A graphical interface for viewing mammograms interactively

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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 $\mu$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 $x$view 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.