The University of Aveiro, Portugal   **Technical University of Denmark**   **Technical University of Łódź, Poland**

„3D Medical Image Analysis With Automated Reporting Engine and Ontology-Based Search"

Author: **BARTŁOMIEJ WILKOWSKI** – (**bw@imm.dtu.dk**)

Coordinators: **Óscar Pereira (omp@ua.pt), Paulo Dias (paulo.dias@det.ua.pt)**

DETI - **Departamento de Electrónica, Telecomunicações e Informática**

PROJECT OBJECTIVES:

The main objective of the presented project was to create a software for radiologist and doctor assistance. It had to integrate two aspects of image-based medicine: visualization of the radiological images necessary for its proper analysis and simultaneous pathology reporting. The generated reports had to have a structure, which can be easily processed by computer. On this basis, an intelligent search engine for medical reports was to be created.

WORK DESCRIPTION:

The whole functionality of the presented software is enclosed in the software package called **MIAWARE** (Medical Image Analysis With Automated Reporting Engine) – www.miaware.org.

The processing of stack images taken from the computer-axial tomography (CAT) scan is performed with usage of ImageJ Java-based software and Visual Toolkit (VTK). The diagram on the right presents the necessary steps which are carried out in MIAWARE in order to create a three-dimensional model easy to manipulate and to generate 2D slices obtained after cutting of the model using the widgets (cutting planes).
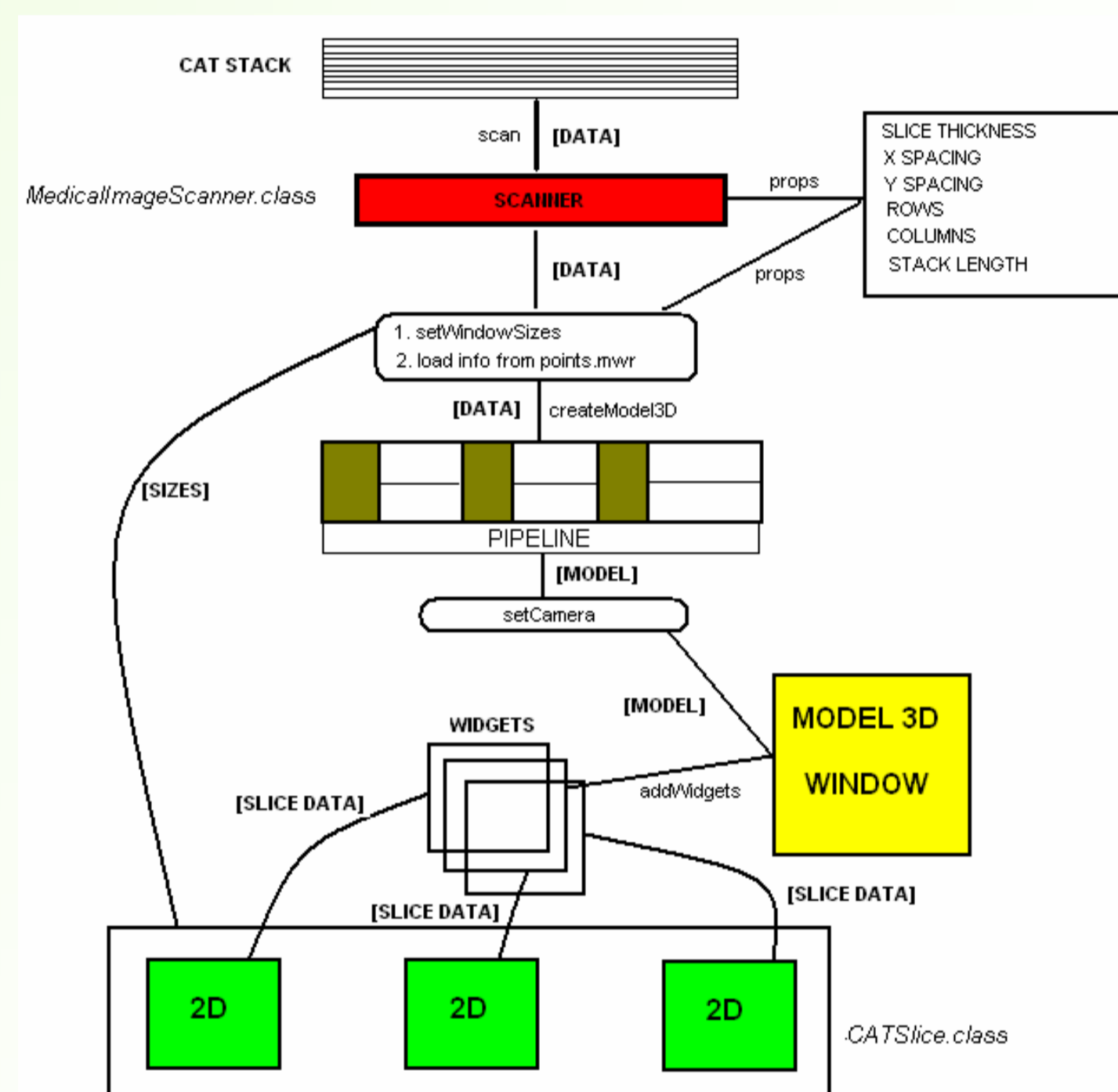
MIAWARE's report generation engine requires from the user (radiologist) a detailed specification of the pathologic changes found in patient's body and their locations. Unlike to the present habits, the radiologist cannot describe those findings with his own words, but can use only the specific medical vocabulary provided by the application. Consequently, MIAWARE software is able to create normalized medical reports (in RDF and TXT formats) according to information about pathologies introduced earlier by the radiologist.
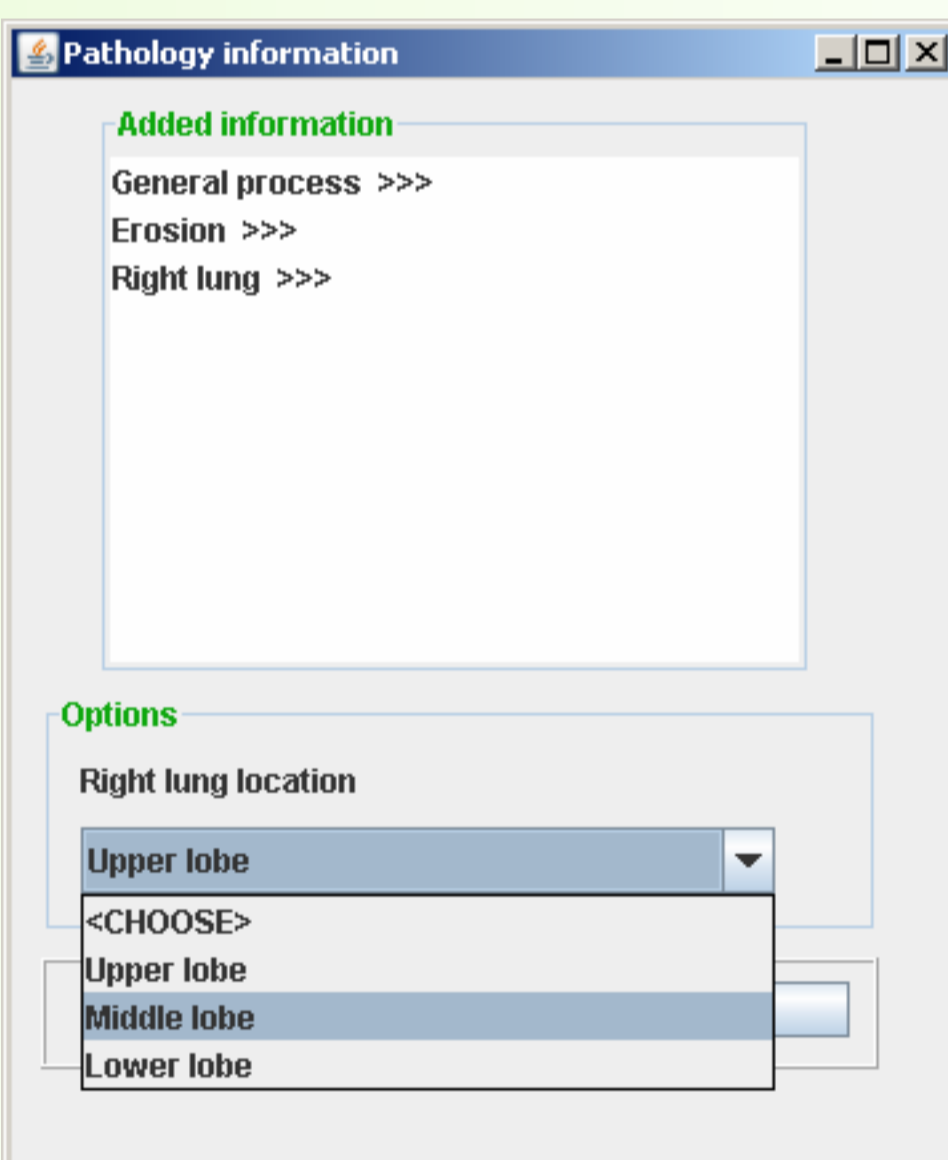
The last objective was to create a special search engine, which will be able to find, in previously created medical reports (in RDF format), any specified pathology in a certain lungs location. It is done not in a lexical way (as the ordinary search engines work), but in a logical way.

