

TECHNICAL ASPECTS IN DEVELOPMENT OF A SOFTWARE APPLICATION USED IN THE FRAMEWORK OF A NATIONAL LEVEL GENERAL PRACTITIONERS NETWORK

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Abstract: *This paper presents several technical aspects related to a software application for general practitioners – MedINS, designed to be used in the framework of a national level network – MediNet, emphasizing several important features the application includes. There are described solutions for the problems met in the software development process: the user interface design, reports sending, documents printing, databases importing and application updating. The MediNet network consists of 100 GPs computerized dispensaries spread all over the country, covering about 1% of Romanian population. The main goal of the MediNet network is to collect data from primary care and to process it in order to get statistical results necessary for knowing the real situation from primary care. The solutions stated in this paper were tested several years in the MediNet network having good results and they could be applied in the national primary care system.*

Keywords: *MedINS, MediNet, General Practitioners, Primary Care, Internet, data reporting.*

1. INTRODUCTION

Seven years ago, the National Society for Family Medicine / General Medicine initiated the "Sentinel Dispensaries Network" Program. The goal of this program was to create an informatics system designed to collect data from primary care in order to observe the real situation from this important sector of the healthcare system.

In the framework of the Sentinel Dispensaries Program were implemented three important projects so far:

- Morbidity Pilot Study PSO (between 1997 and 1998). The main goals of the project were: testing the possibility to implement a

- sentinel dispensaries network in Romania, introducing ICPC classification as an instrument in data collecting from primary care and realizing a database regarding the morbidity in primary care and preparing the General Practitioners (GPs) that had to participate in the future sentinel dispensaries network. The result of the project was the paper based data collected during 80.000 consultations by 30 GPs from 4 important cities.
- ICPC 2000 Project (between 1999 and 2000). The main goals of the project were: realizing the infrastructure of a sentinel dispensaries network, selecting and instructing 100 GPs from all over the country, preparing the working tools:

computers, software, classification systems and a data transmitting system, and finding finances for equipments. In this context it was developed MedINS – a software application meant to help GPs to record specific data in their dispensaries.

- GP-MediNet Project (between 2001 and 2003). The main goal of the project was to start the network functioning and collecting data from the 100 sentinel dispensaries all over the country. To help the data collecting process, the MedINS application was improved in order to include powerful reporting tools to generate and send reports via Internet to a central server [1].

Even if the third project ended, the program continues now with data collecting activity in the framework of a new project. Meanwhile the first and the second phase in processing data collected from the 100 dispensaries was done, having as a result the medical records recorded during one and a half year by the GPs in the MediNet network. The results are significant due to the relevant statistical sample of about 1% of the Romanian population [2, 3]. Those data are useful for knowing the real situation from primary care, the GP activity profile, the continuing medical education needs and research stimulation in family medicine [2].

The software application used by the GPs in the Sentinel Dispensaries Network, named MedINS was developed to be a helpful software tool for the GPs dispensaries. MedINS allows the users to record medical and personal data of a patient, to generate predefined and custom reports, to print medical documents (prescription, referrals, sending forms etc.) and many other facilities. The software was developed by a team of technical and medical staff. Even the GPs included in the network participated to the improvement of the software, being questioned about their opinions regarding the functions that the software application should include. MedINS is continuously improved by the same team, adding it new functions and removing the software bugs.

2. THE ARCHITECTURE OF THE INFORMATICS SYSTEM OF THE MEDINET PROJECT

The information system of the MediNet Project contains two applications: MedINS and

AdmINS. MedINS is the software application used by the GPs in their dispensaries, and it is analyzed in this paper from several technical points of view. AdmINS is a software application designed for the administrator of the MediNet network and allows the management of the reports sent by the GPs included in the network. The interaction between the two software applications is illustrated in Fig.1.

