Protégé-2000 as authoring environment for Clinical Practice Guidelines within the HELEN-Project

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Objectives

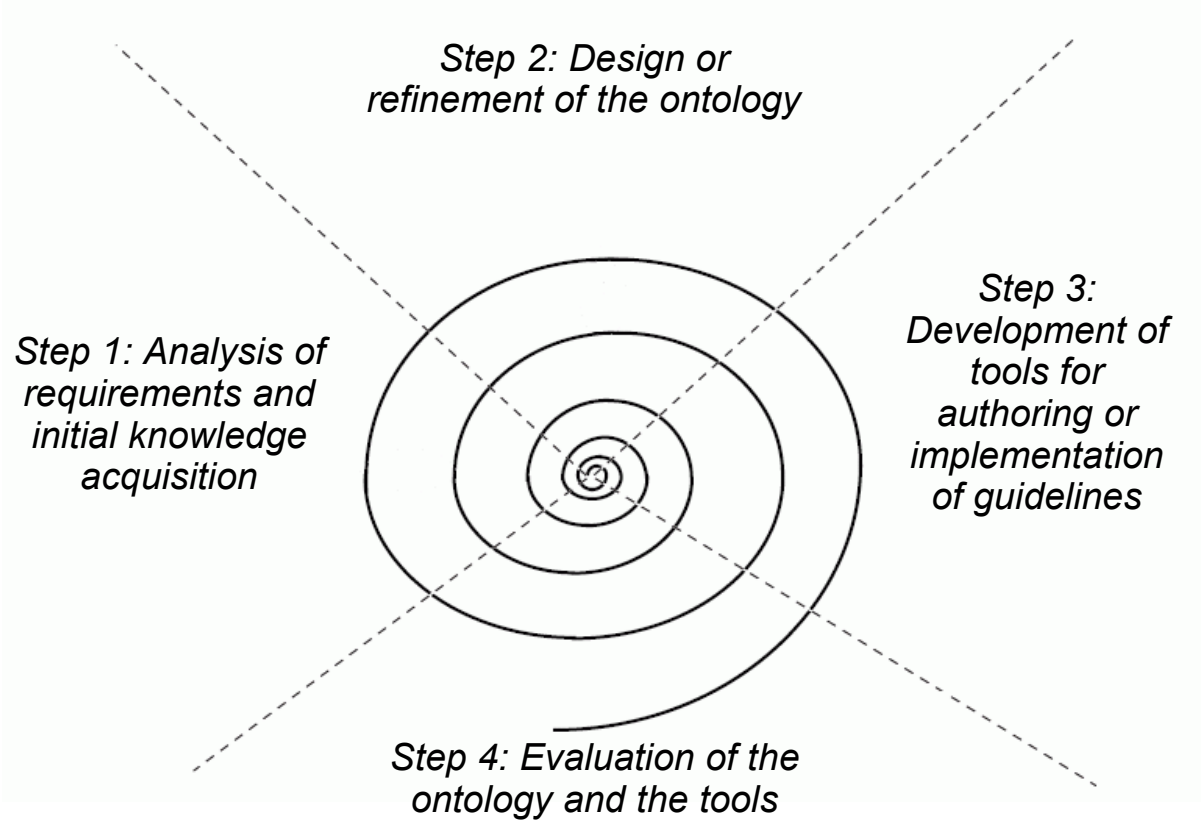
In order to implement clinical practice guidelines for the Department of Neonatology of the Heidelberg University Medical Center we developed a modular framework consisting of tools for authoring, browsing and executing encoded clinical practice guidelines (CPGs).

To minimize the development effort, we based the authoring tool on the existing Protégé-2000 environment.

Methods

Since Protégé does not contain sufficient methods for designing ontologies, we used the Model-based Incremental Knowledge Engineering Process (MIKE). This is a method for developing knowledge based systems based on the Spiral Model of Software Development. Therefore the development consisted of four tasks:

- analysis of requirements
- design or refinement of the ontology
- implementation of an initial knowledge acquisition tool and its extensions
- evaluation by entering examples and test usage of the encoded information.



Based on this development model, we iterated through three cycles:

1.) The first cycle was dedicated to the definition of the ontology
2.) In the second cycle, we aimed at a convenient user interface for entering CPGs
3.) To seamlessly integrate with other tools, in the last step we focused on the design of a widget which exports the entire ontology in a format that can be processed flexibly by all applications supporting XML with schema definition.

Results

The achievement of this development process was an ontology with five major trees containing 85 classes and over 200 descriptive attributes.

