# Web-application system using a Digital Mammographic Database: MamoDB

Christian Mata, Xavier Lladó, Joan Martí
Computer Vision and Robotics Group
University of Girona, Girona, Spain
{cmata,llado,joanm}@eia.udg.edu

*Abstract*—As the time passes, even more hospitals make use of computerized systems for the acquisition and visualization of medical digital images. This increment in the use of digital images and the associated diagnostics supposes a growth of resources required to store, manage and retrieve huge volumes of data. In this work, we propose a web-application system as a tool to facilitate the diagnostics of breast cancer. The proposed system is based on the administration of images and diagnostics having the goal to become a reference for the scientific community. Its architecture, methodology and implementation in web format are presented in this work as well as conclusions and future work.

## I. INTRODUCTION

Nowadays, medical imaging plays a fundamental role to achieve a right diagnostic on many diseases. However, it involves deep changes concerning the management, storing and retrieving of digital images. Thus, in order to improve the current informatics systems, it is necessary to develop architectures and systems databases, as well as communication and PACS [1] systems. Although there exists some public mammographic databases, none of them has been digitally purchased and the images come from analogical acquisition and subsequent digitization of the films [2][3]. For breast imaging, this process involves an inherent loss of quality, depending on the digitizer system, loss of information acquisition and non-standardization of image formats.

Besides, systems based on web applications [4], [5], [6] are particulary interesting due to recent advances in computer technology and in communications systems and protocols, which have allowed the development of online software and data recovery in a reliable and inexpensive way [7]. Therefore, the use of Web Services applied to medical domain has known an important growth during the last years, and has become a communication system in itself.

Moreover, the introduction of file format XML (eXtended Markup Language) allows to exchange information in regardless of the platform, thus introducing a standard format to include diagnosis on the images.

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

## II. SYSTEM DESCRIPTION

### A. Web Application: MamoDB

MamoDB is a query system provided by form queries which contain the basic fields to obtain an ordered list of stored clinical cases (including both images and text annotations) from the database. 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, presence of abnormalities (micro-calcifications, structural distortions, masses, etc.). Depending on the volume of obtained records, the results list is grouped into meaningful blocks for readiness purposes.

Figure 1 shows an example of standard query form where the user can define the type of query (upper area), and the information to be shown where different features can be selected (bottom area).



**Fig. 1:** Example of a MamoDB query form

Three different actions are available once the records have been obtained:

- Display the digitized images contained in the DICOM file.
- Get the diagnosis linked to the case, stored in a XML file.
- Display the information contained in the DICOM file.

Figure 2 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. The results of such actions can be either displayed or downloaded to the user workplace.

**Fig. 2:** Results obtained after a standard query

Login to the MamoDB web-application is performed by means of a standard identification system (username and password). Once logged in, the general control panel is automatically displayed, which provides at any time general access to all the application functions. Similarly, a menu available on the right side provides a shortcut to the most used options. Depending on the security level assigned to the users, the panel control slightly changes its appearance in order to fit the users restrictions.

*B. System Architecture*

The system architecture has been chosen in accordance to the features of the MamoDB application, which has to deal with a mammographic image database, the text annotated diagnoses, and the potential simultaneous access of several users via the web applications. Figure 3 depicts the architecture model of MamoDB, where the application is running on a Zend Apache server configured as a MySQL database manager. It is important to emphasize that the PACS system automatically creates a database inside the MySQL server (named pacsdb), where the information related to the access and mammographic images are stored. Hence, there is a direct relationship between the server and the image database.

MamoDB is also linked to the eXist server, which stores the XML database. All the XML files are stored in the eXist server, which are conveniently linked to the corresponding mammographic image.

Since the application is intended not only to local users (access through an intranet) but also to external users, a web environment was selected.

Finally, the administration control is an alternative option in order to access to PACS and eXist servers. In addition, to establish a higher level of security, authentication must also be performed with username and password information.

## III. CONCLUSIONS

In this paper, an architecture model to build and maintain a web-based mammographic image database has been presented, which also includes for each clinical case a text annotated



**Fig. 3:** Architecture model of MamoDB

file coming from the diagnosis. The proposed system architecture enables to manage and centralize a public database of mammographic images digitally acquired. An authentication process allows to access to the system not only by means of an intranet, but also elsewhere.

Currently, the MamoDB web-application is under prototyping, so much efforts on defining optimal XML file formats need to be in a near future. Besides, refining the query forms is another key point in order to significantly improve the system performance. Tests on heavy multiple access should be also carried on in order to check the system reliability.

