Medical Teleconsultation System

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Abstract

In this article, we present in detail the aspects of design, architecture and implementation of a teleconsultation system, intended to facilitate the access to high quality medical care in all Algerian territory. The system is implemented in Microsoft platform. Microsoft Share Point Portal Server allows developing a smart portal in which doctors can research, publish and share files of patients via Intranet. The designed application is based on multi-user Web architecture and composed of many modules enabling data exchange between distant doctors. Our work consists in realizing a teleconsultation system in order to interconnect Algerian hospitals between them, which allows data exchange. So in addition to standard computer equipments, each hospital must be equipped by: medical images acquisition appliances and a local area network linked to other hospitals via routers.

MOTS-CLÉS : Télémédecine, Téléconsultation, Dicom, Vidéconférence, Web, Client/Serveur, Intranet,...

KEYWORDS: Telemedecine, Teleconsultation, Dicom, Videoconferencing, Web, Intranet,...

1. Introduction

Algeria is characterized by a large area. So implementation of an efficient health care on the Algerian territory, has always been a challenging task because of it’s the centralization of the high quality medical services in the North of the country. So, patients requiring specialist opinion must travel to distant medical centers which are often not feasible due to patient state. Improvement of health care in Algeria can be achieved using electronic means of communication. The development of telecommunication networks has a key role in the development of telemedicine.

The system presented in this paper represents a possible implementation of teleconsultation, which is one of the many aspects of telemedicine. The fast growth of Internet and acceptance of second generation Internet protocols have initiated the development of advanced Internet based applications. So Internet based application for medical teleconsultation is an obvious solution. The basic idea is to achieve greater quality of communication between general practitioners and specialists using teleconsultation [1], which results in an improvement of patient care. Realization of the desired goal is based on two main requisites. First, efficient way to exchange messages between doctors must be provided. Second, adequate exchange of information concerning patient have to be provided [2]. Furthermore, confidentiality of communication and stored data have to be guaranteed [3][4][5].

2. System Description

This article is organized as follows: in the first section we present the architecture of the system, in the second one the functioning mode, then the user interface. The security considerations are presented in the last section:

2.1. System architecture

The developed system is based on “multi-tiers” customer-server architecture. It is composed of [Fig 1][5][6]:

2.1.1. The User: is implemented as a thin-client and needs only a web browser.

2.1.2. The SharePoint Portal Server: hosts the system web site and offers working spaces for the doctors. (The system is implemented using Active Server Page).
2.1.3. **The Database Server:** SQL Server is the database management system. The access to data is done via the interface ODBC.

2.1.4. **The Storage Server:** in which the radiological and biological examinations of the patients are archived. Standards DICOM of the medical imaging [7] is integrated in this Server.

2.1.5. **The Web Server:** It hosts the Chat, the Forum and the News Letter modules.

2.1.6. **The Mail Server:** The Mail Server used is Exchange 2000 Server.

2.1.7. **Video Server:** a server in which is executed a server video conference application using the H323 and T120 video conference norms.

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**2.2. Functioning mode**

The realized application is a portal developed with Microsoft SharePoint Portal Server. Its dashboard consists of several modules [Fig 2]:

- A module of access and processing of the patients' data, a module of Chat, a Forum, a News Letter realized with ASP [8].
- SQL Server is the database management system use.
- An ActiveX allowing the acquisition of medical images and which integrates the DICOM format [7], which is a standard dedicated to the medical images.
- Microsoft Exchange is the mail server used [9].
- A sharing module of the patients' data between doctors, each according to its role (reader, author, coordinator), is set up by using the property of document sharing of SharePoint Portal Server [10].

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**Fig.2 : The Teleconsultation application architecture**

The scenario of access to the system takes place as follows [Fig 2]: the customer formulates his HTTP request to launch the execution of the ASP scripts which are in the Web Server, these scripts and according to the demand allow either to reach the database SQL Server via the ODBC bridge, or to execute the modules of Chat, Forum, Newsletter or mailing.