In order to achieve a deductive (logical) search, a lungs ontology was developed. In an ontology, the real-world concepts and relationships between them can be defined in a computer-readable format. Such a knowledge is then used by MIAWARE search engine in order to deduce all subparts of the given, as a search criteria, lung's part.

FINAL RESULTS:
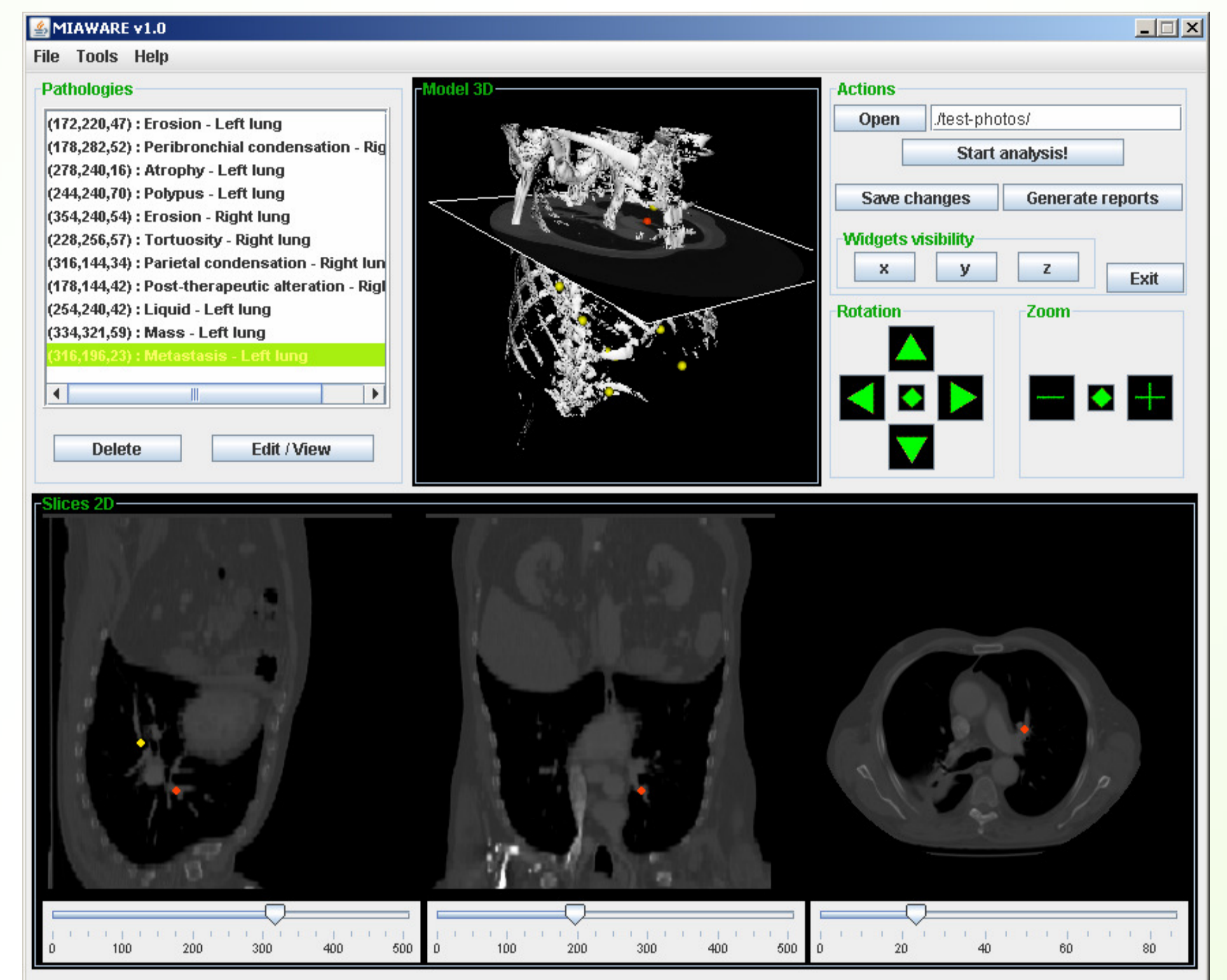
A visible result of the described work is the graphical user interface of the MIAWARE software (visible above). Radiologist is able to observe a 3D model created from the CAT scan images and to cut it using three widgets in order to see the respective model's cross-section. During such an analysis, all the encountered