eDiaMoND: an Overview

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(and many others....)

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Breast cancer: some statistics

- In the European Union, breast cancer represents 19% of cancer deaths
- Breast cancer is diagnosed in a total of 348,000 cases every year in the USA and EU, and kills almost 115,000 women annually
- It is estimated that approximately one in eight women will develop breast cancer during the course of their lives; it is also estimated that one in 28 women will die of the disease

The rationale for screening

- The earlier a tumour is detected the better the prognosis
- A tumour that is detected when its size is just 0.5cm has a favourable prognosis in about 99% of cases
- Few women can detect a tumour by breast self-examination when it is smaller than 1cm, by which time (on average) the tumour will have been in the breast for up to 6-8 years
- The 5 year survival rate for localised breast cancer is 97%; this drops to 77% if the cancer has spread by the time of diagnosis
- This is the clear rationale for screening, which is currently (in the UK) based entirely on X-ray mammography
The benefits of mass screening

- The World Health Organisation’s International Agency for Research on Cancer (IARC) has recently concluded that mass screening via mammography reduces mortality
- The working group discovered a 35% reduction in mortality from breast cancer among women in the 50-69 age group who were screened, when compared to those who were not
- This figure equates to one life being saved for every 500 women screened

Motivation

A large database with fast access would provide an invaluable resource to the breast imaging community by:

- aiding in the breast screening process,
- improving the quality of training, and
- providing a huge resource for epidemiological studies

eDiaMoND: objectives

- The development of the Grid computing infrastructure to support federated databases of images (and related metadata and patient information) within a secure environment
- The design and construction of a Grid-connected workstation and database of standardised images
- The development, testing and validation of the system on a collection of applications

Participants

- University of Oxford (e-Science Centre, Computing Laboratory, Department of Engineering Science)
- Edinburgh University
- University College, London
- King’s College, London
- IBM
- Mirada Solutions
- Scottish Breast Screening Programme
- Churchill and John Radcliffe Hospitals, Oxford
- St George’s Hospital, London
- Guy’s Hospitals, London
A functional description

• The core eDiaMoND system consists of middleware and a virtualised medical image store to support the eDiaMoND Data Grid concept.

• The virtualised medical image store comprises physical databases, with each being owned by a Breast Care Unit (BCU) participating in the eDiaMoND Grid.

• The assumption is that each of these BCUs will own and manage the hardware and software needed for its own data.

• The eDiaMoND Grid is formed by participating BCUs coming together as a virtual organisation, and uniting their individual databases as a single logical resource.

Key functionality

• Image acquisition
• Report capture
• Queries
• Image retrieval
• Image processing

(Some of the) technical issues

• Size of images
• Access control
Size of images

- A mammogram is 30-40MB of data when scanned at 50-micron resolution
- The best image resolution for digital breast screening has not been determined
- Doubling or halving the scanning resolution multiplies or divides the data that eDiaMoND will need to store by a factor of 4
- Changing the image resolution would have a clear impact on the data storage requirements
- It would also impact on performance

Access control

- It cannot be predicted a priori what access control policies the NHS, hospital trusts, hospitals, departments, etc. may wish to impose on the eDiaMoND data that they are responsible for
- In terms of requirements, those associated with access control can be stated quite simply: the model must be flexible and fine-grained
- There a number of interesting questions to be addressed with regards to the implementation (and subsequent impact on performance) of such a model

Deployment

- Each clinical site has a workstation and a staging server
- The staging server holds the database of mammograms that are local to the particular site; it also acts the gateway to the eDiaMoND Grid
- All non-image data in the eDiaMoND Grid is replicated
- A particular workstation may conduct a search of the entire database using a service provided by its locally attached staging server: locally held images are immediately available; remotely held images can be read across the network—subject to any performance penalties imposed by available bandwidth—or may be pre-fetched (‘staged’) to the staging server overnight for examination the following day

Prototype development

- Phase 0 deliverable: internal to the eDiaMoND development team, which allows for the integration and unit test of key system components on a single machine
- Phase 1 deliverable: implements a Grid that allows the eDiaMoND clinical team to amass data and test the system
- Phase 2 deliverable: the prototype
Future directions

- The eDiaMoND project will build a prototype infrastructure to support digital breast imaging in the UK—by considering user requirements, both for screening and for research, we aim to develop a generic, scalable and flexible Grid infrastructure.

- Our aim, once we have proof-of-concept in this initial phase, is to continue towards a production system to support the UK Breast Screening Programme and the work of the breast cancer research community in the UK seen as a blueprint for similar breast screening systems in other countries, and for other imaging modalities.

Summary

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