Clinical Information Retrieval to Support Teaching and Research in Radiology

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supporting medical teaching & research

- major achievement
  - information dissemination
  - towards advanced information management
- current challenge
  - bridge healthcare enterprise with academic and research environment
    - i.e. integrate clinical data with teaching and research software tools

the case of Radiology

DICOM

DICOM server

intranet or internet

web browser

DICOM

research & education

requirements

- flexibility
  - change and adapt easily, and expand to cover emerging needs
- easiness to implement
  - does NOT require expensive infrastructure & long development times
- security
  - data anonymization & integrity
- adherence to open standards
  - accommodate synergy with disparate systems & the open standards academic and research infrastructure

our approach

DICOM

teaching & research

end-user applications

added-value web services

web services acting as wrappers

conventional clinical information systems
**web service paradigm**

- middleware technology for program-to-program interactions
- URI-addressable software with certain functionality
- can act as wrappers for legacy applications

**Service Oriented Architecture**

**web service paradigm**

- enable disparate systems to work together
- based on open internet standards
- broad industry support

**complex DICOM search**

- end-user application
- DICOM web service
- DOM database
- XML/SOAP
- DICOM sources

**DIM web service**

- DICOM services (SOPs)
- query
- retrieve
- store
- login
- web service methods

**performance issues**

- test scenario A
  - 26% increase in overall time
  - 4% of overall time for conversion

- mean of 1200 C-MOVE operations
  - conventional: T1 = 625±41 ms
  - DIM solution: T1 = 625±42 ms

- test scenario B
  - 55% decrease in overall time

- complex association negotiation in DICOM is limited within the same computer
**DQM web service**

- complex query
- retrieve DICOM tag info
- populate & query
- attribute database

**database model**

- DicomObject
  - PK: DicomObjectID
  - DicomObjectFileName
  - SeriesUID
  - DicomAttribute
    - PK: DicomAttributeID
    - FK: DicomObjectID
    - Tag
    - TagDescription
    - TagValue
    - DataType
    - ItemID
    - SequenceID
  - Sequence
    - PK: SequenceID
    - FK1: DicomObjectID
  - Item
    - PK: ItemID
    - FK1: SequenceID

**implementation issues**

- technologies
  - C# (MS .Net Framework 1.1)
  - DicomObjects 4.1 (Medical Connections)
- system requirements
  - MS Internet Information Server >5.x
  - MS .Net Framework 1.1
  - MS SQL Server 2000 Desktop Engine (MSDE)
- security
  - SSL, user authentication, role-based data anonymization

http://iris.med.duth.gr/

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DIM testing set-up

DICOM server - eFilm workstation v1.5.3 on Intel Pentium 4 processor at 2.8 GHz, 1GB RAM (unit C1)

DICOM aware application
DIM web service
DIM web service aware application

on Intel Pentium 4 processor at 2.8 GHz, and 512 MB RAM (units C2-C4)

testing data - DICOM C-MOVE operation performed for 1200 different DICOM objects in a hospital 100 MB/s LAN

DIM testing set-up ⇒ scenario A

T1=625±41 ms  
T2=626±42 ms  
T3=27±11 ms  
T4=134±66 ms

DIM solution:  
26% increase in time
4% for data conversion

DIM testing set-up ⇒ scenario B

T1=625±41 ms  (in A: 625±41)  
T2=121±21 ms  (in A: 626±42)  
T3=28±12 ms  (in A: 27±11)  
T4=132±65 ms  (in A: 134±66)

DIM solution:
55% decrease in time

DICOM search engine

dynamic user interface

- XML based description of interface elements
  - add/change interface elements
  - support multilinguality
  - facilitate personalization

- values for drop-down and checkbox lists automatically updated according to database

further work

- towards a cluster of web services
  - 1st tier: facades for legacy systems
  - 2nd tier: added value services: data mining & knowledge extraction

- special purpose end-user applications for
  - medical teaching file authoring
  - advanced data processing