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Adapting Combinatory Categorial Grammars in a Framework for Health Care Dialogue Systems

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1 Abstract

Dialogue systems have been extensively used to provide access to computer-based applications and services in several domains. Particularly, in the medical domain dialogue systems have been adopted as a wide reaching solution to complement traditional contact channels and have been used successfully(Young et al., 2001; Giorgino et al., 2004; Beveridge and Fox, 2006). Several studies have discussed the advantages of adopting dialogue systems for chronic symptoms monitoring, interviews, counselling, education, etc. (Migneault et al., 2006). Nevertheless, a widely diffused adoption of dialogue systems in the medical domain is still far from reality because of domain complexity and speech technology costs. Health dialogues have an additional complexity because they must confront social and relational issues through continuity over multiple interactions with patients, as well as, criticality in cases of chronic-disease management (Bickmore and Giorgino, 2006).

VoiceXML emerged as way to provide a standard solution to voice applications. However, most of the VoiceXML-based dialogues are system-driven because of VoiceXML shortcomings in supporting dynamic natural language processing (NLP) and discourse phenomena features (Mittendorfer et al., 2002). An extension of VoiceXML to support NLP in dialogues and to overcome its limitations is described in (Hataoka et al., 2004). However, a big effort should still be done in VoiceXML-generative frameworks to support the complex ontologies, guidelines and structured enquiry data collection tasks of the medical domain.

We present a platform for health-care dialogue deployment and for the incremental incorporation of well defined formalisms such as Combinatory Categorial Grammars (CCG) and enables the generation of different backends such as VoiceXML. This work is especially targeted to the health care context, where a framework for easy deployment of more "natural" dialogues could improve patient's perception of dialogues and allow a more widespread adoption of dialogue systems.

1.1 Proposed Approach

We developed a framework for easy dialogue development, motivated by our experience in building and validating a dialogue system for hypertensive patient home management HOMEY(Giorgino et al., 2004). AdaRTE (Adaptive Dialog and Runtime Engine) arises from this experience and the idea of offering a framework for efficient deployment of dialogue solutions in terms of time, cost, development effort and maintainability. This framework is mainly composed of an interpreter, a runtime-engine and an interface media realizer for backend generation (figure 1). AdaRTE is an extensible architecture for dialogue interpretation and representation which supports different backend formats (HTML and VoiceXML) and allows an easy implementation of external resources access such as databases or ontologies.

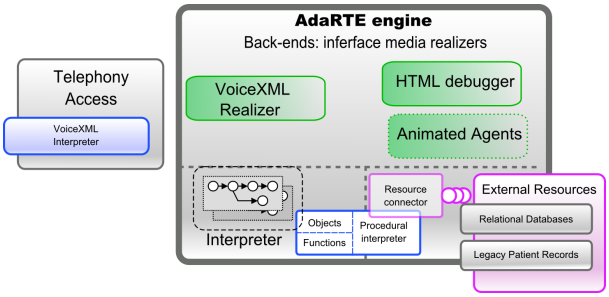

Figure 1: AdaRTE architecture

The AdaRTE framework has been beta-tested with two realistic health care dialogue systems. The first one is based on a prototype based on the TLC-COPD dialogue deployed in the past by the Boston MISU group(Young et al., 2001). This pilot's deployment demanded less than two weeks of man effort, is executed in English and uses DTMF interaction. The second test case is the partial reimplementation of the Homey dialogue system for the management of hypertensive patients. Re-engineering the system from the original proprietary dialogue manager (DM) to the AdaRTE architecture took approximately three weeks (eleven days of man effort), this system uses speech in-

puts and is executed in Italian. This framework yielded an important reduction of the time invested in developing these two prototypes whilst facilitating component reuse in each dialog.

Despite this time optimization, the generated dialogues are user-restrictive, that is to say, the user expressivity was extremely limited because of the restrictive grammar formats (CFG) supported by Voice Browsers. The semantic analysis supported by the VoiceXML standard is limited to complex ECMAScript objects processing. In order to support discourse phenomena features and mixed-initiative, the Voice Browser ASR should be extended to support either NLP-based grammar formalisms or n-grams.

