Grant Agreement Number: 257528

KHRESMOI

www.khresmoi.eu

Public annual report 3

Deliverable number	*D13.3.3*
Dissemination level	*Public*
Delivery date	*15 November 2012*
Status	*Final*
Author(s)	*Allan Hanbury*

Table of Contents

1 Khresmoi Annual Report

The Khresmoi project addresses the challenges of searching through large amounts of radiology data, including Magnetic Resonance (MR) and Computed Tomography (CT), in hospital archives, as well as general medical information available on the Internet. For the latter, it addresses the issues of trustworthiness and readability levels. The project consortium, consisting of 12 partners from 9 European countries, will develop a multilingual multimodal search and access system for biomedical information and documents. The system will allow text querying in several languages, in combination with image queries. It will return translated document summaries linked to the original documents. Khresmoi started on the 1st of September 2010 and runs for four years.

2 Summary of Activities

In its second year, the main achievement of Khresmoi was the integration of the Khresmoi components into a scalable cloud-based architecture, creating the first Khresmoi integrated prototype. Various instantiations of this prototype allow search in web documents and the medical literature, as well as in radiology images (for both 2D and 3D images). A large number of improvements to the components making up the Khresmoi system were also developed and implemented. In parallel to this, the evaluation strategy for the third year of the project was developed, including the development of the evaluation protocols and tasks for the user-centred evaluation planned for the third year of the project. The project is now poised to begin the user-centred evaluations, and to use the results of the evaluations in guiding the improvement and further development of the Khresmoi system and its components.

3 Khresmoi Technology

The open source software that Khresmoi is built upon has undergone significant advancement through work in Khresmoi. The open source software is listed below, along with the advances achieved in Khresmoi:

- **GATE** (https://gate.ac.uk/): The General Architecture for Text Engineering (GATE) is used to annotate at word, section and document levels. Through work in Khresmoi, its capabilities for annotating medical documents have been expanded. The use of cycles of human correction to improve the automatic annotation has also been extensively tested.

- **Mimir** (https://gate.ac.uk/mimir/) uses GATE annotations to perform semantic search. The major achievement was the release of Mimir 4, including the ability to rank returned documents.

- **ezDL** (http://ezdl.de/) is a framework for interactive search applications. It has been extended with the capability to display image search results, as well as extensive tools to facilitate collaborative search, such as the ability to share documents and queries between users.

- **ParaDISE** is a new visual search engine developed in Khresmoi as a successor to the GNU Image Finding Tool (GIFT). It is more scalable than GIFT and contains state-of-the-art image features and visual similarity calculation.

Furthermore, the **MOSES** statistical machine translation software (http://www.statmt.org/moses/) has been adapted to machine translation in the medical domain. Finally, the **OWLIM** semantic repository (http://www.ontotext.com/owlim) has received performance and functionality upgrades, and has also had its medical knowledge base expanded through the addition of new medical vocabularies and new links between the medical vocabularies.

4   End User Requirements

Three surveys to elicit end user requirements of the Khresmoi target user groups have been carried out. The surveys for medical practitioners and the general public were done using online questionnaires. The survey for radiologists was conducted on a smaller scale, but included initial experiments in which eye tracking was used to identity the parts of an image that the radiologist concentrated on. Furthermore, analysis of search logs from the Health on the Net search engine and the Goldminer search engines allowed the types of queries used by the target user groups to be determined.

The results of these surveys were used to specify the features that are to be included in the Khresmoi prototypes. An unexpected result of the surveys was the wish by medical professionals to be able to perform collaborative search, through rating search results and sharing the search results. This led to a stronger concentration on collaborative search in Khresmoi.

