THE VERBMOBIL PROJECT: AUTOMATIC INTERPRETING OF BUSINESS NEGOTIATION DIALOGUES

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With the increasing amount of information, stored in a growing number of databases all over the world, intelligent interfaces for various users have become a crucial asset in information technology. As language plays such an important role in human information processing, it seems adequate to enhance user interfaces with a natural language processing component. This demand for reliable language and speech technology can not yet be adequately met by reliable software for multiple applications. So far, particularly in the more complex fields such as machine translation and language understanding, fundamental research has not reached a level where the robustness and coverage of the software are suitable for the development of commercial systems.

In Germany since 1993, the Bundesministerium für Bildung, Wissenschaft, Forschung und Technologie (BMBF / Federal Ministry for Education, Research, and Technology) has been funding the Verbmobil project, which is a joined effort in developing a speech-to-speech translation system for spoken dialogues in specific business domains. After the first phase (1993 - 1996), it can be said that this project has been a success in stimulating speech and language technology both in the industry as well as at universities and research centers by introducing a common goal, the translation system, into an extremely heterogeneous field of research. The project is scheduled to be continued for another four years until 2000, and it can be expected that the influence of it on academic and industrial spin-off will last and increase even further as the system improves.

PROJECT DESCRIPTION

The specific domain of the Verbmobil project is business negotiations. Two or more business partners are involved in a negotiation dialogue, and their utterances are translated on demand. This means that they can use a foreign language as long as they feel comfortable with it, and if they do not know a word or a phrase in the foreign language, they will use Verbmobil for a translation.

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The first integrated version of the system was presented to the public during the CeBIT in 1995 by Dr. Jürgen Rüttgers, the German Federal Minister for Research. This first version recognizes spoken German input within the context of appointment negotiation (vocabulary 1292 words). The Verbmobil research prototype which was presented in October 1996 at the end of the first phase also recognizes Japanese input and translates it into English.

For these first four years, DM 64.9 million were contributed by the BMBF. Industrial partners have provided an additional DM 31 million. The Verbmobil consortium consists of 29 partners, among them 7 companies from the field of information technology and 22 universities and research centers. Two of the research centers are based in the United States and one in Japan.

THE SYSTEM ARCHITECTURE

RECOGNITION OF SPONTANEOUS SPEECH

Verbmobil is designed for speaker-independent recognition of spontaneous speech. The speech signal is analyzed, and those parts recognized as possible words are assigned probability values and displayed in a lattice with the word hypotheses. A complicated search procedure finds the most plausible way through this lattice and renders a sequence of words. An evaluation of the Verbmobil speech recognizer came up with a recognition rate of about 73.3% on random samples taken from input which had previously not been encountered.

SENTENCE MELODY

Since written language cannot be segmented by punctuation, the sentence melody plays an important role in structuring the acoustic input. The prosody module recognizes sentences and phrase boundaries by using information about breaks, intonation, duration, and energy of the input signal.

LINGUISTIC PROCESSING

The syntax analyzer examines the results of the speech recognizer for grammatically correct input and determines possible readings. In order to determine whether an utterance is syntactically appropriate, the syntax analyzer uses a set of rules which represent the syntax of spoken dialogue contributions as their structure is often very different from written texts. The semantic module determines the meaning of utterances and decides whether it is possible to construct a plausible meaning representation from the meanings of the utterance segments. Verbmobil applies syntactic and semantic constraints simultaneously. In order to integrate the dialogue context, which is often necessary for disambiguation or for the compensation of underspecification, the dialogue module adds contextual information to the process. Apart from German input, the latest Verbmobil version can also – to a lesser extent – process spoken Japanese. The same setup is used for both German and Japanese input, only the knowledge sources (syntactic rules, semantic constraints and the dictionary are different. The syntactic-semantic processor passes its results to a transfer module. This transfer module 'translates' it into abstract representations of the target language. A generator produces these representations into syntactically correct sentences, and a language synthesizer utters the translations as comprehensibly and naturally as possible and with the required emphasis.

SYSTEM INTEGRATION

In order to optimize the available resources, several programming languages are used in the Verbmobil system, and the modules interact with an object-oriented software architecture, which integrates the heterogeneous approaches into a homogeneous architecture.

PERSPECTIVES

So far, apart from the development of the extremely innovative Verbmobil prototype and advances in basic research in speech and language technology, Verbmobil as a consortium also involves cooperation between researchers coming from various backgrounds. It seems that the experience of working together in the Verbmobil environment will prove to be a foundation for future research and development in speech technology.

THE VERBMOBIL PARTNERS (DECEMBER 1996)

INDUSTRIAL PARTNERS

- Alcatel SEL AG, Stuttgart
- CAP Debis Systemhaus – Kommerzielle Systeme und Projekte – GmbH, Fellbach
- Daimler-Benz AG, Stuttgart
- Daimler-Benz Aerospace AG, Ulm
- IBM Deutschland Informationssysteme GmbH, Stuttgart
- Philips GmbH Forschungslaboratorien, Aachen
- Siemens AG, Berlin und München

UNIVERSITY PARTNERS

- Carnegie Mellon University, Pittsburgh, USA
- Center for the Study of Language and Information, Stanford, USA
- Christian-Albrechts-Universität Kiel
- Deutsches Forschungszentrum für Künstliche Intelligenz GmbH (DFKI / German Research Center for Artificial Intelligence), Kaiserslautern and Saarbrücken
- Eberhard-Karls-Universität Tübingen
- Friedrich-Alexander-Universität Erlangen-Nürnberg
- Humboldt-Universität zu Berlin
- Institut der Gesellschaft zur Förderung der angewandten Informationsforschung e. V. an der Universität des Saarlandes, Saarbrücken
- Ludwig-Maximilians-Universität München
- Rheinisch-Westfälische Technische Hochschule Aachen
- Ruhr-Universität Bochum
- Technical University of Berlin
- Technical University of Braunschweig
- Technical University of Dresden
- Technical University of München
- Universität Bielefeld
- Universität Bonn
- Universität Hamburg
- Universität Hildesheim
- Universität Karlsruhe
- Universität des Saarlandes, Saarbrücken
- Universität Stuttgart
- Universität Ulm

VERBMOBIL AT THE UNIVERSITY OF HAMBURG

As an example of an academic institution participating in Verbmobil, the researchers at the Universität Hamburg have conducted work in the following areas:

Architecture
Acoustic Analysis
Hybrid Architectures
Interaction-Based Transfer
Translation Strategies
Data Collection
User Acceptance
Communication Field
User Expectations
Evaluation of Consequences

For the Universität Hamburg as well as the other partners in the Verbmobil consortium, the investigation into the different aspects of the Verbmobil project has turned out to be an interesting experience for all areas of work in the field of natural language processing.

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Further information on Verbmobil can be found at the following URL:
http://www.dfki.uni-sb.de/verbmobil/