We pursue the development of a framework that uses an ASR enriched with probabilistic grammars, NLP application and a flexible DM. The adoption of NLP in our framework allows us to support flexibility in dialogues. Thus, we chose the NLP library OpenCCG[1], which is based on CCG and MMCCG (Steedman, 2000; Baldridge and Kruijff, 2001). OpenCCG has been successfully used in two european projects (Foster and White, 2005; Wilske and Kruijff, 2006).

The strongest advantage of CCG is that it assigns categories enriched with meaning to expressions. Thus, a common-understanding in dialogues could be modelled by taking advantage of this meaning representation, together with the ontologies underlying the medical domain. Since the knowledge handled in the medical domain is complex, a tool for unification of meaning could provide a better representation of the domain and dialogue knowledge. Currently, we are making progress in the construction of an Italian grammar for the hypertensive patients management by using OpenCCG. In this grammar we references ontological definitions. Nevetheless, still a big effort should be done in order to adapt typical linguistic phenomena of romance languages such as Italian and Spanish.

1.2 Discussion and Future Work

We have presented an architecture for dialog representation and interpretation in which we built an engine for dialogue deployment. AdaRTE supports high-level dialog representations and supports VoiceXML generation as one of the generation backends. Even through this framework reduces the time invested in developing dialogue systems, we have found the dialogues being system-initiative.

This approach pursue building not only a reliable platform for health-care dialog deployment, but also a framework for the incremental incorporation of alternative formalisms in order to support features of discourse phenomena and best practices. For instance, we are working in adapt the CCG formalism, which allows a wide-lexicon that increase user expressivity in dialogues, by integrating the NLP library OpenCCG. In addition, we are working in the adoption of common understanding by using complex ontologies that describe the dialogue and the medical domain.

[1] http://openccg.sourceforge.net

References

Jason Baldridge and Geert-Jan M. Kruijff. 2001. Coupling ccg and hybrid logic dependency semantics. In *ACL '02: Proceedings of the 40th Annual Meeting on Association for Computational Linguistics*, pages 319–326, Morristown, NJ, USA. Association for Computational Linguistics.

Martin Beveridge and John Fox. 2006. Automatic generation of spoken dialogue from medical plans and ontologies. *J. of Biomedical Informatics*, 39(5):482–499.

Timothy Bickmore and Toni Giorgino. 2006. Health dialog systems for patients and consumers. *J. of Biomedical Informatics*, 39(5):556–571.

M.E. Foster and M. White. 2005. Assessing the impact of adaptive generation in the comic multimodal dialogue system. In *Proceedings of IJCAI-05 Workshop on the Knowledge and Reasoning in Practical Dialogue Systems*.

T. Giorgino, Azzini I., C. Rognoni, S. Quaglini, M. Stefanelli, R. Gretter, and D. Falavigna. 2004. Automated spoken dialogue system for hypertensive patient home management. *International Journal of Medical Informatics*, 74(1386-5056):159–167, apr.

N. Hataoka, Y. Obuchi, T Mitamura, and E Nyberg. 2004. Robust specch dialog interface for car telematics service. *ieeecnf*, (10.1109/CCNC.2004.1286882):331 – 335, jan.

Jeffrey P. Migneault, Ramesh Farzanfar, Julie A. Wright, and Robert H. Friedman. 2006. How to write health dialog for a talking computer. *J. of Biomedical Informatics*, 39(5):468–481.

M. Mittendorfer, G. Niklfeld, and W. Winiwarter. 2002. Making the voice web smarter-integrating intelligent component technologies and VoiceXML. *ieeecnf*, 2(10.1109/WISE.2001.996736):126–131, dec.

Mark Steedman. 2000. *The syntactic process*. MIT Press, Cambridge, MA, USA.

Sabrina Wilske and Geert-Jan Kruijff. 2006. Service robots dealing with indirect speech acts. In *International Conference on Intelligent Robots and Systems*, pages 4698–4703.

M. Young, D. Sparrow, D. Gottlieb, A. Selim, and R. Friedman. 2001. A telephone-linked computer system for COPD care. *Chest*, 119(5):1565–1575, May.