



Murdoch
UNIVERSITY

MURDOCH RESEARCH REPOSITORY

<http://dx.doi.org/10.1109/IEMBS.1999.804186>

Chandrasekhar, R. and Attikiouzel, Y. (1999) A graphical interface for viewing mammograms interactively. In: Proceedings of the First Joint Engineering in Medicine and Biology BMES/EMBS Conference. 21st Annual Conference and the 1999 Annual Fall Meeting of the Biomedical Engineering Society, 13 - 16 October, Atlanta, GA, USA, pp. 1033.

<http://researchrepository.murdoch.edu.au/19766/>

Copyright © 1999 IEEE

Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the IEEE.

A graphical interface for viewing mammograms interactively

Ramachandran Chandrasekhar and Yianni Attikiouzel
Centre for Intelligent Information Processing Systems
Department of Electrical and Electronic Engineering
The University of Western Australia, Nedlands, WA 6907, Australia
e-mail: chandra@ee.uwa.edu.au and yianni@ee.uwa.edu.au

Abstract

This paper presents the design principles for a graphical user interface for viewing mammograms interactively, in the context of self-paced, computer-aided instruction. Patient data, whole image and full resolution views, feature highlighting, image processing and radiology and pathology reports, are all integrated into a self-contained package with intuitively understood graphical icons to permit rapid learning and comfortable use. The image database is searchable by patient, view, date, similarity of lesion appearance, and pathology so that different slices of the same data may be reviewed to consolidate knowledge and test understanding. *Keywords:* graphical user interface, design, mammogram, image processing, self-paced computer-aided instruction

1 Introduction

Video terminals are considered unsuitable at present for reading and reporting on mammograms, but they may be used beneficially to display mammograms for self-paced, computer-aided instruction. The principles for the design of such a terminal are outlined briefly here, although space constraints prevent graphical presentation of results.

2 Design principles

In our implementation, mammograms were digitized at x and y resolutions of $64 \mu\text{m}$ per pixel with a bit depth of eight. The graphical user interface was designed to be flexible, extensible and modular. The main elements are:

- a patient database that may be indexed and selected by patient, mammogram date, view, visual feature and pathology;
- a main viewing frame with windows to display the full image at reduced resolution and an adjacent, mouse-tracked window that displays a square region-of-interest at full-resolution;

- a set of feature buttons that highlight, by means of colour-coded squares and circles, features such as asymmetry, architectural distortion, masses, microcalcifications, enlarged ducts, neodensities on sequential images, and film defects;
- magnification by a factor of five of any selected region of the full-resolution image, allowing differentiation, for example, between microcalcifications and film defects;
- icon-activated display manipulation such as contrast enhancement, histogram equalization and image inversion (image appears as a positive);
- click-and-drag measurement capabilities on the full-resolution image that allow sub-millimetric measurements to be made easily and accurately;
- pop-up radiological and pathological reports associated with each image pair.

3 Implementation and future enhancements

The interactive graphical user interface was implemented in ISO C on a Unix system running X-windows using the *xview* library. The availability of several newer, easily customizable, platform-independent graphical user interface toolkits means that the above system, when re-implemented with these libraries, will be portable. The addition of paired-image viewing and augmented image processing will further improve the system.

4 Conclusions

We have presented the design principles for a user-friendly, flexible, modular, extensible graphical interface for viewing mammograms interactively and indicated its future growth path.