

## An Information System for a Pharmaceutical Network

*Nikolay Dokev<sup>1</sup>, Daniela Smiliankina<sup>2</sup>*

<sup>1</sup>*Institute of Information Technologies, 1113 Sofia*

*E-mail: niki@iinf.bas.bg*

<sup>2</sup>*New Bulgarian University, 1618 Sofia*

### 1. Introduction

Nowadays Internet technologies find wide application in large organizations. There are a lot of reasons that make these organizations integrate their existing data bases in Web applications. The information contained in the data bases of one organization can be organized with the help of Web-based applications and then presented to the users.

The corporations adapt their communications so that they can rely on the networks that will reach on one side every single member of the organization and on the other – their providers, advisors and customers. These innovations increase the efficiency of the companies, and also allow the decrease of their personnel in many of the cases.

The purpose of the present paper is to discuss the introduction of modern technologies in the administration of a pharmaceutical network and to offer a design project of a specialized information system for this network. The use of the information system is expected to improve the control, to increase the activity of the separate offices and of the entire working process and to develop the communication between the separate branches (chemist's shops). The automation of the job facilitates the entry of the information, the account and the quick documentation. The comparatively easy and cheap implementation of the system requires reasonable resources that could be afforded by every company. The information system offers good conditions for work on the account of unpretentious investments. The solution chosen and applied in the present study is a centralized server, in which the data bases are stored, remote access and working through a browser. The probable users of the information system are the pharmacists working in the different branches and also some non-authorized consumers, having access to the information site only, where medicines and other articles spread by the pharmaceutical companies can be found.

## 2. Modern Web-based information systems

### 2.1. Technologies in modern Web-based information systems

The development of computer networks enables easier receiving of actual information from the existing data bases (DB). The larger the company or the shop is, the more important the question about its efficiency is, and also of the time spent by the staff in different accompanying activities.

The most general problem solved by an information system, is rising the efficiency of labour. Some of the most important requirements towards such a system are:

- possibility for free use of the information from the existing data bases;
- presence of a powerful defensive system against unauthorized access;
- a developed system with a reasonable computer configuration;
- user-friendly interface;
- facilitation of the main activities in the company automating the operations;
- speeding up the book-keeper's, computing, describing and other operations, which require time and valuable human resources;
- presence of an efficient and flexible data base for all the objects, concerning the company activity and its clients, providers, articles, etc.;
- control and report of the current status of the store availabilities and of all the material sources of the company;
- relative universality with respect to its implementation and application, i.e. it must cover the necessary minimum of activities and processes, typical for a larger part of the companies;
- flexibility when an alteration in the company activity is necessary or a change is set in the regulation rules of the state institutions;
- generation of detail references about the activity and status of the company;
- support of peripheral devices such as barcode reader, cash apparatus, cash printer, etc.
- possibility for simultaneous work of more than one user in the system (work in a network);
- possibility for remote setup and administration of the system;
- possibility for remote data entry and results output.

### 2.2. Web and data bases

A lot of the existing information systems are incompatible. This is due to the time period when they were designed, the machines and technologies used in their construction. The data exchange between such systems is very difficult. The changes in the systems or their replacement is almost unthinkable due to the considerable volume of the data, the users and the high price of such a procedure. It is obvious that the unification of the systems is not the most appropriate way, but the standardization of their communication capacities would open them to the information world.

### 2.3. Application of a universal client-server in the design of information systems operating with data bases

The personal computers connected in a network are denoted in this architecture either as clients or as servers. The data required by the user and not found in the local

machine, are taken from the server. In case the user wishes to send data to another user, they are transmitted to the server that transfers them to the corresponding working station. The server plays the role of a central store of data files, accessible for all the working stations in the network.

The universal client-server scheme is based on Web technology (Fig. 1). Its structure consists of two parts. The first one comprises everything found between the client and HTTP server. This part is standard, independent on the platforms, based on Internet services and able to support networks with a low flow.

