

An Approach to Ontology Elaboration for Gallbladder Ultrasound Images

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Abstract

The process of ontology elaboration for gallbladder ultrasound images on the base of knowledge enclosed in decision support system SonaRes is described in this article.

Keywords: ontology structure, ultrasound images, gallbladder, characteristic, knowledge.

1 Introduction

Ontology in computer science is considered as an attempt of comprehensive and detailed formalisation of a knowledge domain with the help of conceptual scheme. Unlike other methods of knowledge representation, ontology permits to provide knowledge interoperability. In the paper we describe the way of representation knowledge on gallbladder pathologies with the help of ontology. As the source, the formalized knowledge base (KB) created and being used for SonaRes – the decision support system for ultrasound diagnostics [1], was used. As the tools, editor Protégé (<http://protege.stanford.edu/>) was used.

Our primary goal is elaboration of the ontology of ultrasound images (UI) of hepatopancreatobiliary zone organs on the base of knowledge enclosed in SonaRes. Here we speak about gallbladder. Solution for the problem is based on the fact that the UI have verbal descriptions in medical terms: concepts and characteristics with relations and dependences. So, the problem of UI ontology elaboration turns to a

problem of medical descriptions of UI ontology elaboration. Formalization of characteristics and relations involved in UI description, their logic ordering is one of the major stages of ontology elaboration.

Currently the KB contains the formalized information about general and ultrasound characteristics of gallbladder and relations between them. They have provided basis for our ontology.

Let's take the description of gallbladder pathology "Flexion of gallbladder" from the point of view of ultrasound diagnostics: "The gallbladder is of abnormal shape (with flexion or there can be instable/functional flexions). The septa are absent." There is a model ultrasound image for this pathology (see Fig. 1.b). So, we have verbal description and image, and we have to construct interconnection between them. The verbal description in SonaRes has a formalized structure (see Fig. 1.a). It can be used for UI ontology elaboration.



Figure 1. Pathology "Flexion of gallbladder"

2 Ontology Structure

The ontology has 5 basic interrelated classes: *Organ*, *Pathology*, *Patient*, *Image* and *Complex_characteristics*.

- Class *Organ* is for description of organs and relates with classes *Pathology* (to reflect the link between certain description of organ and pathology) and *Patient* (to display, which patient has this pathology).
- Class *Image* is a "container" of images of patients. It is related with class *Patient* to reflect the patient to which this image belongs.
- Class *Pathology* is meant for pathologies arranged by organs/areas.
- Class *Patient* is a "container" of patients. It is related with classes *Pathology* (to reflect, what pathologies this patient has) and *Image* (to reflect, what images belong to this patient).
- Class *Complex_characteristics* is used for description of complex organ characteristics. It is related with class *Organ* (with some its subclasses, depending on the organ which is described by respective characteristic).

3 Instances

When all characteristics from knowledge tree are described, however the knowledge in the ontology is not full. It is necessary to describe gallbladder pathologies by the elaborated structure. For this, the subclasses involved in the class *Complex_characteristics* have the slot *pathology*. Instances for these classes are created. Every instance for each class, corresponding to some characteristic, is the description of some combination of characteristics values. These combinations may be found in some pathology, and this fact is indicated by the value of the slot *pathology*, related to the respective subclass for pathologies.

Every instance of any subclass of class *Organ* contains a pathology, characteristics which describe this pathology, and the corresponding image. Thus, instance of any subclass of class *Organ* is the description of the specified pathology. Since class *Organ* (and all its subclasses) has the slot, related with class *Patient*, every instance of subclass of class *Organ* specifies patients having this pathology.

4 Queries

Any structure is useful not only because the knowledge in it is formalized, classified and is convenient for viewing. It has to help extracting the needed data from the enclosed knowledge. Having an ontology, one

can extract necessary data by means of queries. E.g., the user with the help of query got the list of patients with the pathology “Hypoplastic gallbladder”. This result allows to view the model image for this pathology (with its description) and the image(s) for selected patient(s) and – which is most important – to compare them (see Fig 2).

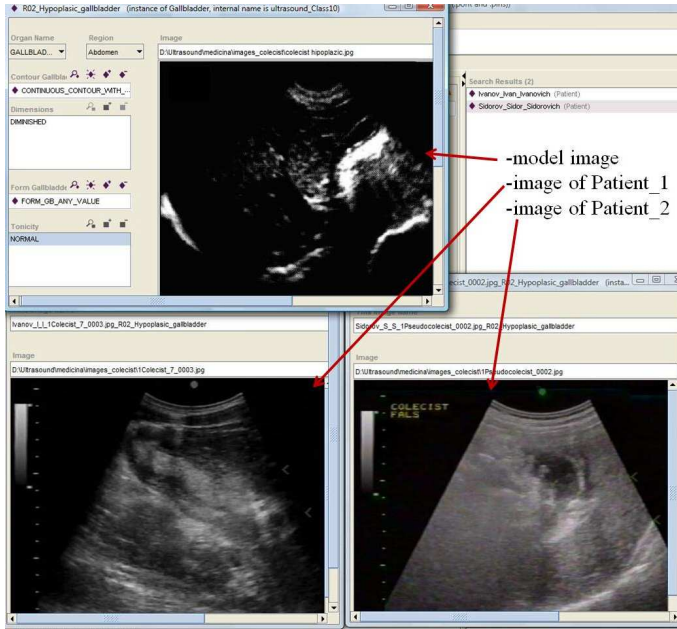


Figure 2. Possibility to compare personal images with model one.

References

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