pathologies can be marked (green and red points) and automatically, the pathology's characteristics are to be reported using MIAWARE's reporting engine. After the entire image analysis a normalized RDF and TXT reports are generated.
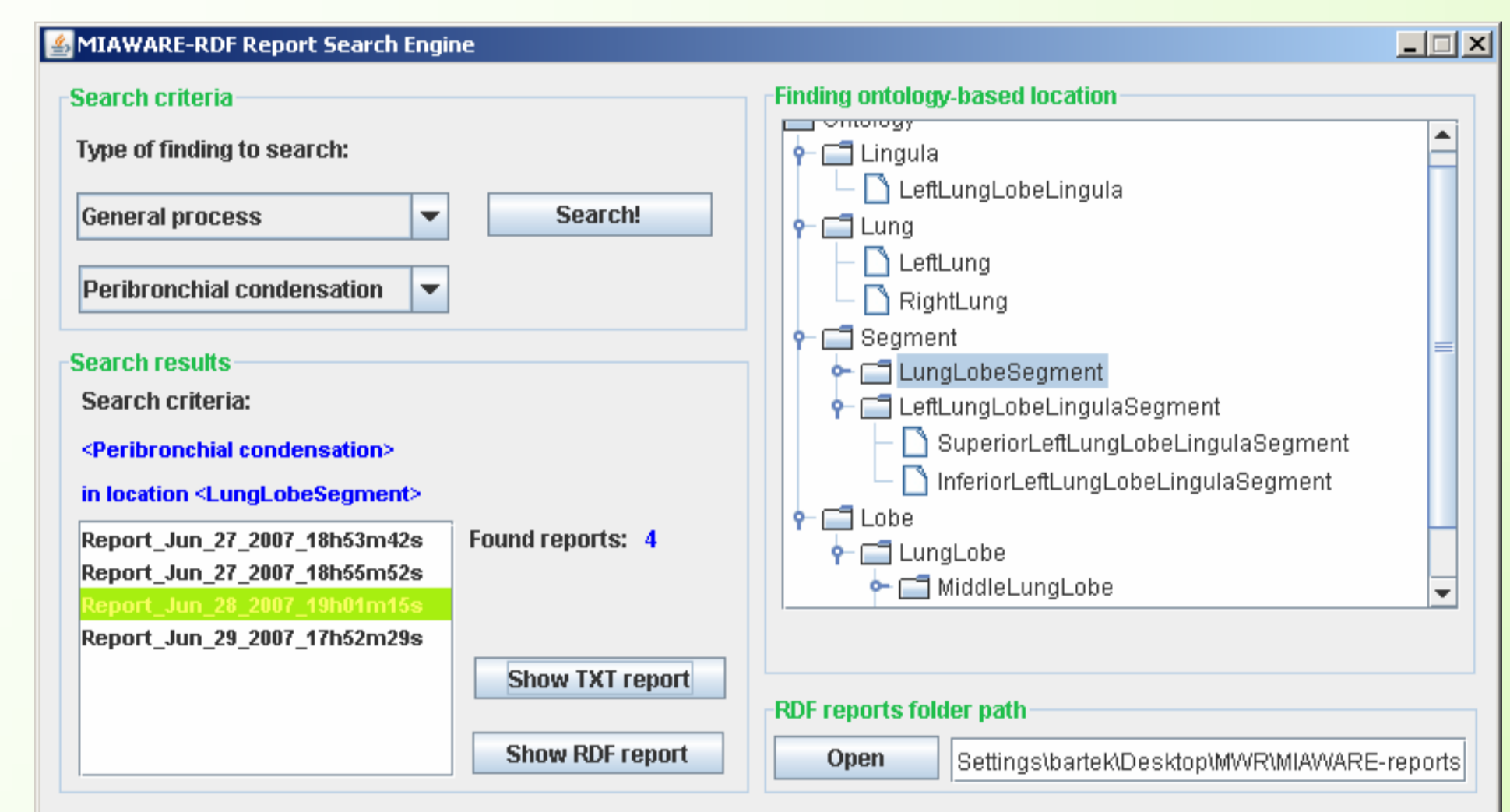
Finally, the ontology-based search engine was created (figure above). The user can choose a pathology to be searched and its location in the lungs. Afterwards, a previously specified set of RDF reports is verified according to the given criteria. Thanks to that, doctor can consult the database of old medical reports in order to find similar patient's cases. This can speed-up a diagnosis process and improve disease recognition.

