RIS-driven mining and visualisation of second-opinion candidates for telemetric-driven diagnostics

Thorsten Schaaf[a], Anja Oldenburg[b], Hans Tepe[b], Rafael Poschmann[b], Joachim Hohmann[c], Karl-Jürgen Wolf[b], Thomas Tolxdorff[a]

[a] *Institute of Medical Informatics, Charité-Universitätsmedizin Berlin, Hindenburgdamm 30, 12200 Berlin, Germany*
[b] *Clinic of Radiology, Charité-Universitätsmedizin Berlin, Hindenburgdamm 30, 12200 Berlin, Germany*
[c] *Clinic of Radiology, Universitätspital Basel, Spitalstraße 21,4031 Basel, Switzerland*

Abstract and Objective

Second-opinion in a diagnostic workflow improves quality but the lack of information who could be an expert according to a supposed finding is prejudicial to a general use. The aim is to encourage peer-to-peer second-opinion processes by context-sensitive visualization of experts with integrated links to picture- and voice-over-internet communication for ad-hoc collaboration.

Keywords:

Radiology, Diagnostics, Collaboration

Introduction and Methods

Based on the findings stored in the radiology information system (RIS), an algorithm was developed to create score values which represent the relationship between the skills of physicians and the given search criteria. The whole representation of knowledge and relationships based on the RIS domain is described by an adapted ontology. Substantial characteristic of the draft presented here is to specify the collection of the characteristics and relations in type of an ontology. We are using the standard OWL (Web Ontology Language) for the description of the ontology. The linkage between approved findings and the personal data of the creator, made available by the RIS, is - combined with a specific weighting - stored in the ontology. From this ontology, based on a user-specific metric, proposals for potential experts for a concrete diagnostic question are generated automatically.

The base method for the automatically generated proposal is defined as follows:

Given is an expert with the data-vector $\vec{e}$:

$$\vec{e} = (e_1, e_2, \ldots, e_n) \in \mathrm{IR}^n \qquad (1)$$

Every component of this vector represents one attribute of the expert.

Defined is the set E of m-available experts:

$$E := \{\vec{e}_1, \vec{e}_2, \ldots, \vec{e}_m\} \quad |E| = m \qquad (2)$$

Given is a function f which transfers the expert-vector e to a scalar s :

$$f(\vec{e}) = s, s \in \mathrm{IR} \ with\, s \in [0,1] \qquad (3)$$

The general selection criterion targets the maximization of the benchmark result:

$$\forall \vec{e}_i, \vec{e}_j \in E \ choose\ e_i : f(\vec{e}_i) \geq f(\vec{e}_j) \qquad (4)$$

The concrete selection function consists of the benchmark function b, and the weighting function w. The range of values is from 0 to 1.

$$f(\vec{e}) = \left|\vec{b}(\vec{e}) \cdot \vec{w}\right| = \tfrac{1}{n} \sum_{i=1}^{n} b_i(e_i) \cdot w_i \qquad (5)$$

$$with\ the\ precondition \sum_{i=1}^{n} w_i = 1 \qquad (6)$$

The function $\vec{b}(\vec{e})$ transfers the data vector $\vec{e}$ to an analyze vector. This vector represents a benchmark of the several components, e.g. how many days ago an expert has written a finding which is equivalent to the assumed finding. Other examples could be the regularity of the diagnostic performance of an expert or the actual work load of an expert.

Results and Conclusion

The whole user interaction is based on the displayed SVG graphic which is visualized inside the browser application window. To a given disease, a radar-like graphic is generated.

During finding processes the map of second-opinion candidates is visualized sensitive to the context of the tentative finding. Contact with the proposed expert is offered by a one-click-action. Owing to the video transmission of the medical image from the local desktop, the remote expert gives his advice while discussing with his colleague.