5   Khresmoi Prototypes

Two integrated prototypes combining Khresmoi components have been created. These provide search of both text and image information. The following image shows the comprehensive search interface to the Khresmoi search system:
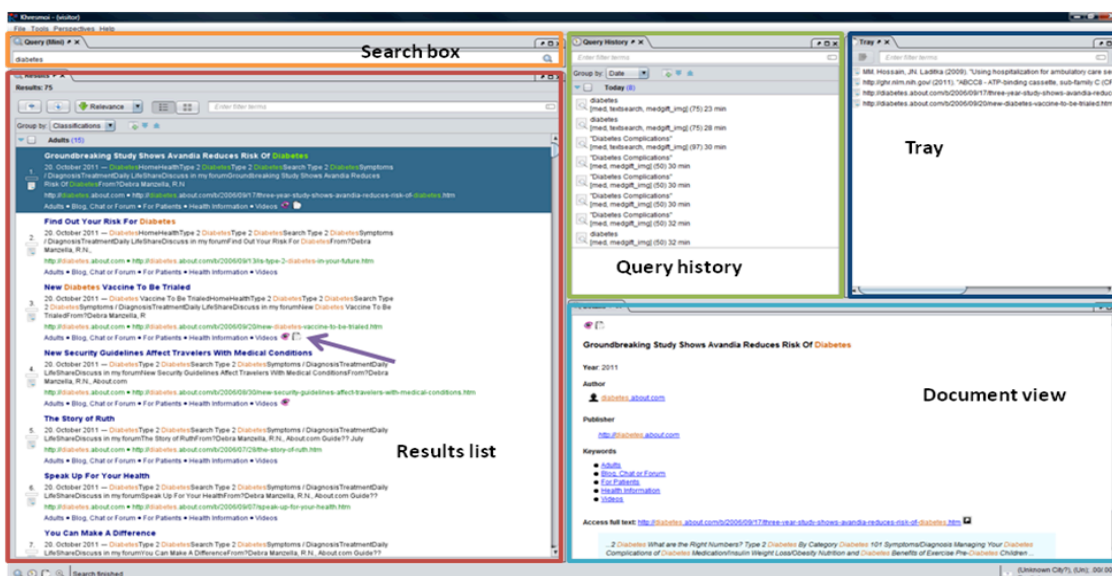
This interface has the following features:

- **Search box:** The simple search box is shown. Advanced search is also available.

- **Result list:** A summary of each document is given. Controls at the top allow the results to be reordered or grouped by various criteria and filtered by terms. The icons indicated by the arrow show when a document has been viewed (eye icon) and moved to the tray (clipboard icon).

- **Tray:** Documents can be dropped here to be stored for future use. Logged in users have access to personal libraries, allowing more flexibility in organisation, including the capability to add tags to results and share results with other users.

- **Query history:** Lists details on all queries entered (including date and time) and allows queries to be repeated.

- **Document view:** All data available on the document selected in the results list are shown, including a link to the full document.

The 3D image retrieval prototype is shown in the following image:
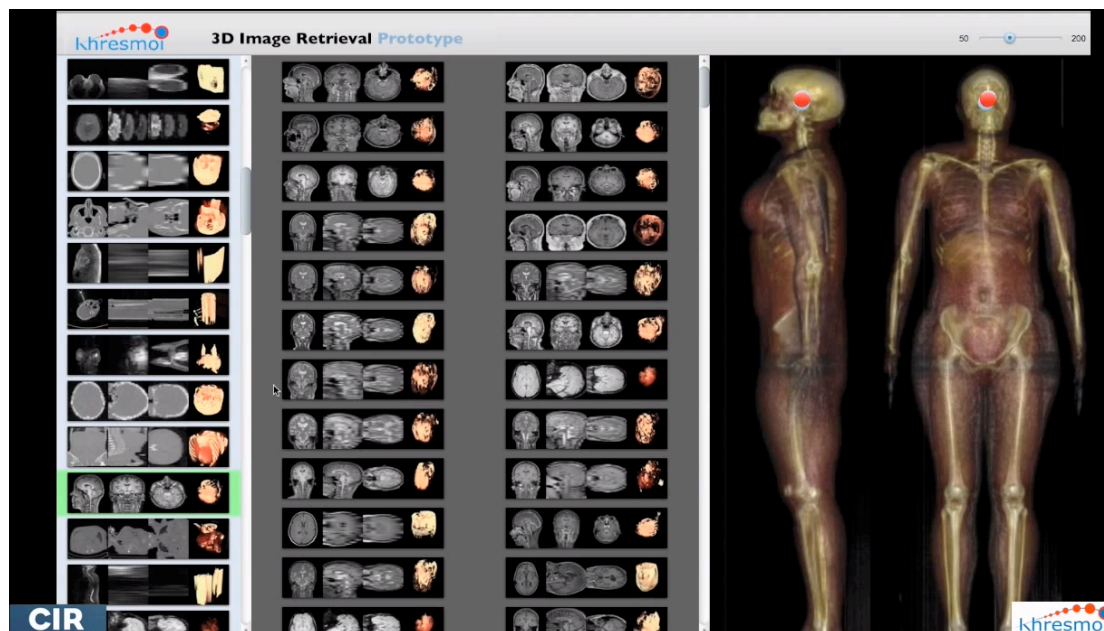
Various query volumes (3D images) are shown in the left pane of the interface. No information on the anatomical structures or the position in the body is known for these volumes. Clicking on a query volume shows the most similar volumes from the database in the middle pane. The right pane shows a position estimate in the human body suggested by the system for the query volume.