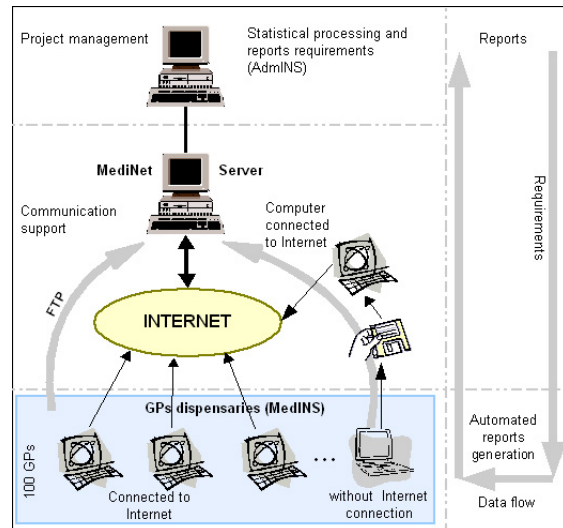


Fig. 1. Information flow within MediNet Network

2.1. The software application for the GPs – MedINS

MedINS is the software application that runs on the computers from the dispensaries of the GPs included in the MediNet network. This application has a multi-modular architecture, being composed of a main module and several auxiliary modules. MedINS is episode-oriented, uses the SOAP Philosophy (Subjective, Objective, Assessment, Plan) and stores medical data using two classification systems: ICD-10 for diagnostics and ICPC for the other elements of a consultation [4]. The main functions implemented in the application are: the management of the patients list, the management of the medical file of the patients, documents printing, generation of predefined and custom reports, reporting for the MediNet network, and the update of the application modules.

2.2. The software application for the management of the reports – AdmINS

The GPs included in the MediNet network send monthly reports via Internet to the central server of the project. On this server, every GP from the network has an ftp account. The administrator,

using the AdmINS application may accomplish three tasks regarding the reporting activity:

- To generate the settings file used to specify the format of the reports to be sent by the GPs to the server [5];
- To copy the settings file into the main directory of each GP ftp account from the MediNet server;
- To concatenate the reports from the GPs in a single database, this is easier to process.

3. TECHICAL SOLUTIONS RELATED TO THE DEVELOPMENT OF MEDINS

The development of MedINS started almost seven years ago and, in the meanwhile, some of the technologies the application includes may become obsolete. Nevertheless, this software application is in a renewal process, in order to keep the pace with newest software technologies.

The main module of MedINS was written in Visual Basic and auxiliary modules were written also in Visual Basic using ActiveX Exe technology. Visual Basic is a RAD (Rapid Application Development) tool that allows programmers to create Windows applications in very little time. Visual Basic is one of the most popular programming languages in the world, and has more programmers and lines of code than any of its nearest competitors.

In the following, there will be enumerated several of the technologies that led to a better implementation of MedINS.

3.1. The user interface

One of the most important aspects in the development of a software application is the design of the user interface. It must be taken into account the category that the users belong to. For example, the applications designed for non IT professional users should have a simple and intuitive interface. According to this, in the development of MedINS, the designing of such kind of user interface was one of the first problems we tried to solve. The users of MedINS are medical staff and most of them are beginners in use of the computers. It was needed to create a user interface that allows an easier access to different functions in a natural way. An illustration of the graphical interface of MedINS can be observed in Fig.2.

There exist software applications that have such interface that makes them difficult to use by the users, thus taking time to spend for learning to access the application functions. A user interface should be designed to be humane. An interface is humane if it is responsive to human needs and considerate of human frailties [6].



Fig. 2. The main window of the MedINS application

In the development of MedINS there were followed several principles for designing a humane user interface suitable for medical applications:

- The user interface should be simple, not having lots of menus and command buttons. The main window should contain just several commands to launch the main application modules, following a logical way to select information from general to particular.
- The user interface shouldn't include only text based commands, but to associate them small suggestive graphics or even a suggestive colors code. It isn't also recommended that user interface to include only graphical elements, because the users could become confused.
- An application shouldn't have many windows opened at a certain moment.
- Some windows contain a large amount of information (like patient medical file and patient consultation), thus the information have to be well structured and easy to locate. To perform this, there must be used graphical controls that allow including much information in a limited area: Tab control, TreeView control, CoolBar control etc. (Fig. 3, Fig. 4 and Fig. 5).
- Software applications should have advanced text search features. Such kind of medical

applications have many lists containing text elements (patients list, symptoms, diagnostics, dispensary procedures etc.). When the users search a certain element, they should have the possibility to find it quickly through an advanced search command. Typing first letters or a group of letters that searched text element contains should be sufficient to find it. It is very useful for the users to have the possibility to access quickly the most frequently selected items (Fig 6).

