Management of Clinical Case Studies in Virtual Medical Communities

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Abstract: - In the modern medicine context, the main factors affecting medical decision could be related to lack of communication, inadequate transfer of knowledge, inappropriate information flow, inexperience The paper presents a web based platform for management of medical cases, support for healthcare specialists in taking the best clinical decision. Research has been oriented mostly on multimedia data management, classification algorithms for querying, retrieving and processing different medical data types (text and images). The medical case studies can be accessed by healthcare specialist and by students as anonymous case studies providing trust and confidentiality in Internet virtual environment. The MIDAS platform develops an intelligent framework to manage sets of medical data (text, static or dynamic images), in order to optimize the diagnosis and decision process, which will reduce medical errors and will increase the quality of medical act. MIDAS is an integrated project working on medical information retrieval from heterogeneous, distributed medical multimedia database.

Key-Words: clinical case, multimedia medical database, second medical opinion, web portal

1 Introduction

Better quality, safety and effectiveness of health care are the primary goals of the e-health. The increasing amount and the complexity of medical knowledge and information involved, the deepen specialization required by the medical practice, the increasing pace of emergence of new medical procedures and treatments made the information and its processing even more important in providing healthcare services. The Internet has become the effective information exchange strategy in healthcare services. One of the most important aspects of this strategy is the possibility offered to healthcare professionals to exchange information, to discuss, to take or to give advice to other professionals, by creating a web based large medical information database. A properly organized medical database can compensate human memory limitations and provides a specialized environment for improving patient care, research and education.

Nowadays, nationwide there have not been developed online platforms to support clinical decision. Also, there haven’t been developed online multimedia medical databases which give access to relevant medical information no matter the location where medical experts work. There haven’t been defined the communication support which permits the dialogue between healthcare professionals in case of atypical medical problems where the decision is essential. The aim of the portal is to deliver reliable clinical information as well as to preserve all consistent data required for high quality information control.

The MIDAS platform develops an user-friendly platform for searching, mining and processing medical information available in a multimedia medical database. The platform is a very helpful tool for professional training inside medical virtual communities and will assure the support for communication between healthcare professionals from medical communities to analyze difficult medical cases and to establish the intervention methods or the adequate medical care.

2 General Description

The MIDAS platform is implemented as a web portal application, supporting:

- Management of medical information organized in clinical case studies;
- Exchange of information between healthcare specialists

The information platform is used to maintain a dialogue with the system in order to optimize medical diagnosis. Thus, users can interact with the system in order to publish a specific case which requires attention or to ask for extra information to optimize medical diagnosis, as well as to participate at discussions on different medical topics. The platform enables the dialogue and consultation between healthcare professionals by creating
descriptive models for medical data, information and image acquisition, as well as displaying them in intelligent and user friendly graphical interfaces [1].

IT experts monitor and manage the execution environment of the platform.

The main modules of the MIDAS platform are:

- Management of heterogeneous medical information module;
- Consultation module between healthcare professionals;
- Monitoring module visible only for the administrator of the portal

Also, the platform provides e-mail services for collaboration between specialists and a forum for healthcare professionals to exchange medical, training, support information.

2.1 Functional Requirements

Starting from an abstract level, we have identified two major functional requirements for the most important modules of the platform (for the management of medical heterogeneous data module and specialists consulting module). These requirements are:

- **Publishing a clinical case** – MIDAS will enable the publishing of a medical case by the usage of templates predefined by medical specialists. An interesting clinical case can be published in order to inform the specialists that work in the same medical area (in this context, the medical case will contain imaging investigations, patient data, medical analysis, diagnosis and treatment possibilities) or to ask for supplementary information from other medical specialists (the clinical case would contain imaging investigations, patient data, medical analysis and the requirements for diagnosis and treatment).

- **Assisting difficult case studies** – A registered user has the possibility to view all cases which need assistance to give a personal opinion to help the owner of the case to take the best decision for diagnosis and treatment.

At a more detailed level, the two main requirements presented above can be extended in this manner:

- **Logging in and authentication of users (health specialists)** – the platform will enable the logging in and the authentication of users (doctors) that will publish clinical cases.

- **Clinical case elaboration** – after authentication the user will elaborate the clinical case that he will publish.

- **Publishing a clinical case** – there will be two possibilities for publishing a clinical case: to inform the medical personnel from the same area (in this context, the medical case will contain imaging investigations, patient data, medical analysis, diagnosis and treatment possibilities) or to ask for supplementary information from other medical specialists (the clinical case would contain imaging investigations, patient data, medical analysis and the requirements for diagnosis and treatment).

- **Medical case assistance** - A registered user can post a personal opinion to help the owner of the case in taking the best decision for diagnosis and treatment.

- **Monitoring and administrating a clinical case** – after publishing a clinical case, the user that created it has the possibility to monitor the evolution of the case.

2.2 Stakeholders and Roles

The main purpose of the MIDAS platform is to process sets of medical data (text, images). This goal is realized by publishing an interesting medical case on the web portal in order to inform the other specialists about this clinical case or in order to obtain furthermore information from the medical experts regarding diagnosis and treatment possibilities.

In order to reach the main goal, the first step will be to describe the categories of actors involved in the system, actors that will have the possibility to access the MIDAS platform. An actor can be considered a certain role played by the user interacting with the system. The actor can use the system according to one or more utilization cases. There are three groups of actors that can access the MIDAS platform, thus:

**IT experts** have the role of monitoring and technically administrating the platform;

**Users (doctors)** can access medical information or can resolve problems related to certain medical cases in order to optimize diagnosis and treatment, or they can publish interesting medical cases, all of these being performed through a dialog with the system.

