

# SmartWeb: Mobile Access to the Semantic Web<sup>1</sup>

A. Ankolekar<sup>1</sup>, P. Buitelaar<sup>2</sup>, P. Cimiano<sup>1</sup>, P. Hitzler<sup>1</sup>, M. Kiesel<sup>3</sup>, M. Krötzsch<sup>1</sup>,  
H. Lewen<sup>1</sup>, G. Neumann<sup>2</sup>, M. Sintek<sup>3</sup>, T. Tserendorj<sup>1</sup>, R. Studer<sup>1</sup>

<sup>1</sup> AIFB, Universität Karlsruhe, Germany

<sup>2</sup> DFKI GmbH Saarbrücken, Germany

<sup>3</sup> DFKI GmbH Kaiserslautern, Germany

**Abstract.** We present the SmartWeb Demonstrator for multimodal and mobile querying of semantic resources and the open WWW. The end-user interface consists of a Pocket Data Assistant which accepts written or spoken questions as input and delivers answers based on a multitude of resources including a semantic knowledge base, semantically annotated online web services, and semi-automatically created knowledge from text-based web pages. If answers cannot be found using these structured resources, then the system returns answers based on linguistic query-answering techniques on the open WWW.

**Keywords:** question answering, ontology engineering, semantic web services, multimodality, mobile and ubiquitous computing

## 1 Introduction

Recent progress in mobile broadband communication and semantic web technology is enabling innovative internet services that provide advanced personalization and localization features. The goal of the SmartWeb (<http://www.smartweb-project.de>) project is to lay the foundations for multimodal user interfaces to distributed semantic web resources and services on mobile devices.

SmartWeb is based on two parallel efforts that have the potential of forming the basis for an advancement of the web. The first effort is the Semantic Web, which provides the tools for the explicit markup of the content of web pages. The second effort is the development of semantic web services which results in a web where programs act as autonomous agents to become the producers and consumers of information and enable automation of transactions.

SmartWeb exploits the machine-understandable content of semantic web pages for intelligent question-answering as a next step beyond today's search engines. Since semantically annotated web pages are still very rare due to the time-consuming and costly manual markup, SmartWeb is using advanced language technology and information extraction methods for the automatic annotation of traditional web pages encoded in HTML or XML.

SmartWeb provides a context-aware user interface, so that it can support the user in different roles, e.g. as a car driver or a sports spectator. One of the demonstrators of

---

<sup>1</sup> The academic partners of SmartWeb are the research institutes DFKI (consortium leader, Prof. Dr. Wolfgang Wahlster), FhG FIRST, and ICSI together with university groups from Erlangen, Karlsruhe, Munich, Saarbrücken, and Stuttgart. The industrial partners of SmartWeb are BMW, DaimlerChrysler, Deutsche Telekom, and Siemens as large companies, as well as EML, Ontoprise, and Sympalog as small businesses. The German Federal Ministry of Education and Research (BMBF) is funding the SmartWeb consortium from 2004 to 2008. We acknowledge the funding under project number 01 IMD01.

SmartWeb is a personal guide for the 2006 soccer world cup in Germany, that provides mobile infotainment services to soccer fans, anywhere and anytime, using a PDA as user-interface. We will present this demonstrator at the conference.

## **2 Multimodal Recognition and Modelling**

Access to SmartWeb is either gained on the field via a PDA/Smartphone (UMTS) with a server-based speech-recognizer or in a mobile car-scenario via a built-in speech-recognizer in the car. On the PDA, the interface is supplemented with multimodal input, e.g. with a pen. In addition, a camera monitors the face and recognizes whether the user is addressing the system.

## **3 Ontological Infrastructure**

The SmartWeb project comprises the definition, implementation, and application of ontologies for various parts of the system. Using ontologies enables the formalization of concepts that are understood and accepted by a wide user basis. They lay the foundation for the dialogue with the user as well as for the flexible communication between applications from various, wide-ranging areas. The ontologies also enable important basic tasks such as the formulation of structural queries and inferencing.

## **4 On- and Offline Extraction of Semantic Structures for Question Answering**

SmartWeb derives answers through open-domain question answering (QA) or from an automatically generated knowledge base. The QA component extracts answers from web pages that are retrieved and analysed in real-time by use of statistical and shallow linguistic techniques. The SmartWeb Ontology-Based Annotation (SOBA) subsystem automatically populates a knowledge base by information extraction from semi-structured and free text soccer match reports from the WWW.

## **5 Web Services**

The SmartWeb system utilizes existing web services, including the T-Info web services. They include navigational and weather information. For use within the SmartWeb system, the web services are semantically annotated. Certain queries invoke calls to corresponding web services whose responses can be fed back to the user.

## **References**

P. Buitelaar, P. Cimiano, S. Racioppa, M. Siegel, Ontology-based Information Extraction with SOBA. In: Proceedings of LREC 2006.

G. Neumann, B. Sacaleanu, Experiments on Cross-Linguality and Question-type driven Strategy Selection for Open-Domain Question Answering. In: C. Peters et al. (Eds.), Proceedings of CLEF 2005, LNCS 4022, Springer, Berlin, pp. 429–438, 2006.

D. Oberle et al., DOLCE ergo SUMO: On Foundational and Domain Models in SWIntO (SmartWeb Integrated Ontology). Technical Report, 2006. Available from [http://www.aifb.uni-karlsruhe.de/Publikationen/showPublikation?publ\\_id=1246](http://www.aifb.uni-karlsruhe.de/Publikationen/showPublikation?publ_id=1246).

N. Reithinger, D. Sonntag, An Integration Framework for a Mobile Multimodal Dialogue System Accessing the Semantic Web. In: Proceedings of Interspeech 2005.