Interactive Paper for Radiology Findings

Daniel Sonntag, Markus Weber and Marcus Liwicki

German Research Center for Artificial Intelligence, Saarbrücken and Kaiserslautern, Germany

sonntag@dfki.de, markus.weber@dfki.de, marcus.liwicki@dfki.de

Introduction

We present a pen-based interface for clinical radiologists.

It is of utmost importance in future radiology practices that the radiology reports be uniform, comprehensive, and easily managed. This means that reports must be "readable" to humans and machines alike.

We allow the radiologist to write structured reports with a special pen on normal paper.

A handwriting recognition and interpretation software takes care of the interpretation of the written report which is transferred into an **ontological representation**.

The resulting report is then stored in a semantic backend system for further use. We will focus on the pen-based interface and new interaction possibilities with gestures in this scenario.

Our Approach

We present a new interaction method that shows how a radiologist can use our special paper writing system to

(1) **provide the images and image region annotations;**

(2) **provide free text entries; and**
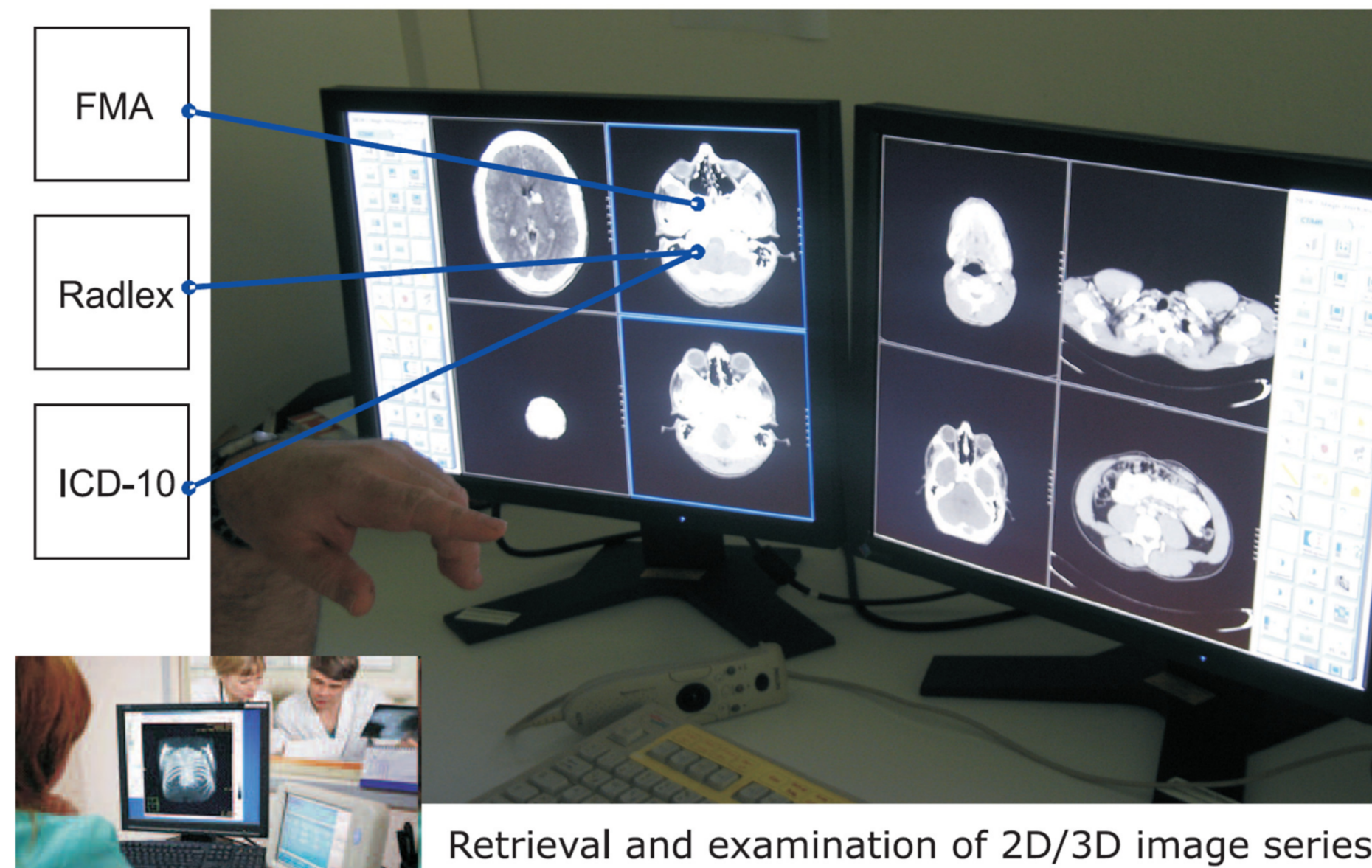
(3) **select / correct annotations.**

Thereby, he uses a pen-based interface and a new writing modality which is called **interactive paper**.