6 Evaluation Strategy

It is important to know how well the technology developed in Khresmoi is functioning. For this reason, an evaluation strategy has been developed in Khresmoi. Each of the components of Khresmoi has already undergone individual evaluation and the results have been published. The next step is to perform global evaluations, which will take two forms:

- The **global empirical evaluation** will measure how the components work together in the Khresmoi system. For the pipeline of components used in performing a query, the effect of the

output of a component on the performance of the subsequent component in the pipeline will be examined.

- The **user-centred evaluation** will get end users from all three Khresmoi target user groups to perform tasks on the Khresmoi prototype. The effectiveness with which these tasks can be solved will be measured, and user feedback on the system will be gathered. The tasks that users will be asked to perform are based on the end user surveys and search log analyses.

7 User Involvement, Promotion and Awareness

In the second year of the project, the following main events took place:

1. **Events at the Medical Informatics Europe (MIE) 2012 Conference:** Khresmoi had a booth, presented at the Village of the Future, and had a tutorial, two oral presentations and a poster presentation.

2. Khresmoi results were presented at a booth at the **IMAGINE exhibit of the European Congress on Radiology (ECR)**, the largest radiology congress in Europe that gathered over 20,000 participants from 102 countries, from March 1st to March 3rd 2012.

3. Khresmoi partners were the main organisers of the **Summer School on Image Processing (SSIP)** from July 4th to July 13th in Vienna, Austria. The theme of the summer school was "Medical Image Analysis." Lectures focused on this topic, and medical image analysis problems, on provided medical image data, were set as practical work for the students.

Khresmoi has signed Memoranda of Understanding with four EU projects: PROMISE on the evaluation of search, CHORUS+ on multimodal search, LOD2 on Linked Open Data and MetaNet on multilingual technologies.

8 Future Work

The next major step in the Khresmoi project is conducting user-centred evaluations of the Khresmoi prototype. Evaluations will be conducted with end users from the patient and medical practitioner communities, as well as with a group of radiologists. In addition, a global empirical evaluation of the prototype will take place, evaluating how the various components of the system affect each other. The results of these evaluations will guide the improvement and further development of the Khresmoi system and its components.

A number of high impact dissemination activities are planned for year 3, aimed at the business and medical communities, including:

- Booth shared with other EU projects at the CeBIT 2013 in Hannover, Germany in March 2013

- Booth at the European Conference on Radiology (ECR) in Vienna in March 2013

9 Further Information

Third Khresmoi Newsletter: http://www.khresmoi.eu/assets/Newsletter/newsletter3-khresmoi.pdf

Fourth Khresmoi Newsletter: http://www.khresmoi.eu/assets/Newsletter/newsletter4-khresmoi.pdf

Anatomy Search Prototype video: http://www.khresmoi.eu/news/anatomy-search-prototype-video/