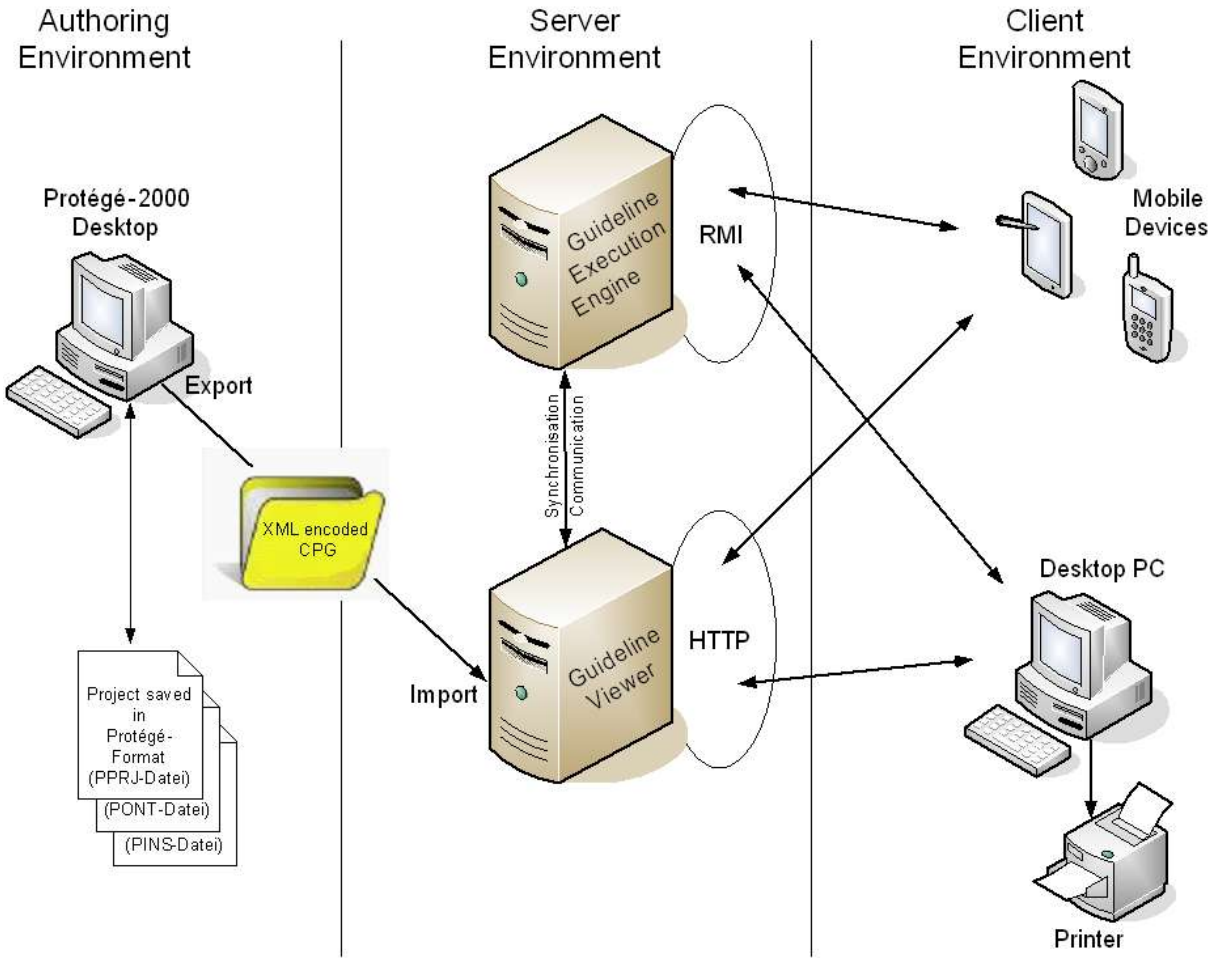
For representing text-based guideline components, we introduced an enhanced HTML format called HELEN_HTML with several special tags to refer to other instances within the ontology. This HELEN_HTML content is stored in a text slot for which we developed a simple HTML editor in form of a slot-widget.

To strengthen the evidence base of CPGs, usually an extended amount of literature citations are necessary. We support this time-consuming step by offering an import widget for PubMed citations that automatically fills in the required descriptive fields.

Another widget was developed to support Protégé's graph widget. This widget creates a file containing an image of the flow-chart and stores the filename into an associated text-slot. Even though the current Protégé version has the ability to create image files, we continue using our widget because we need the ability to refer to the generated file during further processing of the guideline.

Finally we developed an XML schema export filter in order to integrate the guideline editor within our guideline implementation framework. This widget extends Protégé with the ability to produce an XML schema definition according to the ontology and to store the encoded CPG as a valid XML file. With this step, we detach the ontology from Protégé and make it an independent information object. Therefore we used the XML Venetian Blind Model to structure the schema definition, resulting in a good compromise between the object-oriented Protégé model and the abilities of the XML language. Based on this widget, we are now able to export and import the guideline to/from XML without losing information. Other required features of the export widget for further processing are the export of all information needed to create an image map for each algorithm graph which links to the contained instances and the information about the order of the steps to support the automatic execution by a finite-state machine. This is realized by re-enacting the slots next_step and previous_step supported by earlier Protégé versions.

To round up the description of our work, we will describe the integration of the Protégé-based authoring environment into the remaining framework.



Besides the authoring environment (on the left) we introduced two server components using the output from the Protégé environment (in the middle): the Guideline Viewer and the Guideline Execution Engine. The viewer is a servlet which produces a HTML-version of the guideline enriched with e.g. in-line links to other instances and image maps for the algorithm graphs. The execution engine is specialized in traversing and processing included algorithms for certain patients during encountering. The users can interact with both servers using one of the provided clients (on the right).

Following the objectives of our work, we successfully applied the developed framework during some projects focusing on implementing CPGs within the Department of Neonatology. Some of the topics are management of hyperbilirubinemia in the healthy newborn or treatment of apnea in pre-term newborns.

Conclusion

We have shown the successful use of Protégé as authoring environment for CPGs. The flexible plug-in architecture allowed us to enhance the automatically generated forms with specialized widgets for our field of appliance. An export widget was developed based on systematic rules for translating a Protégé ontology, precisely the HELEN-Ontology, into XML schema.