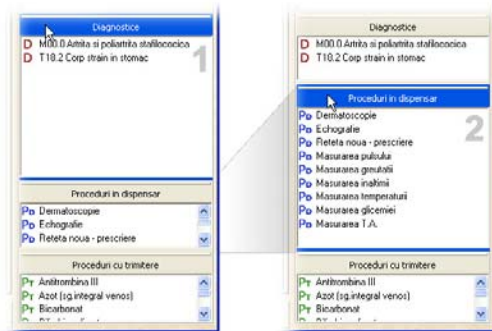


Fig. 3. Expanding the contents of a band in a CoolBar control.

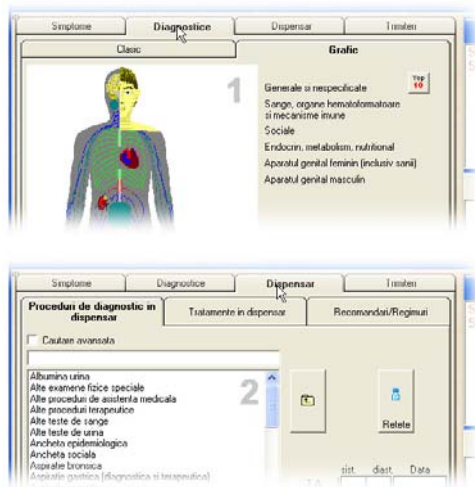


Fig. 4. The concentration of the information in a compact area using Tab controls.

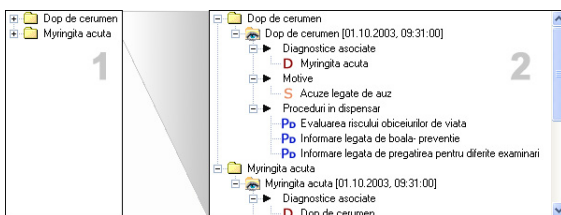


Fig. 5. Displaying the healthcare episodes of a patient using a TreeView control. Note that the information tree can be expanded or condensed.

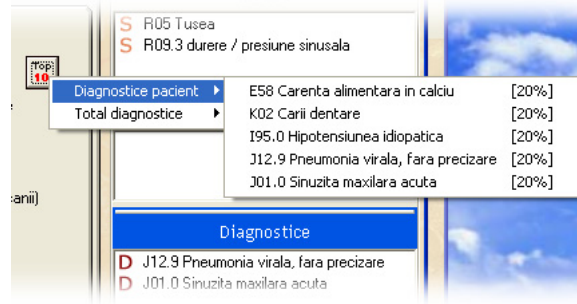


Fig. 6. A top of the 10 most frequently selected diagnostics can be accessed quickly in the time of a consultation in MedINS. Note that a top for the selected patient and one for all the patients is available.

The results of a study related to the user interfaces of the software applications designed for GPs show that the user interface of MedINS is well appreciated [7]. The strongest points of it were:

- It is easy to use;
- It is efficient;
- It is easy to learn;
- It is easy to understand;
- It is flexible;
- It produces easy-to-watch results.

3.2. The reports sending

As stated at the beginning of this paper, the main goal of the MediNet network is to collect data from Primary Care. To achieve this, the GPs included in the network send monthly reports containing a selection of the data they are recording in dispensaries. This process is supervised by an administrator that sets the format of the reports the GPs send and collects them. Each time when connects to the MediNet server, a GP must authenticate by entering the username and the password. Only authorized users can access the server. The authorized users are the GPs included in the MediNet network and the administrative staff. The report sending procedure consists of three main operations:

- Connecting to the server and downloading the settings file that specifies the format of the report to be sent.
- Generating the report based on the existing settings file.
- Uploading the report on the FTP server.

