

A *MINIPACS* DESIGN FOR THE VIEWING OF DIGITAL MAMMOGRAPHIES

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Abstract:

Nowadays many efforts are being focused on design of general systems to manage medical images. Conventional mammography is currently the most efficient technique to detect early breast cancer. Due to special requirements of breast radiography images, integration of digital mammography in PACS is not yet achieved. In this paper, we present a possible solution with a specific *miniPACS* design to mammography.

INTRODUCTION

PACS is currently changing the way of working in clinical environments¹. But the whole integration in hospitals of these digital technologies could be reached by using specific *miniPACS*². Owing to peculiar characteristics of mammographic images, *miniPACS* can be adequate to solve archiving, transmission, viewing and other limitations of conventional mammography in relation with detecting signs of early breast cancer (masses and microcalcifications)³. Thus, new topics like *telemammography*⁴ and CAD (*Computer-Aided Diagnosis*)^{5,6} would be easily introduced to radiologists. Nevertheless, their development is strongly related to hardware technology advances. In any case, we believe that preservation of optical image quality is the most important aspect to take into account in a mammographic *miniPACS* design in order to reach acceptance among radiologists.

MATERIALS AND METHODS

A friendly system design needs to combine computer sciences and psychology, focusing on user perception. The main point to take into account in this case would be the radiologist-computer interaction^{7,8}. So, several systems with different philosophies have been proposed to be used in clinic environments.

Seven years ago, a text mode user interface has been developed with a pull-down menu on a PC monitor and a bit-slice processor: first using a low resolution (512x512 pixels) and secondly with a high resolution (1024x1024) TV monitor to display mammographies.

A few years later, a second system over a RISC workstation with a high resolution 20" monitor for displaying a GUI (*Graphical User Interface*) and mammographies was implemented, which leads to a higher interaction between workstation and radiologists.

The current system consists of two specific black and white MegaSCAN 2Kx2.5Kx10bits monitors with DOME controllers, working over a SunSPARC20 workstation under the Solaris operating system. A friendly user interface and hierarchical mammographic database with three levels (patients, studies and views) have also been developed under OSF/Motif (figure). Several mammographic viewing tools have been implemented, such as window/level controls, zoom and roam, ROIs selection, etc. The first three functions have been implemented using the three-button mouse. So, interaction is improved, since radiologists do not need to look away from the screen to manage the above mentioned tools. Furthermore, both a local non-deforming automatic enhancement technique based on Unsharp Masking filters⁹, and a specific lossless wavelet algorithm for image compression¹⁰ have been developed.

A continuous evaluation of systems is needed in the introduction of new technologies in hospitals. Statistical and practical studies over the LLNL mammographic image database with microcalcifications from UCSF¹¹ have been done in order to test our system.



Figure: General view of the current system.

Results and discussion: evolution

In order to preserve radiography quality, high spatial and gray level resolution should be used in the digitalization process. This fact normally involves that powerful machines and special devices are required in archiving, transmission and viewing processes.

The first system had computational power, portability and image quality limitations. RISC architecture of the second system increases computational power, while the use of UNIX and OSF/Motif improves its portability. In addition, the GUI leads to a higher radiologists-computer interaction. However, image quality is not enough for radiologists, so the current system is trying to solve it, at the expense of using a high-cost specific hardware again.

Archiving and transmission are optimized by our specific compression module. Viewing is improved by the specific mammographic tools and the use of high resolution monitors. At the moment, all the utilities are only possible if developing specific designs (*miniPACS*) with a intuitive GUI.

Nevertheless, one critical issue in transmission mammographic images continues to be communication protocols among different devices in hospitals. Nowadays, the DICOM (*Digital Imaging and Communication in Medicine*, or ACR/NEMA 3.0)¹² standard for medical images is under development. But DICOM is not yet standardized for mammographic viewing, due to its special image high quality requirements.

To summarize, philosophies and tendencies in system designs are changing across time. On the one hand, portability is desirable, which frequently implies the use of general hardware systems. On the other hand, image quality is necessary, but this aim is only reachable at the expense of high hardware cost or general hardware technology advances. Its future installation in hospital will need more screens and speed to display mammographies in diagnosis.

CONCLUSION

Our experience has shown that *MiniPACS* could be an approximation to introduce new advances in clinical environments. Radiologists should be enticed to use these kinds of systems. However, mammographic image quality needs to be improved by technology in order to achieve acceptance among radiologists.

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