A special feature is the possibility to mark regions (circles, checkmarks, or arrows) of interest on the images and refer to them in the handwriting annotations. Technically, we rely on several software components:

- Anoto's Digital Pen and Paper technology (www.anoto.com);

- iGesture's framework to recognise pen-based gestures and to translate them into the corresponding digital form;

- Vision Objects MyScript Builder to recognise text;

- Microsoft's handwriting recognition engine; and

- DFKI's medical ontologies, digital paper printers, and IUI frameworks.

Distributed Interpretation and Interaction Architecture

Annotations

FMA

Radlex

ICD-10

Retrieval and examination of 2D/3D image series

Bluetooth

Battery

Pressure Sensor

Memory

Processor

Ink

Camera

Erlangen Hospital, Department of Radiology

Patient: M. Müller   Image: DCIM1489   Referring physician ID: **9938**
ID: **36716263861**   Series: S-3454-13-08-10   Date of Issue: 23.10.2010

Findings

FMA	Radlex	ICD-10

Fatty liver: [Yes/No].
Iron deposition: [none/diffuse/patchy]
Gall bladder is [normal/abnormal] and there is intrahepatic or extrahepatic biliary ductal dilatation [Yes/No].
Rim enhancement [Yes/No]
Other cysts / cystic masses: [Yes/No]
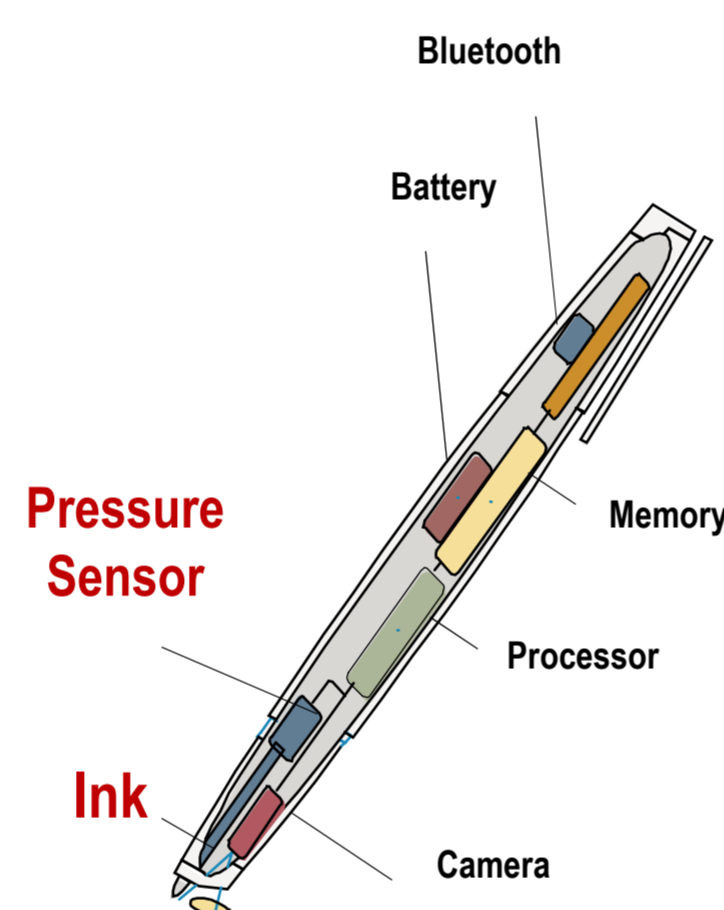
Gestures:

Structured Reporting and User Interactivity

A structured report is a report generation technique that permits the use of pre-determined data elements or formats for semantic-based indexing of report elements. The Radiological Society of North America (RSNA) provides textual templates for us.

Physical Paper   Digital Paper

For annotations, we reuse existing reference ontologies and terminologies. For anatomical annotations, we use the Foundational Model of Anatomy (FMA) ontology. To express features of the visual manifestation of a particular anatomical entity or disease of the current image, we use fragments of **RadLex**. Diseases are also formalised using the International Classification of Diseases (ICD-10).

After controlling the results on screen, the RDF repository is updated again. This improves the quality and consistency of reports. Radiologists are also not forced to dictate in the order information appears on the report. **Most importantly, complete reports are available in seconds**; the demo shows that the time required to release a report is 80 seconds (avg.) instead of several hours.