

# MamODB as a new e-learning tool in Digital Mammography

Christian Mata, Joan Martí, Arnau Oliver  
Computer Vision and Robotics Group  
University of Girona, Girona, Spain  
{cmata,joanm,aoliver}@eia.udg.edu

**Abstract**—MamODB is a research web-based tool which has been customized in order to incorporate learning capabilities for training and guidance of newly employed or resident radiologists in Digital Mammography. MamODB allows panels of experts to collaborate at different hospitals and research centres by means of integrating a Picture Archiving and Communication System (PACS) to store the Digital Imaging and Communications in Medicine (DICOM) files as well as a database with the eXtended Markup Language (XML) files containing the experts' annotations for each clinical case. Its architecture, methodology and implementation in web format are presented in this work as well as conclusions and future work.

## I. INTRODUCTION

Technology in health allows to record, measure, monitor, manage and provide guidance to the patient, together with the opportunity to offer care services through the Internet in real time. E-learning health systems have enabled to maximize the collection, delivery and communication of medical information, clinical messaging, interaction with doctors and medical records [1]. We propose to use MamODB as a part of the problem-based learning paradigm, which in fact, is an innovative and challenging approach to medical education. It is a new way of using clinical material to help students to learn, and it requires the medical expert to use facilitating and supporting skills rather than didactic, directive ones. Such paradigm emphasizes the application of knowledge and skills to the solution of problems instead of just recalling the facts.

Therefore, stated that the training process for the radiologists should include a large number of cases with multiple benign and malignant findings, MamODB allows testing and training a radiologist's ability to detect mammographic findings, properly characterize mammographic findings according to their number, location, shape, size, margins, density, and distribution. Finally, Issue a diagnosis according to the detection, correct identification and characterization a mammographic finding.

In this sense, this work is to provide a useful tool to the medical and scientific communities in order to manage a mammographic image database including their associated diagnoses (MamODB), featuring the advantages and functionalities of a web service (i.e. authentication, security and data retrieval).

## II. SYSTEM DESCRIPTION

### A. Architecture

MamODB has been designed as a web-based application within the Zend Apache server [2] which is also used as a MySQL database server for data storage. The application links both the PACS [3] and the XML servers which store clinical cases (as DICOM and annotation files). All data transmissions between users and the web server are encrypted in order to ensure complete confidentiality of the data. Currently, the Secure Socket Layer (SSL) cryptographic protocol is used. Queries to the MamODB are performed through a web form and provide a user with a list of clinical cases according to the query parameters, including the image and the annotation files. Figure 1 shows the system architecture of the MamODB.

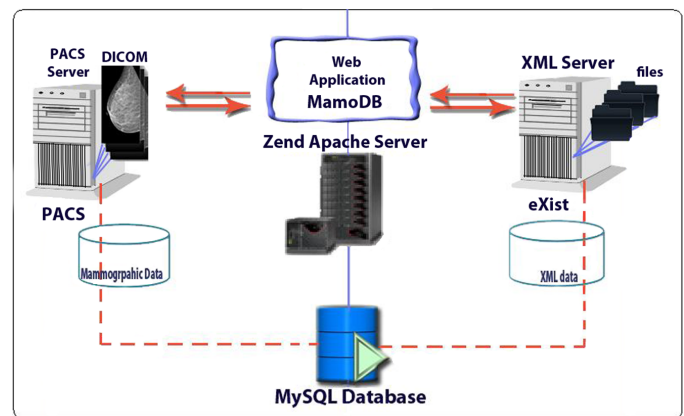


Fig. 1: Architecture model of the MamODB

Finally, the access system has been designed in order to facilitate both local and external [4]. The users should log in correctly using a unique username and password independently if the connection is via intranet or external.

### B. Web Application: MamODB

We propose the use of the web-application MamODB as a part of the problem-based learning paradigm. This section describes the most important features of the MamODB application. This e-learning platform uses queries to the MamODB through a web form and provides a user with a list of clinical cases according to the query parameters, including both the image and the annotation files.