The filtered reports (in both, RDF and TXT file format) can be viewed and investigated by the doctor using MIAWARE software.
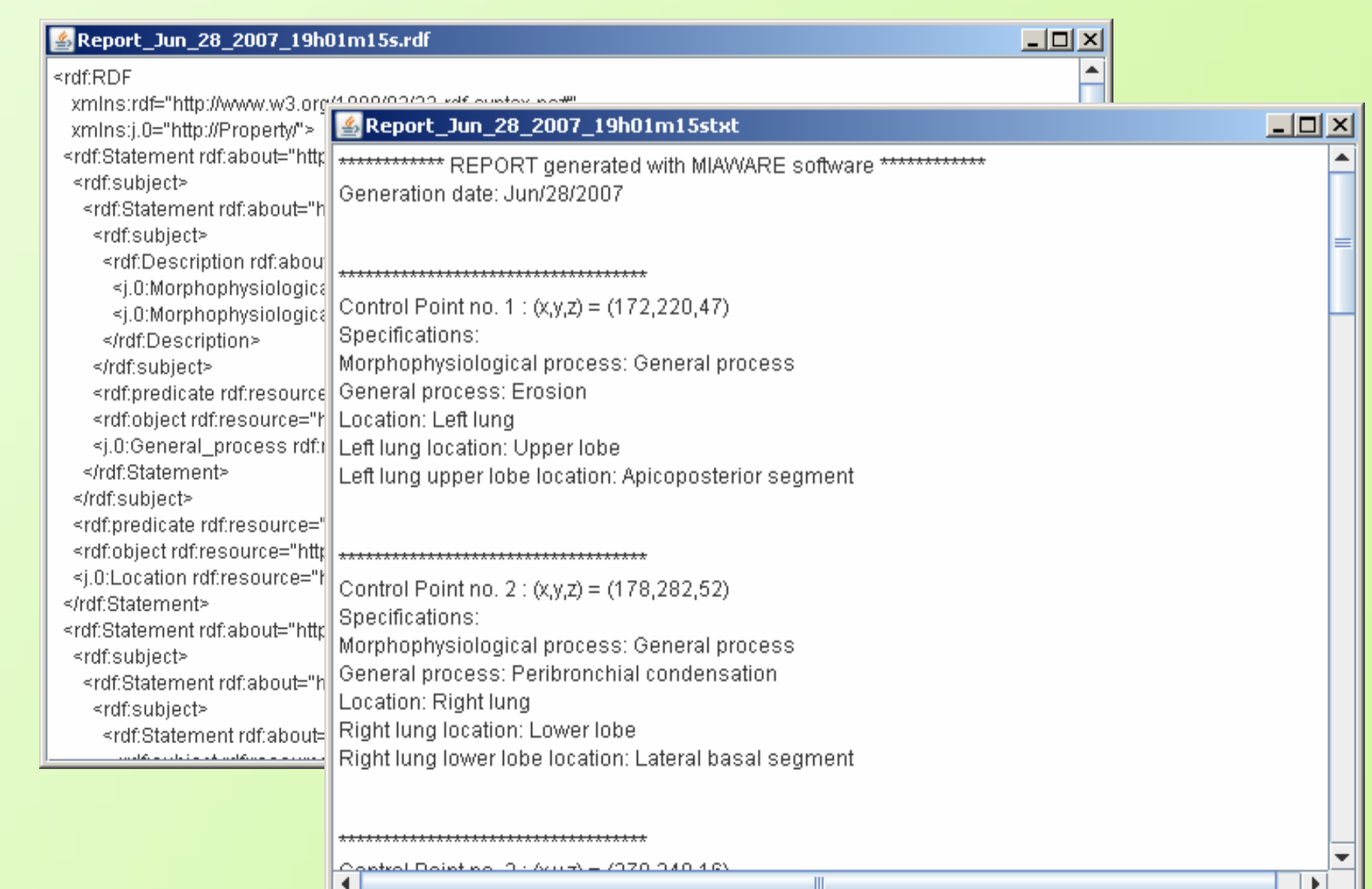
CONCLUSIONS:

MIAWARE software contributes directly to the image-based medicine. Its major advantage is a fact that radiological images visualization and analysis are integrated together with the automated reporting scheme and state-of-the-art search engine in the single application. Consequently, it should improve and speed-up the radiologist's and doctor's work.