Semantic Discovery of Medical Advice Services with Glue

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Nowadays a General Practitioner (GP) works in contact with a limited number of colleagues (either other GPs or specialists); therefore when a GP is seeking for a medical advice service, it may happen that he/she does not know the right colleague to contact or the suitable one is unavailable.

In order to cover this need, all over Europe, several National and Regional health care projects aim at building up directories of medical doctors willing to provide advice, second opinion and teaching services. For example, GPs can call a health care service center and they can explain to the call-center operators their medical issues. The operators use their *medical knowledge* to discover the best suitable specialists available according to the medical issues and they arrange a teleconsultation meeting for the GPs through a virtual collaboration platform. In this example, the call-center acts as a collection point for the available specialists. It continuously updates the list of expertises provided by each of the doctors and their nominal availability (e.g., Doctor J. Doe is a hypertension expert available on Monday morning and Friday afternoon). When a GP asks for advice about a problem, the call-center operator maps the medical problem to the needed expertises, checks the nominal availability and, if they both fit, tries to arrange the teleconsultation meeting.

But maintaining and updating a call-center can be very expensive; therefore, we can imagine automating the process of discovery of specialists.

The collaboration platform on which GPs and specialists are interacting through can expose the agenda of each specialist as a Web Service. However, the agenda Web Services are only gateways to the advice services: while the agenda of a hypertension expert does not technically differ from the agenda of a Parkinson expert (since they are provided by the same virtual collaboration platform), but their actual services (advice on hypertension vs. advice on Parkinson) differ a lot.

Moreover, the efficiency of this process can be improved by providing a proper technology to the GP capable of suggest him/her the list of the most suitable specialists available according to the medical problem, avoiding the interactions with the call-center operator.

Glue [1], a WSMO [2] based semantic discovery engine for Web Services, can actively support the virtual meeting platform to support the GP in such discover. With such integrated application, the GP starts the discovery process by describing the problem of the patient and his/her preferred date-times to arrange the teleconsultation meeting. Then, Glue performs the discovery by matching the problem expressed by the GP against the descriptions of the Web Services offered by each specialist, and it returns to the GP application a list of references to agenda Web Services, ordered by decreasing relevance. Finally, the GP interactively selects one of agendas exposed as Web Service to find a slot available for the teleconsultation meeting.

Glue works in a similar way than a UDDI [3] registry: Web Services descriptions need to be *published* into Glue and then a client application can query it in order to *discover* the needed Web Services. But Glue is much more than a UDDI registry, since it uses ontologies to semantically enhance discovery. Glue is based on the notion of class of Goals and class of Web Services descriptions: those classes have to be modelled inside Glue during its *configuration*, as well as the ontologies. The instances of these classes represent the semantic descriptions of the actual GPs' needs and specialists' advice services. Hereafter, we provide a description of the entire process:

Configuration time

- the knowledge of the medical domain (concepts and relationships for diseases, drugs, allergies, body parts and also the coding systems used, such as: ICD [4], SNOMED [5]) and of the advice service domain (concepts and relationships for date, time, meeting, agenda) is formalized in one or more ontologies inside Glue;
- the service provider defines the classes of Web Service descriptions that describes the common structure of the advice services provided by the specialists on the collaborative platform;
- the service requester defines the classes of Goals that describes the common structure of the GP requests inserted in the collaboration platform;
- in order to improve the matching between the requests and the responses, Glue uses mediators, i.e. it employs similarity rules for matching instances of a class of goals with instances of a class of Web Service descriptions;

Publishing time

- each specialist that registers in the collaboration platform, registers also in Glue his clinical capabilities and the date-time intervals he is normally available. E.g., Doctor J. Doe "delivers intervention based on beta blockers with nominal availability on Monday morning and Friday afternoon";

Discovery time

- a GP expresses his/her medical problem. E.g., the GP asks for "advice on the use of Atenolol, if possible on June 8th from 10.00 to 13.00 or on June 9th from 13.00 to 16.00";
- Glue uses the ontologies and the matching rules in the mediators for matching the GP goal against the descriptions of the advice services offered by each specialist; then it returns a list of references to the best suitable advice services, ordered by decreasing medical relevance;
- the GP selects one of the specialists in the list and the collaboration platform invokes the relative Web Service to arrange the meeting on the specialist agenda.

REFERENCES

[1] E. Della Valle et al. *The mediator centric approach to Automatic Web Service Discovery of Glue*. In Proc. of Mediation in Semantic Web Services 2005

[2] D. Roman, U. Keller, H. Lausen (eds.): Web Service Modelling Ontology. http://www.wsmo.org

[3] UDDI.org white paper, UDDI Technical White Paper, 6 September 2000, http://www.uddi.org

[4] ICD: International Classification of Diseases

[5] SNOMED: Systematized Nomenclature of Human Medicine