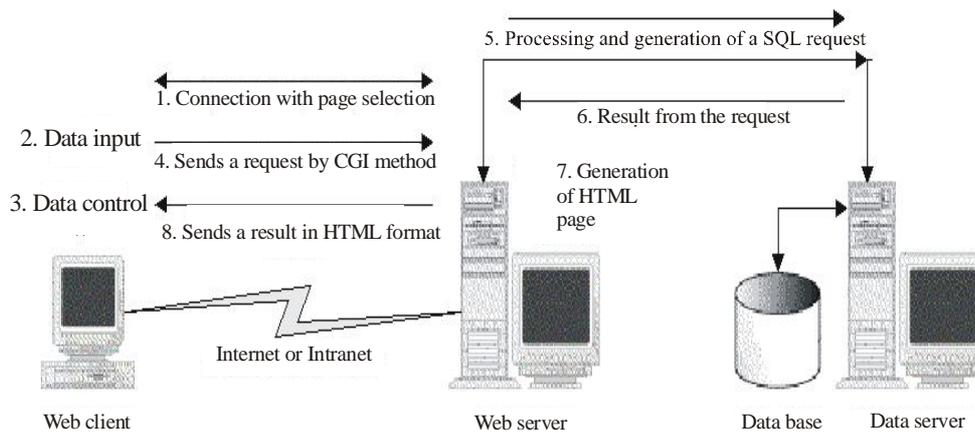


Fig. 1

The second part includes what is located after the HTTP server. It contains elements and technologies specific for the classical scheme client-server. The client controls the user interface and the data entered, thus avoiding the unnecessary traffic through the network. The Web server HTTPD connects the data between the client and the data server. The processing of some data and requests is accomplished in the data server (usually Structured Query Language – SQL) and in order to accomplish data access, connection is realized with the server of data bases. The processing can be divided among several physical machines, which will load not only a single one and will increase their resource possibilities to process a considerable amount of requests.

The actions of one application in the environment of a universal client-server consist of a sequence of operations:

- connection is established between the HTTP server and the Web client and the corresponding page is derived;
- data is entered in HTML forms, depicted by a Web browser;
- a script language controls the place of the input information (Javascript, VBScript);
- the request is sent to a HTTP server in CGI method;
- the data from the requests in the server are processed and SQL requests are generated;
- access to the data via a DB server (SQL server);

- a HTML page is generated with the data received; the pages are generated by a server so that they are interpreted by a client;
- the results are sent to the user and visualized by a browser.

The advantages of the universal client-server scheme in comparison with the classical scheme are defined above all by the ability of one client, no matter what their platform is, to communicate appropriately with an arbitrary configuration of a DB server with the help of Web technology or HTTP sever. The modern Web browsers provide easy interface and relatively simple programming tools, accessible to a wide circle of users. Some alterations in the structure of the data bases or in the procedures of data processing in the server, or a change in its configuration do not influence the client's part, what is impossible in the classical scheme.

The system ensures registering of the creation, copying, storing and destroying of different types of documents in conformance with the regulation laws.

Client-server scheme is designed to operate in new computer environments, which connect a large number of personal computers, working stations, printers and other hardware units.

Client-server is a model of computer information processing which divides the processing into two separate processes called "a client" and "a server". In this way the processes work independently, execute specialized tasks and share the processing complexity. The advantage of the model is receiving an optimal ratio "price/productivity".

### 3. Implementation of an information system for a pharmaceutical network

#### 3.1. Functional features of the system

The system architecture as a whole is based on the model client-server. The technology, which realizes the architecture selected, is ASP. When accomplishing the project discussed in the paper, an attempt was made to show the possibilities of ASP by creating some ASP-based applications.

The functional model of the paper suggested discusses the system functions that must be realized. The model is conditionally divided into modules, which are easily invoked. They can be realized separately, which simplifies the creation of comparatively complex systems. The first step of every user is logging in the system (LogIn), which is one of the common functions.

When the users have entered valid information, they receive access to the functions suggested, depending on their rights. There is a function for logging out (LogOut) after the client's session, which removes the possibility of getting advantage from an unclosed session by some hostile users.

Every module, which builds the system, is characterized by the respective functions.

The first module – "Administrative" – contains the three methods for data operation – entry, editing and deleting of data.