Java language is used by integrating the API JMF allowing the realization of a Video Server application. It is possible from this server to open several sessions to the doctors each according to its access right to attend visual conferences [11] [12].

The module of sharing documents allows sharing the data of the concerned patients between several doctors. For that purpose a working space is reserved for each hospital. Every doctor is a coordinator in his working space and the others are readers, thus the document can be modified only by his owner and can be seen only by the doctors who have the right of reading. This right is attributed by the coordinator. Each user of the system can be coordinator and reader at the same time. A common work space for all hospitals is created for the documents which can be seen by all doctors.

The scenario of the patient folders sharing is very simple: after an authentication step, if a doctor wants to pass on a patient file to another doctor either to consult the file sent by another doctor, he has to access to the module: documents library, then select the directory Document to reach finally the working space.

The system is modular and can be adapted to users' needs: it is stretchable and allows the addition and the
importation of other modules as ACTIVEX or Microsoft COM objects.

2.3. User Interface

The interaction between the customer and the various servers is made via an interface [Fig 3]. This one allows the users to formulate theirs requests.

The Medical Teleconsultation project proposes the access to a medical data base, to the professionals of medicine. This access in question permits exchanges of data (Medical imaging and Information on patient), with a better diagnosis aim.

The professionals of medicine will find, with this project, a mean of communication through a mailing service and Chatting.

The Menu of the 'Medical Tele consultation system ' contains these modules [Fig 3]:
- Access and update of a medical Data base.
- Forum between the professionals of the medicine.
- Chat.
- mailing.
- News Letter.
- Medical images acquisition.
- Videoconference
- Documents sharing.

![Fig.3 : The Teleconsultation portal interface](image)

2.4. Security considerations

The security is a very important aspect in the Web applications, particularly in the case of medicine where the confidentiality and the integrity of patient data must be protected. So several levels of security were used [12]:

2.4.1. Level 1 (low level Security)

The level 1 security is assured by the installation of a FIREWALL on an independent machine to control the transfer of piece of information resulting from the outside of the network[14].

2.4.2. Level 2

The appropriate security for Windows 2000 Server system, which is assured by the NTFS (NT File System) file system and the users authentification.

2.4.3. Level 3

The SQL Server Data Base security system: the access rights in the Data base are defined by its administrator, which are completely independent of access rights to files defined at the level 2.

2.4.4. Level 4

The professionals of medicine will find, with this project, a mean of communication through a mailing service and Chatting.

Use the Microsoft SharePoint Server security system which is based on the roles used during the sharing of the patient’s informations [10]. The coordinators can give to doctors the right to reach the contents by adding them to security regulations defined on a file and by classifying them in one of the following three roles: reader, author or coordinator.

2.4.5. Level 5

The security of the application is made by allowing the access to the application by password, what allows to control the users and their access rights in the data.

3. Discussion

We opted for a Web technology what assured an easy navigation on Internet for the doctors and similar.

On the other hand software maintenance was simplified seen that it is made only on servers.

The use of the standard DICOM for the medical images assures the portability.

Nevertheless, the quality of the videoconference and the transfer of high images resolutions were altered by the limitation of the busy band what requires the use of adequate Algorithms of compression / decompression.

On the other hand, the multiplicity of the sizes of data imposes us the adoption of the standard format XML witch is the most suited, in the future versions.
4. Conclusion

In this article we presented a Web application for the medical teleconsultation. The purpose of such application is to satisfy the problems and to facilitate the collaboration between doctors by creating common bridges of communication and transmission of knowledge between them. The objectives of the developed platform are the secured sharing of applications and data between professionals of medicine. The obtained results are very satisfactory and concern the integration of Microsoft portal tools to realize an interactive real-time opened system and enabling the coverage of medical images in DICOM format as well as the use of video conferences multi point between the doctors through an integrated video server.

This platform allows the addition of the other features by the user through shared Microsoft COM objects. Works of implementation of the patient files (given, radio with Dicom images, video) in XML format are in progress and allow a standardization and a more intelligent manipulation of the information.

5. References


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