In order to send the monthly reports, GPs need an Internet connection. Some GPs have a direct Internet connection, but others don't. The both situations were taken into account by the developers of the system. Thus, the final solution includes the following situations:

- A GP that has in the dispensary a computer connected to Internet can access directly the MediNet FTP server and follow the three steps stated above.
- A GP that has in the dispensary a computer without any connection to Internet can access the MediNet FTP server from another computer connected to Internet, for example from an Internet club. The GP can access the FTP server through a dedicated web page, entering the username and the password in order to download the settings file. Then the file is transported to the computer from the GP's dispensary, where the report can be generated. After this step the report is copied on a floppy disk or on other storage unit and is transported back to the computer connected to Internet, where it is uploaded on the server. In special cases, GPs may send the monthly reports through e-mail directly to the administrator of the MediNet network.

For any of the two situations stated above MedINS has a command button which automates the entire process (Fig 7). These two commands were implemented to be sure that the GPs will execute the commands in the right order (the download of the settings file, the generation of the report and its sending to the server).

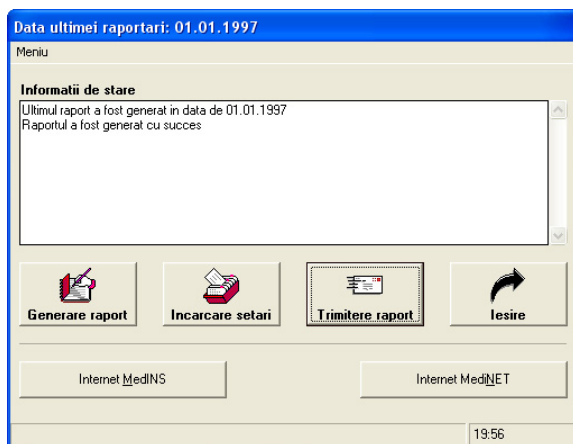


Fig. 7. The reports sending module. “Internet MedINS” and “Internet MediNET” are the two commands which automate the entire sending process.

3.3. Documents printing

In the GPs dispensaries, the printing of the entire medical or administrative forms (patient medical file, referrals, medical prescriptions, medical recommendations, bills, etc.) would make easier the work of the GPs. All they have to do is to record all the specific data into a database.

The problem of printing documents in MedINS was a complex one. First, the printing of documents was realized using RTF documents, then MS Word documents. When the RTF documents were used, it was not possible to display and print tables of data. The major problem of in the case of MS Word documents was that all the users had to buy MS Office and to install it on their systems in order to print a document within MedINS.

This problem was solved using a HTML based solution. HTML has the advantage that it can be accessed through free WEB Browsers (e.g. Internet Explorer, Netscape, Mozilla, Opera etc.). Since Internet Explorer is installed by default on every Windows system, there is not need to install other applications. To implement the printing solution in Visual Basic, it was used *DHTML Edit Control for IE 5*. DHTML (Dynamic HTML) is a set of innovative additions to HTML that allows page authors and developers to dynamically change the style and attributes of elements on an HTML page, as well as insert, delete, or modify elements and their text after a page has been loaded [8].

An important advantage of using the DHTML control is the possibility of grouping and displaying information in a hierarchical mode and the possibility to use evaluation expressions and formulas, in a similar mode as in SQL.

In MedINS, a HTML document contains a fixed part and a variable part. Fixed part consists in titles, tables or labels, and the variable part contains tags delimited by special characters that are processed and replaced with certain data, like patient name, numerical personal code, date of birth, age, sex, GP's name, current time and data, or custom data (symptoms, diagnostics, medication etc.). When a document is accessed by the printing module, a recordset containing all the variable data is passed to it, then the printing module process the HTML document and replaces those tags with certain data. After this operation, the document is displayed in a print preview form (as seen in Fig. 8), but the user still can edit the data if needed.