The second module – "Operations" – consists of forms, in which Post method is used.

The last module of the system is "References". The data acquirement from the base is done by Get method, and the data are visualized in a tabular form after the operation.

Separate verification is intended for each operation, the data acquirement is done according to given parameters and values. After the operation is finished, the pharmacist chooses an option for exiting from the system.

### 3.2. Logical structure of the architecture

The logical structure of the system described is standard. The customers are connected to the web site of the system via a global network and their browser. The largest part of the users are the pharmacists, after them are the final users, who may accomplish different activities depending on their authorized rights. Another type of users who have the greatest rights, are the administrators.

The users may be divided into three main classes, depending on the actions they can realize:

- Class of final users: The Internet users, who access the information site only, belong to this class. The access to it is free, no registration is needed and the information in it is free of payment. The remaining modules in the system are not accessible to the final users; the other two classes can use them.

- Class of pharmacists: This class is characterized by limited rights over the system. The pharmacists have some rights over the main starting module and the information site, and to the system also. They can control the data base as far as they are allowed to enter some information concerning the pharmaceutical system, edit or delete it, or search for some references (about medicines, articles, providers, etc.). The pharmacists use the user name and the password given by the administrator.

- Class of administrators: Their actions are connected with the maintenance and administration of the system.

### 3.3. Selection of a software realization

#### a) Program structure

An example program structure of an ASP page will be discussed. It is as follows: a block for checking the input data, a request towards the SQL server, processing of the results and visualization on the screen.

#### b) WWW server structure

- Directory “/” encloses a special file GLOBAL.ASA which contains basic definitions for operation with the data bases, and also DEFAULT.ASP file, executed immediately after the system is started;

- Directory “/Db” which contains all tables with the data bases;

- Directory “/Connections” which comprises all the connections which have been made between the data bases and the dynamic environment in Open Database Connectivity (ODBC);

- Directory “/Images” which contains all the files (images) which appear in constructing the interface of each page;

- Directory “/Cgi-bin” which has all service files necessary for the correct work of WWW server.

#### c) Protocols and connection with other programs

The system operates on the basis of TCP/IP protocol, and WWW server supports HTTP. The connection between WWW server and the data bases is realized using ODBC drivers supplied by Microsoft Inc.

ODBC is a functional library developed so that it ensures common interface for creating applications (API), which operate with different data bases (Fig. 2). This interface communicates with the data bases through a driver from the library in the same way in which Windows communicates with the printer via a driver.

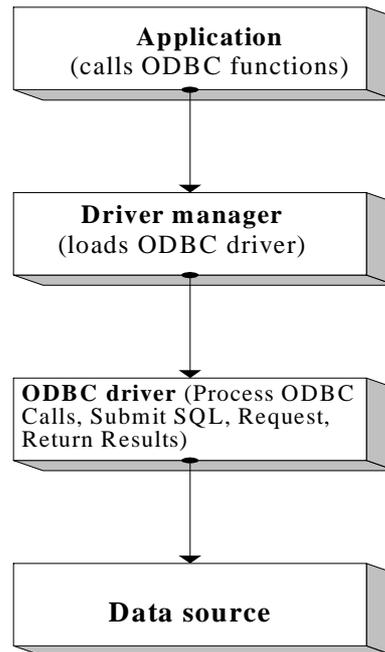


Fig. 2

Depending on the data bases used, a network driver may be needed in order to connect to a remote data basis. The architecture of ODBC is illustrated in the next chapter.

#### 4. Structure of the information in the data bases

The data bases are relational, they consist of more than one table, with defined connections (relations or correspondences) between them, realized with the help of some keys. The relational DB enable the simultaneous complete updating of the data belonging to different tables. They avoid the destruction of data integrity, doubling the records or the lacking elements in any table. This is due to the built in possibility Referential integrity, which allows the updating of different tables with the help of one operation. The relational DB allow easy acquirement and updating of the information with the help of the standard language accepted in this area SQL (Structured Query Language). It is used in the majority of the wide spread systems controlling data bases.

The following Fig. 3 describes schematically the data flow in operation with Web applications.