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# Automatic LV Myocardium segmentation in Late-Enhancement CMR images

Xènia Albà*, Rosa M. Figueras i Ventura*, Alejandro F. Frangi*†

*CISTIB, Universitat Pompeu Fabra, CIBER-BBN, Barcelona, Spain
†ICREA, Barcelona, Spain

*Abstract*—We have implemented an automatic method to segment the myocardium on late-enhancement cardiac magnetic resonance images (LE CMRI). Cardiac MRI provides important functional information for cardiovascular diagnosis and prognosis. LE CMRI are used to assess myocardial tissue viability. To ease the task of scar delineation and constrain its results to lay within the myocardium, we have developed an automatic myocardial segmentation approach of the myocardium, which consists on deforming a template that minimizes shape, gradient and contour constraints in each slice of the LE CMR volume. The obtained results are positioned within the inter-observer ranges of manual segmentation.

## I. INTRODUCTION

Viability assessment is nowadays an important part of patient examination necessary for diagnosis and treatment selection and planning of cardiovascular diseases [1]. This assessment is currently performed using late enhancement (LE) cardiac MR images [2]. LE CMR is performed after administration of a contrast agent. Due to the loss of membrane integrity in damaged tissues, the contrast accumulates there. The non-viable tissue is consequently enhanced (becomes bright) while healthy myocardium remains dark.

Before locating and quantifying the non-viable tissue, a previous and very important step is the delineation of the endo and epicardium contours (the inside and outside contours of the left ventricle myocardium) on every slice of the short-axis volume. Manual segmentations involve a lot of time and vary from user to user. So, in order to fully exploit the information in the MRI data and considering the amount of data involved, automatic extraction of the myocardium is essential.

To segment the myocardium in CMR images, semiautomatic [3] and automatic [4]–[6] methods are proposed. However, most of the automatic ones are related to dynamic (or cine) anatomic images, in which the myocardium is clearly visible but there is no scar information. In LE CMR images, however, the scar can be highlighted but the myocardial boundaries are hardly enhanced. Our strategy is an automatic method appied to LE CMR images and based, with some modifications, on Ciofolo et al.'s method [7] by matching a geometrical template to the myocardial contours and ensuring that infarcted tissue is included inside the final segmentation.

## II. METHOD

We have based our segmentation on the first step of Ciofolo et al. [7]'s multi-step approach to segment LE CMR images.
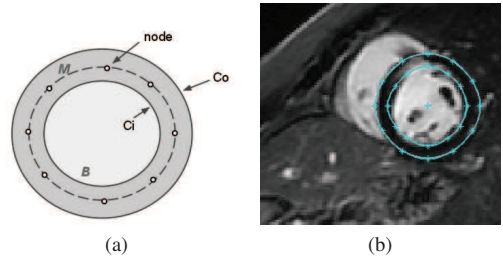


Fig. 1: (a) Template geometry (b) Initial position, radius and width of the template

The segmentation method proposed uses a 2D geometrical template, which is deformed using the minimization of a set of parameters.

### A. Template description and initialization

The template is initially a circular ring with an imaginary centerline ($\mathbf{C}$) and a variable width ($w$), which provides a good approximation of the LV myocardial shape. The parameterization of the template is carried out interpolating splines and using uniformly distributed control points, along the circumference of the template. This compact representation provides a smooth description of the endocardium ($\mathbf{C_i}$) and the epicardium ($\mathbf{C_o}$). Moreover, it defines the myocardium ($M$) and the blood pool ($B$) regions (see Fig. 1a).

The dark and circular appearance of the myocardium makes it detectable using the convolution of the image with a kernel modeling a dark ring. The convolution is computed using various radius and widths and the best response provides us the center, radius and width of the deformable initial template (see Fig. 1b).

### B. Template deformation

The template is deformed inspired in the features used by clinicians to visually identify the myocardial borders. The deformation process can be formulated as follows [7]:

$$min\{F(\mathbf{p},\mathbf{I})\} = min\{F_s(\mathbf{C},\mathbf{w})+F_c(\mathbf{C_i},\mathbf{C_o},\mathbf{I})+F_r(\mathcal{M},\mathcal{B},\mathbf{I})\},$$

where $\mathbf{p}$ is the set of points minimizing the sum of three parameters (referring different features). The mathematical description of each parameter is:

$$F_s(\mathbf{C},\mathbf{w}) = \lambda_0 \int_0^1 |k(s) - \bar{k}|^2 ds + \lambda_1 \int_0^1 |w(s) - \bar{w}|^2 ds,$$