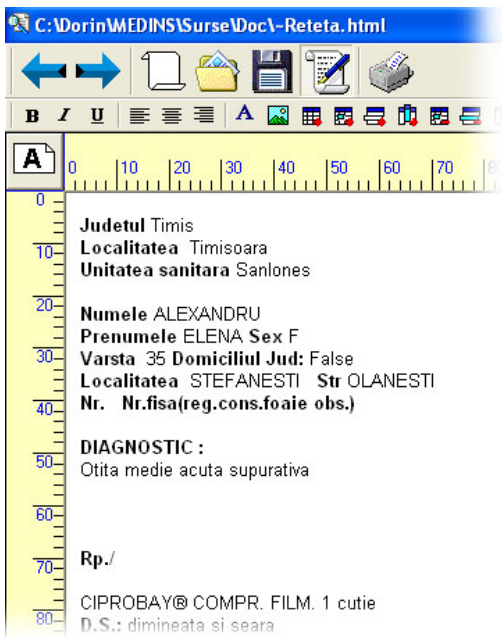


Fig. 8. The preview of a medical prescription before printing

The documents may be formatted in order to print them on different paper sizes (A4, A5, Envelope #10, etc.) and orientations (portrait and landscape), thus matching any type of document. Using formulas there it can be processed complex data like the date of birth or the sex of a patient from the numerical personal code.

3.4. Automated application update

As stated above, MedINS is a multi-modular application. One of the reasons that led to this architecture was that the application is easier to update when changes appear. Always, the newest versions of MedINS components are posted on a dedicated server, being available for download. In the case of small changes the users doesn't need to download the entire application, but a single component, thus reducing download time. This is a major advantage especially due to slow dial-up connections usually used by the GPs in the MediNet network.

From the main module of MedINS, the Update command launches an independent client application called MedINS Update and then it closes MedINS. That is because it isn't possible to replace a module while it runs. MedINS Update makes a connection to the server application and authenticates itself. The application running on the server, called Secure FTP Server, checks whether an update request is

made by an authorized MedINS user, otherwise the request is rejected. The client application checks the versions of the components posted on the server and then compares these versions with the versions of the local components of MedINS. If the remote components are newer than the local components or if there are posted new components of the system, other than the local components, the client application notifies the user about the possibility of upgrading. The user can select the components for upgrade and then clicks the Update command (Fig 9).

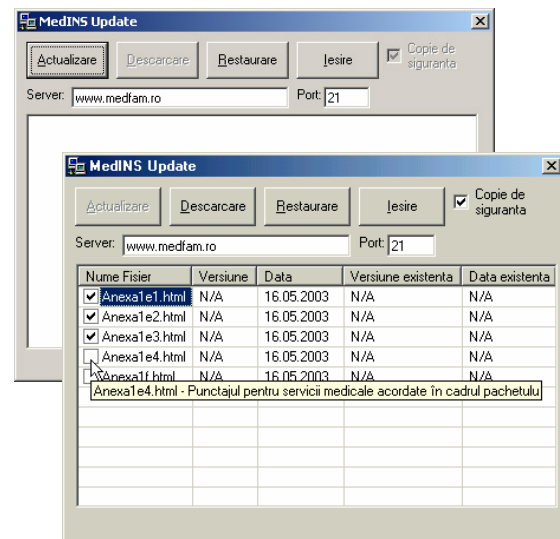


Fig. 9. The update procedure for several MedINS components

The remote components are downloaded and then a backup of the local components is made before their replacement. This update technique is safe and secure.

3.5. Databases import

MedINS uses MS Access databases. One of the most unpleasantly problems in exploitation of MedINS was the import of the initial patient data from FoxPro format (DBF) into MS Access format (MDB). During a long time period, the National Health Insurance House (NHIH) returned to GPs the list of valid patients in FoxPro format. To avoid reentering of the data every time when NHIH returns patients list, it was implemented a data import module. Now, the databases in FoxPro format are imported in MS Access format accordingly to the structure of the MedINS databases (Fig 10.). The only task the users have to do is the manually association between the fields in the FoxPro database and the fields in the MS Access database (Fig. 11).

```
'Conversion to MDB
Name_mdb = DB_path & "\Import.mdb"
If Dir(Name_mdb) <> "" Then Kill Name_mdb
Set dbImport = CreateDatabase(Name_mdb, _
    dbLangGeneral, dbVersion30)
Set td = dbImport.CreateTableDef("Import")
td.Connect = "dBASE IV;DATABASE=" & DB_path
td.SourceTableName = "Import"
dbImport.TableDefs.Append td
```

Fig. 10. A short Visual Basic code sequence used in DBF database import procedure