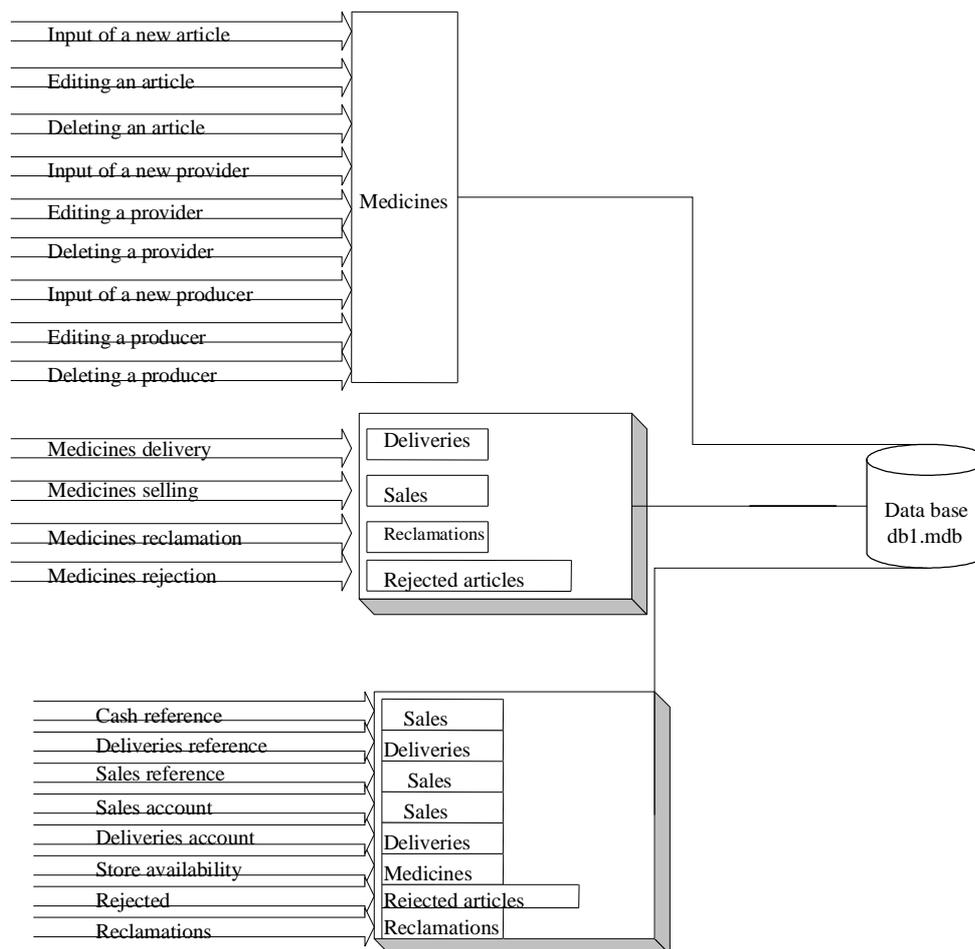


Fig. 3

#### 4.1. Table description

The tables contain:

- wasters – contains nomenclature of rejected articles in the separate branches;
- providers – a list of the providers, data about them;
- deliveries – nomenclature with the provided medicines in the chemists' shops;
- branch – a service table, used to review the branch where a given user works;
- medicines – a nomenclature of the articles and data about them. It reflects the availability of the articles at every time moment;
  - medical form – a table containing the code and description of the medicine;
  - passwords – a service table, used by the administrators to enter the user name and password when a new employee joins the given branch;
  - sales – tables with sold articles on a certain date, quantity of the sales, type of receipts, etc.;

- producer – a list with the names of the producers, with whom the pharmaceutical shops work;
- receipt – a table with the code and type of the receipts;
- reclamations – nomenclature of all rejected articles by the chemist' shops.

#### 4.2. Relations

The relations can be seen in Fig. 4.