**Visitors are unregistered users. They can view only public sections of the platform**
3. Platform Architecture
The informational platform uses web technologies for the management of medical information. The platform is based on open standards like web services or XML to be interoperable with other existing medical information systems. The conceptual model of the MIDAS platform is shown in Fig. 1.

3.1 Portal Presentation
The portal is organized in four main sections:
- Personal Account;
- Shared medical case studies
- Medical case assistance
- General information.

3.1.1 Personal account
Only registered users, healthcare specialists have access in this section. The user can update his profile, can register new cases for sharing medical information or for asking a supplementary opinion to solve the case, or can view a list of favourite cases selected from the portal database.

In the system, a medical case is structured using the patient health record model from the Romanian hospitals.

The main sections are:
- Personal data: name, surname, personal identification number, age, sex. To ensure the anonymization of the case only sex and age will be public for other users. The identification data are available only for the user who registers the case in the system.
- Anamnesis
- Anatomical Systems Investigations. The section contains a description of all accomplished medical investigations.
- Laboratory: contains information about patients’ laboratory investigations.
- Image Section. In this section the clinician can upload significant medical images to describe the case (radiography, echography, endoscopy, MRN, CT). The images could be static (JPG, PNG, GIF, DICOM format) or dynamic (AVI or DICOM format) [2], [3].

We present a screenshot of this section in Fig. 2:

3.1.2 Shared medical case studies
In this section there are listed all public clinical cases. The access is unlimited including unregistered users (students, healthcare authorities, etc). The user can create a filter based on available parameters (e.g. diagnosis, medical speciality, period) to extract information from the database. Only the registered users can create a favourite case list selecting medical cases which will be viewed in the “Personal Account” section.

3.1.3 Medical case assistance
This section is structured like a forum and is visible only for the registered users. The case contains an additional field where the clinician can post the medical difficulties in solving the case and can require assistance from other healthcare professionals. The cases can be viewed using a list of criteria based on user requests. For every case saved in the database requiring assistance, a registered user can view all stored information about the case, can download the medical images of the case for studying and give an opinion to help the owner of the case to establish a diagnosis or/and the appropriate treatment. The users can create a
favorite case list selecting medical cases which will be viewed in the “Personal Account” section. A screenshot of this section is presented in Fig. 3.

3.1.4 General information
This section presents public information about registered users, medical events, research news and is managed by the administrator of the portal.

4. Technical Description
The MIDAS platform is a WEB portal that is able to perform various operations: recording and retrieving of medical case studies, communication between healthcare specialists in order to solve medical cases.

The hardware architecture of the platform consists in:
- Data Layer[4]
- Presentation Layer.

4.1 Data Layer
The system architecture enables us to translate the managed objects into a format, which is accessible through SQL. Standard SQL is used to query the data from system repositories.

The database tested within the platform is MySQL. The database independence is achieved by:
- Isolating the SQL code in the application so that the SQL code can be rewritten for another database
- Isolating the SQL code in the installation procedures. This SQL code creates tables, stored procedures, indexes etc, when the system is installed.

4.2 Presentation Layer
The Presentation Layer contains components that are required to enable user interaction with the application. The user interface components display data to users, acquire and validate data from user input and interpret user requests that indicate their wishes to perform an operation on the data. Additionally, the user interface filters the available actions to let users perform only the operations that are appropriate at a certain point in time.

The web application is based on open-source technology PHP for reducing costs of implementation and administration of the web portal.

The operating system installed on the central server is Windows 2003 Server R2i, including IIS 6.0 web server.

4.3 Security
MIDAS platform architecture was developed with strict and important security requirements.

Security mechanisms rely on correct installation configuration and integration (e.g. physical security, system configuration and operating system and platform set-up). We use role-based security and each user is associated with one or more roles. The roles are associated with certain groups of users and access to different data in central database. Audit trail logging is implemented and logs security-related transactions.

The sitemap of the portal is shown in Fig. 4:
5. Privacy and confidentiality
MIDAS platform assures privacy and confidentiality of medical information over the internet using a set of rules which refers to:

- Extracting identification information from the medical case studies and using an encryption algorithm to save patient data in the database. Only the users who register the case have access to this information.

- All identification information is extracted from DICOM files when there are uploaded and saved in the database.

- Only cases that are registered as public cases are visible for all persons who access the web portal.

- For registration in the portal the user must contact the administrator and transmit solicited data in order to be verified if he is a valid healthcare specialist.

All data stored in the database is protected by the requirement to specify a valid username and password in order to update or delete the data.

6 Conclusion
The article has presented the MIDAS platform designed for the management of heterogeneous medical data that integrates medical and information concepts, support for healthcare professionals in taking the best clinical decision for prevention, diagnosis and treatment.

The conclusion that can be drawn is that at the end of the project, the following main benefits should be achieved:

- Reduction of medical errors;
- Processing of large objects such multimedia medical data;
- More efficiency by supporting remote reading and diagnosis of clinical cases;
- Continuous training of healthcare professionals;
- Access of the specialists to relevant medical information;
- Support for education and research in medical sciences;

The project will be an information support for healthcare specialists, an useful tool which aims to achieve the goals referred by evidence-based medicine concept.

References:
[3] medical.nema.org