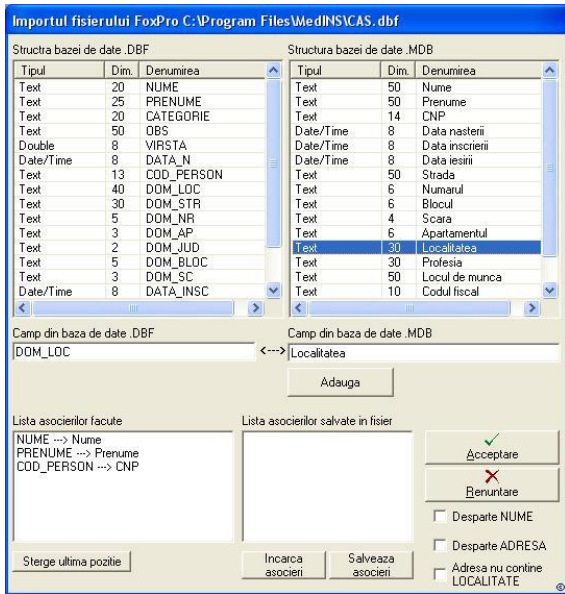


Fig. 11. The manually association procedure between the fields in the FoxPro database and the fields in MS Access database

Unfortunately, sometimes, the structure of the FoxPro databases doesn't match the structure of the MS Access database, because the FoxPro database contains some fields representing internal codes specific to each County Health Insurance House (CHIH), their signification being known only by the CHIHs staff.

The import tool implements some functions that allow a better data import. For example, in some cases, the address of a patient is stored in a single field, but in others, the address is divided in many fields representing its component parts (city, street, number, apartment etc.). To solve this problem, this module has a parser which can split the address of a patient into components. The user can also indicate whether the first name and the last name of a patient are stored in separate fields or in the same field. After these settings are done, the import procedure can start. The import procedure can be accomplished manually, importing record by record, or automatically, letting the application to

automatically import all the records in a database based on the settings the user made (Fig. 12). In the future, this module could be extended in order to accept the most usual database formats for import.

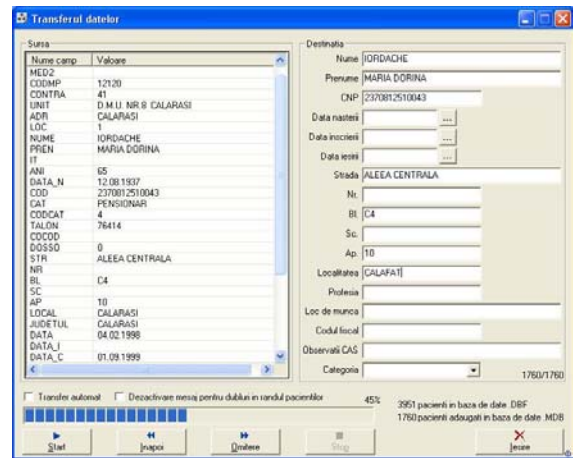


Fig. 12. FoxPro database importing process

At this moment other new features are going to be implemented in MedINS: multi-user access [9], multilingual captions and automated windows scaling to any screen resolution.

4. CONCLUSIONS

The paper presents several technical aspects related to the development of a software application used in the framework of a national level project that aims data collecting from GPs. The solutions presented above may serve as an example that can be followed by the Romanian authorities, for the automation of the entire data flow in the healthcare sector. Because one of the main activities of the GPs consists of recording data and reporting to the Health Insurance Houses and Public Health Directions, the stated solutions could be feasible to be implemented in primary care information systems at national level.

It can be taken into account the reusable character of the data collected in the MediNet network. The most of the data collected in the actual primary care system are stored in huge "data graveyard", where the data enter but aren't used anymore. The data collected from MediNet network are processed periodically, resulting complex statistics regarding the real situation of the primary care in our country.

In the near future, the processed data can return to the GPs as a feedback, containing, by

example, different correlations between diseases based on the records made by the GPs in the MediNet network, thus helping GPs in finding the correct diagnosis. This can be a starting point for creating an efficient Romanian primary care system.

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