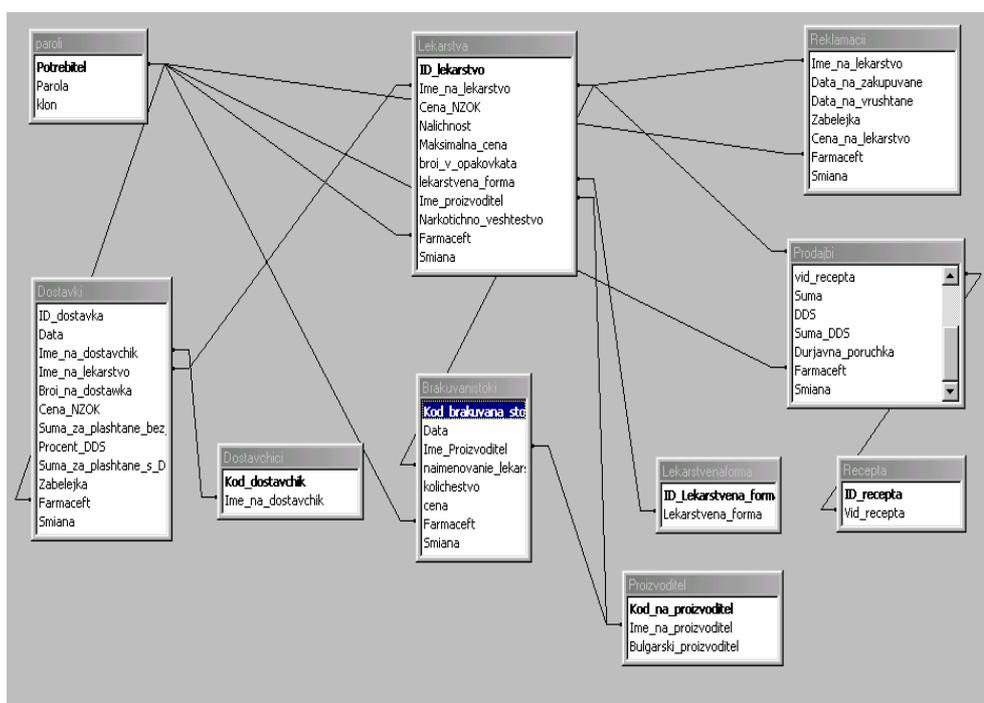


Fig. 4

#### 4.3. Scheme of operation

This chapter will discuss the connections between the system interface (forms for filling, editing and deleting, i.e. the methods used in the present study) and the data bases.

- **ADMINISTRATIVE** menu

Three methods are used in this menu: data entry, data edition and data deletion. The menu is divided into 3 parts.

When a new article is input, the first link of the menu is applied. The system makes a connection to the data basis, named as db1.mdb and Table Medicines is used to enter a new record.

When editing or deleting a given record, the same Table Medicines is used. This is the main table, containing all the records and data that the branches possess. The data in this table are used when checking the store availability.

In the next menu – Provider, the same three methods are used that were above mentioned for the previous menu. The only difference is that the table contains data that concern the providers.

The last table is producers' menu. Its name in the basis is Producers.

- OPERATIONS menu

The links for this menu are:

Medicines sales – Table Sales is used

Medicines delivery – Table Deliveries is used

Medicines rejection – Table Rejected articles is applied

Medicines reclamations – Table Reclamations is applied

- REFERENCES menu

The references are classified into sections:

Money accounts – Cash reference, Deliveries reference, Sales reference

Sales report – Medicines report, Report of receipts

Deliveries report – Report about the provider, Report about a medicine, Store availability, Returned reclamations

#### 4.4. User's interface

The access to the system through Web is realized by ASP technology and VBScript. With the help of ASP some sample pages are created as .asp files, and their invoking transfers parameters, which define different characteristics of the information required.

Several basic screens are necessary for the user's interface: a main screen, a screen of the information site, a screen for the system, dialogue for entering the system, screens leading to the use of the pharmaceutical network.

The first screen, which is loaded when entering the site, is the main screen. It contains the main links of the whole system: information site, UniPharm site, Service accounts, e-mail for contacts and a link to the National Health Cash (NHC).

