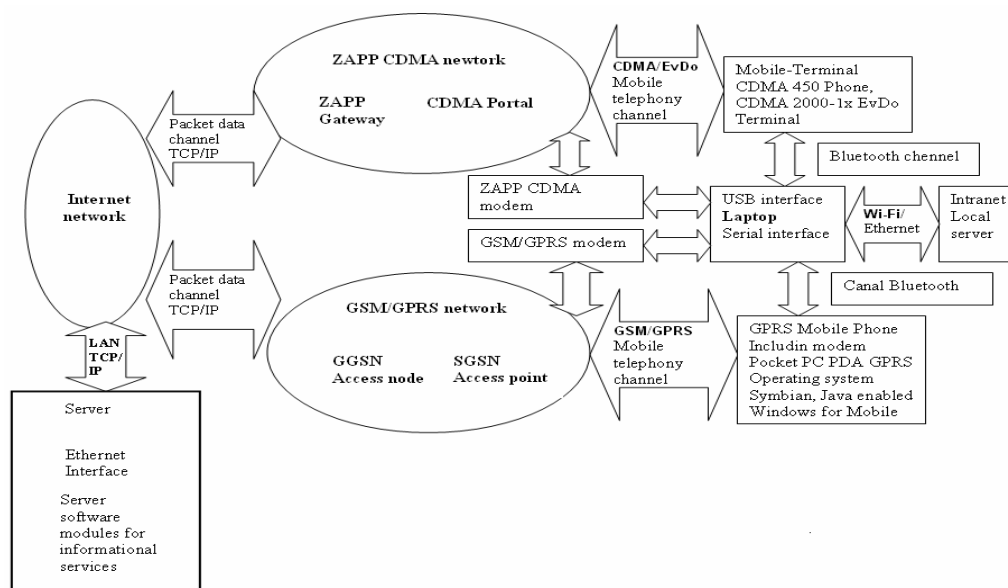Fig. 3 Stock market exchange information on the SE P990i display

Fig. 1 The general block scheme of the client server system using mobile network

Fig. 4 Providing information for maxim or (minim) quotation threshold on the SE P990i display
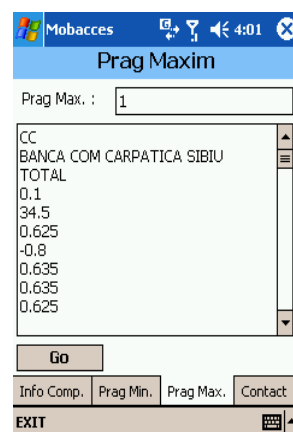

Fig. 6 Providing information for maxim or (minim) quotation threshold on QTEK 2020i display
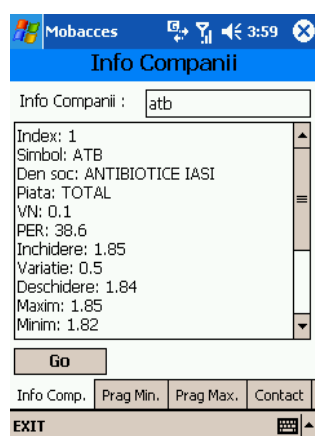

Fig. 5 Stock market exchange information on the PDA QTEK 2020i display

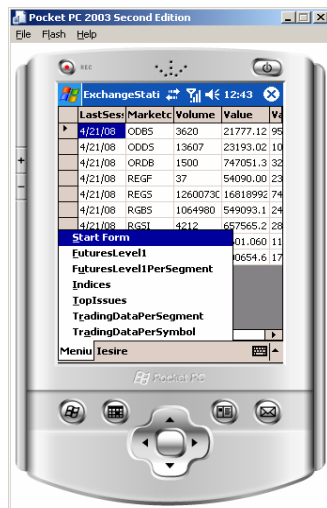Fig. 7 Main graphical user interface for PDA WEB service client application

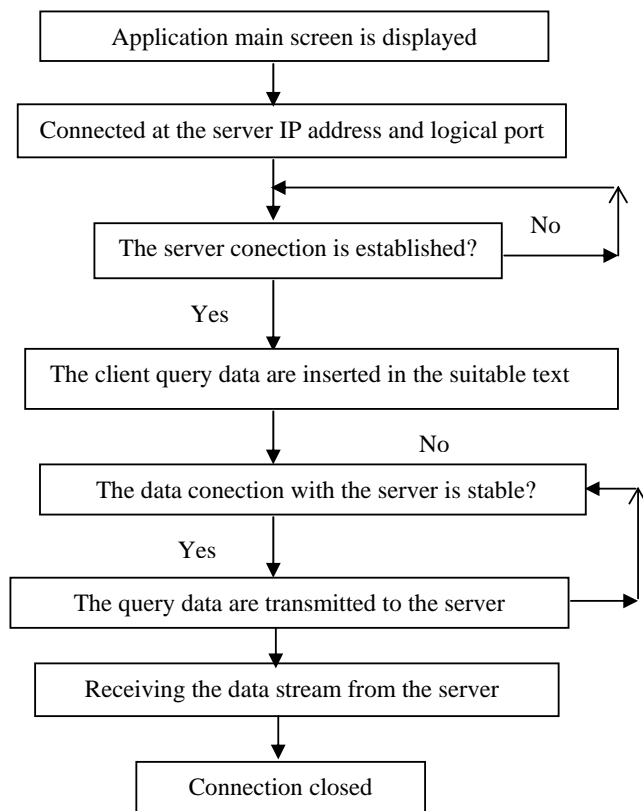Fig. 8 Exchange statistics information, ordered by market type, on the QTEK 2020i display

Fig. 9 The diagram of the client software application

VII. CONCLUSION

A client server system for a stock market transactions e-service was realized. The e-service can be accessed using laptop, Smartphone or PDA's, on GSM/GPRS, CDMA or WLAN channels. The server contains the data base which stores the information about companies, regarding the stock transactions indexes. A WEB service is implemented, to provide the answers to the client's queries:

-selected companies stock transactions information;

-the list of companies whose quotation variation is under the maxim threshold, introduced by the user;

-list of companies whose quotation variation is above the minim threshold, introduced by the user.

The stock market information is available to the client by browser, or by direct and dedicated applications, which is significantly reducing the access time and data traffic cost.

The service's client is able to decide optimally, having the mobility advantages, whether to buy or sell shares. He has the opportunity to increase his financial benefits.

The service's site offers to the client access applications samples for SE P990i and QTEK 2020i mobile terminals. These samples, posted on the site, can be downloaded on a PC, and then installed on the mobile phone, using ordinary Sync tools. The executable files can also be directly downloaded on the mobile phone, using a web browser, or can be sent as an email attachment.

The following functions of the client server system have been implemented and tested:

-server software application for stock exchange informational service;

-client software applications for Smartphones and PDA's, suitable for electronic services access.

The client server system can be extended and updated to develop and provide any kind of electronic service like: e-commerce, e-banking, e-government, etc.

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