The first step required from the student for this training process is the use of the query MamODB form. In order to obtain desirable results the user should select appropriate criteria, as directed by the expert or medical staff. Their work is to find mammographic studies according to the criteria used by the user. The search is performed in all the XML files stored in the database and the list of results is shown in the web interface.

Fig. 2: Example of a MamODB query form

Figure 2 shows an example of a standard query form where a user can define the type of query (upper area) and select the information to be shown in the result (bottom area). This training criterion is based on the query form with the purpose to detect a mammographic finding according to its their number, location, shape, size, margins, density, and distribution. In addition to a comprehensive list of clinical cases contained in the database, the query forms allow to search according to some specific medical criteria: reported diagnosis, BIRADS classification [5], presence of abnormalities (microcalcifications, structural distortions, masses, etc.)

Instance	Study	Information	XML	View	Download
114	28 - 2010/3/23/10/97495033E5651D8C72E7CC3B				<input checked="" type="checkbox"/>
115	28 - 2010/3/23/10/97495033E5651D8C72E7CC3B				<input checked="" type="checkbox"/>
116	28 - 2010/3/23/10/97495033E5651D8C72E7CC3B				<input checked="" type="checkbox"/>
117	28 - 2010/3/23/10/97495033E5651D8C72E7CC3B				<input checked="" type="checkbox"/>
118	29 - 2010/3/23/10/680709041920EBC7B150EF14				<input checked="" type="checkbox"/>
119	29 - 2010/3/23/10/680709041920EBC7B150EF14				<input checked="" type="checkbox"/>
120	29 - 2010/3/23/10/680709041920EBC7E45E328E				<input checked="" type="checkbox"/>
121	29 - 2010/3/23/10/680709041920EBC7241A85C1				<input checked="" type="checkbox"/>

Fig. 3: Results obtained after the training query form

When the list of results is obtained, the user can get information about all studies and compare them in order to perform a classification and selection of the best results according to the preferences selected in the query form. This is the educational part of this e-learning tool and it is useful

to understand its methodology. Depending on the volume of records obtained from the results list, the application uses automatic paging group records in a more visual way. Figure 3 shows the results obtained after a standard query: the upper area contains the list of records provided by the MamODB, while the bottom area shows the effect of the three different actions to perform. Furthermore, a student can select the cases that are of interest to the learning process and start the download process immediately.

Finally, in Figure 4 two examples of DICOM images associated with the selected study are displayed. It also shows overlays marked by doctors and their individual annotations. This information is very important because users should compare and classify studies in order to later download all the cases useful for the learning purposes.

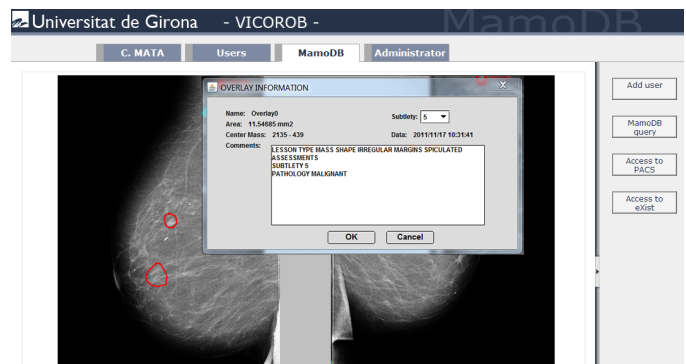


Fig. 4: Display the DICOM images with their associated overlays. It is also possible to obtain the description about each overlay

### III. DISCUSSION/CONCLUSION

MamODB has been designed as a web-based application within the Zend Apache server which is also used as a MySQL database server for data storage. The application links both the PACS and the XML servers which store the clinical cases (as DICOM and annotation files). Database queries are performed through a web form and provide the user with a list of clinical cases according to the query parameters, including both the image and the annotation files.

As future work to improve MamODB, we propose to define a single XML file format for the medical community, which would correspond to the annotations of the images associated with mammography. Moreover, we plan to define custom search forms that ensure optimal results and are tailored to the needs of the user.

### REFERENCES

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