The user X starts the main site, from where he chooses a link, used by the outer users "Information site". The selection directs the user to the next page, where a menu with system options appears. They are the following:

- Menu Information, consisting of the following links:

- non-stop chemist' shops – a site with the non-stop working pharmacies in Sofia;

- pharmaceutical shops in Bulgaria – a site with the chemist' shops in Bulgaria, as well as links to other sites;

- medical clinics – a site with the on-line registered clinics and hospitals.

- Menu Information – offers a set of pharmaceutical companies and links to the respective sites.

- Menu Nomenclatures – consists of 3 links, which are distributed in sections in an alphabetical order.

- Menu Search.

The banner "Products catalogue" enables the users to see all medical products, permitted by the Ministry of Health, spread in the branches of the system.

There is also information for contacts, the addresses and phones of the branches.

The third screen is loaded from the main site from link "Service accounts". It comprises the following menus.

- Service reference menu.
- Reference of branches:
  - Cash (general reference);
  - Deliveries (general reference);
  - Sales (general reference);
  - Store availability (general reference);
  - Rejected articles (general reference);
  - Reclaimed articles (general reference).
- Exit.

The two links “e-mail” and NHC allow connection with the administrator supporting the system and NHC with the page of this institution.

The screen loaded after link “UniPharm” is selected, leads to a site with a dialogue for entering the system, It supports two fields – the first one is for user’s name entry, the second – for a password. The main screen of the system is shown after successful logging in.

The working area, which comprises elements of the user’s interface, is divided into 3 basic parts. In the upper part, after the system name, there are located in a horizontal position the connections for direct access to the functions suggested. Below it there is a connection for exit from the system, and after its activation, the user is returned to the main site of the system. When clicking on “Exit from the system”, the connection with the server is interrupted and the session is closed.

The right part of the lower region represents the essential part of the system. In it the data are entered and the results of the processes and formatted information are visualized. The lower left part contains the menus for each one of the functions suggested.

## Conclusion

The information system is designed to serve the information necessities of a company, possessing a chain of pharmaceutical shops. Its main purpose is to create a possibility for entire review of the articles movement in quantitative and value aspect for the company as a whole and for each one of its stores. Having the complete and detail information about the activity of a certain company, it is possible to make short- and long-term prognoses, in order to optimize the activity and the financial results.

The system is able to optimize the activity in several aspects:

A method is applied, using the analysis of the average daily sales, and the minimal and maximal quantitative threshold values; distribution of the articles between the shops, in this way avoiding the unnecessary supply of additional quantities; tracking of unsold or missing articles, over storing, etc., accompanied by an alarm. The system offers a rich set of references with respect to criteria set by the user.

Some of the references give information in quantity and value of the sales with respect to articles, pharmaceutical shops, account periods and incomes and ways of payment. The system computes some analytical parameters for every one of the articles, like the days of sale, the daily realization, time in sales, etc.

The cash accounts show the movement of the money for each shop and for the chain as a whole. Information is obtained about the incomes and the expenses, differentiated according to the types of documents, chemist’ shops, producers and periods. Information is also given about the money in cash, the cash saldo, etc.

## References

1. Nielsen, J. Designing Web Usability. New Riders, 2000.
2. Grey, D. Professional Web Design. Sofia Press, 1999.
3. McCormack, C., D. Jones. Building a Web-Based Education System. New York, John Wiley & Sons Publishers, 1998.
4. Bruce, B., C. Fallon, W. Horton. Getting Started with On-line Learning. Macromedia Press, 2002.
5. Davis, H. The Secrets of Creating Web pages. Alexsoft, 1998.

## Информационная система для аптечной сети

*Николай Докев<sup>1</sup>, Даниела Смилянкина<sup>2</sup>*

<sup>1</sup>*Институт информационных технологий, 1113 София*

*E-mail: niki@iinf.bas.bg*

<sup>2</sup>*Новый Болгарский Университет, 1618 София*

### (Резюме)

Рассматриваются проблемы, связанные с эффективным управлением аптечных сетей. Предлагается подход, в котором существующие базы данных при администрировании фирмы и отдельных аптек интегрируются в Web приложениях. Показана реализация информационной системы обслуживающей фирмы, у которых в расположении аптечные сети.