



*Tele-imaging in MEDicine*

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Edition: 5

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## 1 TIME Image Retrieval

In the second newsletter (June 2005), we proposed to work on a prototype tele-imaging and retrieval system. In this newsletter, we report on progress achieved using a Content-Based Image Retrieval (CBIR) system which we hope to tailor to the requirements of the TIME project.

The GNU Image Finding Tool (GIFT) is an open-source initiative for Content Based Image Retrieval (CBIR) developed mostly at the University of Geneva. It is based on the Query-by-Example (QBE) paradigm whereby images from a collection that most closely resemble a query image are retrieved from the server. The reasons for choosing it to implement an image database for the Tele-Imaging in Medicine (TIME) project are that

- it has a simple, user friendly interface to interact,
- the source code is accessible and hence extensible,
- there is an active community of researchers engaged in state-of-the-art CBIR research using it,
- the tool is well covered by many research publications,
- the GIFT online community is an excellent place for support and sharing of ideas,
- the University Hospitals of Geneva have used it for medical image (in particular lung image) retrieval in the so-called medGIFT project,
- the client and server communication is based on

Extensible Markup Language (XML) making the client implementation programming-language independent.

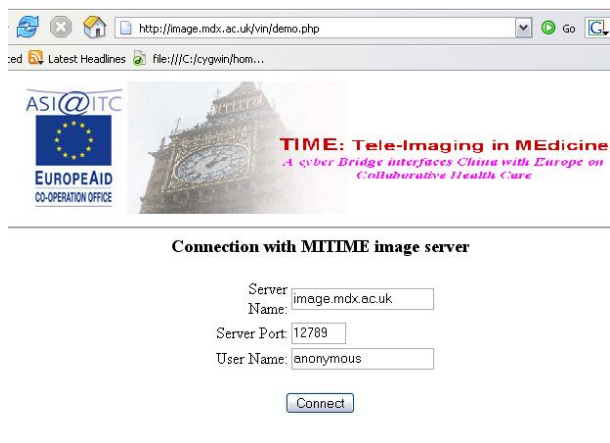
## 2 Client-server interaction

The GIFT software is installed on the server side only. The indexing and feature extraction tools are used to process a collection of images present on the server. Features are extracted for this collection of images and thumbnail pictures are generated for the user client interface. The GIFT server can subsequently be started on the server machine with a configuration file showing where to find the images, thumbnail images, and feature files.

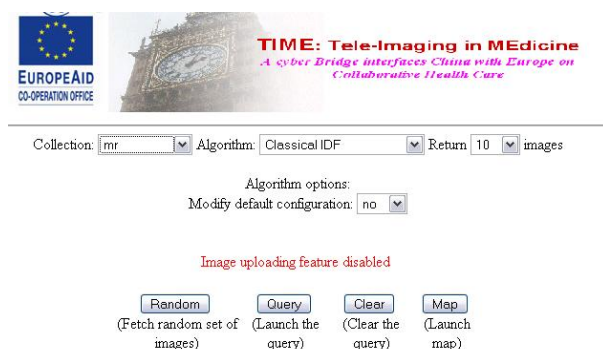
The client-server communication is achieved using the XML-based Multimedia Retrieval Markup Language (MRML). All client-server communication, including queries from the client or results returned by the server, use message passing. As a result, the client can be implemented in any programming language. The current TIME client is implemented using PHP to generate dynamic web pages for the client web browser. We have also experimented with a client desktop application using Java.

## 3 Features of the interface

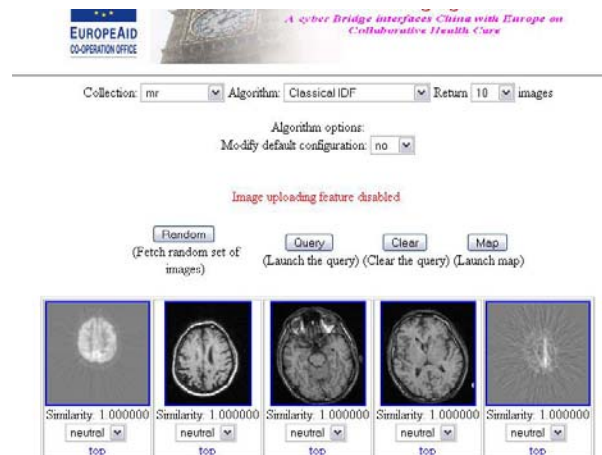
This review is based on the PHP web interface on the TIME server at <http://image.mdx.ac.uk/vin/demo.php>.



The login page allows the client to establish a connection with the server and to obtain information on the collection of images available. Once a session is started, the page displays the name(s) of the collection(s) of images available on the server together with the associated algorithms for assessing similarity.

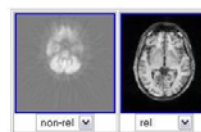


The first step involves fetching a random set of images from the chosen collection with which to query the database. The functionality to upload a user image to perform the query is currently disabled until the accompanying security issues have been addressed. As a result of pressing the 'Random' button, the web page changes to display a certain number of random thumbnail images from the selected image collection. Clicking on any image opens the full-sized image.



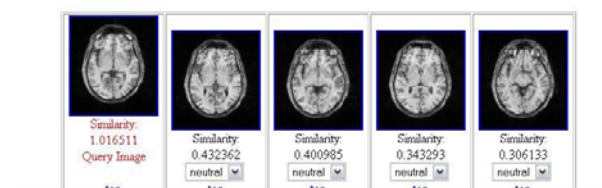
Before launching the query, the relevance feedback mechanism is used to indicate preference score. By default, all the displayed images have their relevance set to 'Neutral' but this can be changed to 'Related' or 'Non-related'. The user can indicate his preference or aversion for as many images as (s)he wants. By clicking the 'Query' button, the user causes the client to generate a message to send to the server concerning those images selected as related or not. The server returns a list of those images that most (least) resemble the image(s) used for querying. The search can be further refined by rating the images from the resulting list as 'Related' or 'Non-related'. A clean new search can be initiated by pressing the 'Clear' button.

Query:



QueryRequest:

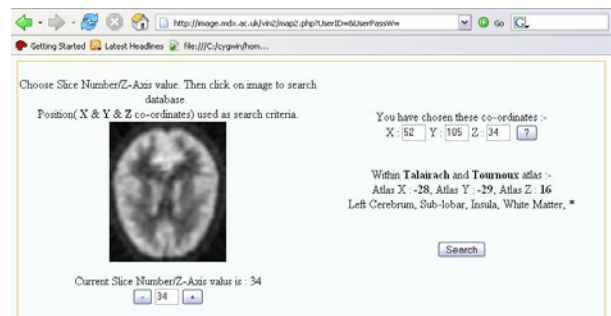
Result:



## 4 Relevance and future extensions

In its current form, the prototype image retrieval system enables the sharing of data among the project partners. We are working on two main extensions to improve the system, one of a technical nature and the other of a pedagogical nature.

The first extension will involve contribution to the online interpretation of PET images. The brain PET collection contains images of a functional nature and as such they provide little or no structural information. A digit anatomic atlas is provided by pressing the 'Map' button. This opens a new window showing slices of a standard template human brain with anatomic labels which are displayed by clicking on the relevant locations of the slice.



We will attempt to integrate these two disparate sources of information by co-registering the PET images to the template in real time thus allowing the user to interpret any PET image in its native format in the collection.

Any suggestions and recommendations are welcome and should be addressed to [x.gao@mdx.ac.uk](mailto:x.gao@mdx.ac.uk) or [n.savill@mdx.ac.uk](mailto:n.savill@mdx.ac.uk).