HUMAN LANGUAGE TECHNOLOGIES FOR E-GOV

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Abstract: Effective provision of government services implies that, besides being provided online, services become available through other channels, are organized according to citizen's expectations, are accessible to everyone, anytime and anywhere, and include information from unstructured sources. It is also essential to provide the tools that allow citizens to correctly identify the services they need. In this paper we will discuss how it is possible to improve e-gov service delivery by using human language technologies. We argue that these technologies can contribute to: deliver services in more inclusive manners; provide human centered and multilingual service and support; and include non-structured information scattered across different sources.

1 INTRODUCTION

eGov "refers to the use by government agencies of information technologies (such as the Internet and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions" (World Bank, 2009).

Human language technologies (HLT) refer to speech and natural language processing (NLP). Research and development in speech include automatic speech recognition (ASR) to get a textual representation of a speech sound wave, and text to speech (TTS) to generate a speech sound wave representing a given text. NLP "refers to computer systems that analyze, attempt to understand, or produce one or more human languages, such as English, Japanese, Italian, or Russian. The input might be text, spoken language, or keyboard input. The task might be to translate to another language, to comprehend and represent the content of text..." (Allen, 2003).

Paper structure: in this paper we will discuss how it is possible to improve e-gov services by using HLT. After a brief overview of needs regarding better service delivery in e-gov (section 2), follows an overview of HLT (section 3) and the potentials of its application to e-gov (section 4). The last sections of the paper address some recent related work, our ongoing work and the relevant conclusions.

2 CITIZEN NEEDS IN E-GOV

eGov is "a dynamic concept of varying meaning and significance" (Relyea, 2002). It is commonly used to refer to several alternative or complementary concepts, including the use of the Internet in the interaction between government and citizens or businesses, a reengineering of government processes catalyzed by Information and communication technologies (ICT), and a symbol of ICT usage in increasing the efficiency and effectiveness of government.

Electronic service provision is probably the most common approach to e-gov. In effect, ICT allows traditional services to become online, with clear benefits for clients (citizens and businesses) and government, avoiding travel, speeding up processes and diminishing costs. However, besides being delivered online, government services should also be integrated in such a way that they fit the citizens and business

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concrete needs (Dias and Rafael, 2007). One-stop e-gov corresponds to this perspective: services should be provided through a single entry point and be integrated across agencies from the client's point of view (Wimmer et al., 2001). They can be organized into life-events (as birth of a child, marriage, etc) targeted at specific costumers at particular times in their life (Oteniya et al., 2006).

Digital divide refers to the gap between people with effective access and capacity to use ICT and those with very limited or no access or capacity at all. If not properly addressed, online service provision can contribute to increase this problem. Before using an e-gov service users sometimes cannot identify which public administration institutions provide the services they need and what inputs are required to execute the service (Sroga, 2008). It is necessary to have tools to help every client to find and use the appropriate service regardless of its level of expertise in government services or ICT, because government must serve 100% of its clients (Trochidis et al., 2008).

Finally, the development of a customer oriented approach implies that government agencies learn how to communicate with each other, interoperation becoming a crucial issue. To this respect, it is important to note that a very relevant set of government information is not stored in searchable databases. Many documents although digitally stored, remain in their original format. eGov services should be able to include and combine these sources of information.

3 HUMAN LANGUAGE TECHNOLOGIES

3.1 Interface Technologies

A natural language interface allows people to interact using a human language, such as English, as opposed to a computer language, command line interface, or graphical user interface. Spoken language interfaces are capable of handling spoken human language. Advances in ASR, language understanding, language generation, and speech synthesis (see Jurafsky and Martin, (2000) for technical details) enabled the emergence of complex conversational spoken language interfaces (Bohus and Rudnicky, 2009).

These systems are typically connected in a pipeline architecture (Bohus and Rudnicky, 2009). The audio signal from the user is captured and passed through a ASR module that produces a sequence of words. This recognition hypothesis is forwarded to a language understanding component to create a corresponding semantic representation which is passed to the dialog manager that, using also the discourse context, produces the next system action, usually in the form of a semantic output. A language generation module produces the corresponding textual form, subsequently passed to a TTS module to produce synthetic speech. It is possible to create an automated chat by adding text input alongside with the ASR module and a text renderer alongside TTS or to connect a software agent (e.g. a talking head). Examples of conversational spoken language interfaces include (Bohus and Rudnicky, 2009): Jupiter, AdApt, and TRIPS.

3.2 Natural Language Queries

A natural language interface requires algorithms to query information using natural language. Also, in dealing with large amounts of information as in e-gov, a central problem is the formulation of queries that are communicable to the system. Database query languages can be intimidating to the non-expert, leading to the popularity for keyword based search in spite of its significant limitations (Hendrix et al., 1978).

Two major obstacles lie in the way of supporting arbitrary natural language queries: automatically understanding natural language is itself still an open research problem; to translate the understood natural language query into a formal query requires mapping the understanding of intent into a specific database schema. Regarding the first problem, state-of-the-art techniques can reach acceptable results but it is still far from being totally resolved. The second problem has been tackled with good results by works like NaLIX (Li et al., 2005), Panto (Wang et al., 2007), and ESTER (Bast et al., 2007).

3.3 Unstructured Information

As described above, HLT allows users to perform queries in an intuitive way and also allows to feed the system knowledge base with information from more sources. The knowledge base is accessed by the dialog manager or the query system.

Information extraction (IE) takes texts as input and produces fixed-format, unambiguous data, as output. It involves processing text to identify relevant information, such as named entities (NE) or relations between them (Appelt, 1999). NE include people, organizations, locations and so on, while relations include physical relations (located, near, partwhole, etc.), personal or social relations (business, family, etc.), and membership (employ-staff, member-of-group, etc.) (Bontcheva et al., 2008). State-of-the-art

systems perform NE recognition over the web contents with good results (Whitelaw et al., 2008).

To find relationships between named entities is a task related to syntactic parsing, which is the process of analyzing a text to determine its grammatical structure with respect to a given formal grammar. Recent works achieved good results in any context by including machine learning algorithms to find relationships (Suchanek et al., 2007).

4 HLT POTENTIAL IN E-GOV

eGov services should be provided in a way that meets customers natural communication paradigm. Therefore, whenever possible, e-gov services should use natural language interfaces: accepting written and speech inputs (over the web and telephone) and allowing people to experience a level of interaction comparable to traditional, face-to-face services.

In brief, the great potential of speech and natural language technologies for e-gov can be supported by the following advantages:

More intuitive user interface - profiting from the recent advances of natural language interfaces in other areas, we argue that it is possible to develop e-gov support systems that are able to solve user queries formulated in natural language, instead of forcing users to look for instructions or to find information in the set of rules that regulate the service. The linguistic coverage of natural language interfaces is not always obvious but some strategies allow dialog systems to intuitively drive the user to use the right vocabulary set (Gorin et al., 1997).

Dialog becomes an option - dialog processing is, by its very nature, incremental. An incremental system can work with units smaller than utterances, allowing the creation of a more reactive system capable of taking the initiative in the conversation to clarify, ask for missing information, or suggest. By having a conversation, individuals would be able to explain their problem to discover a solution, instead of having to make a thorough search to find how to proceed.

Take advantage of voice channels - speech is the most natural and easy existing interface, not only for people with special needs, but for people in general, as Nass & Brave (Nass and Brave, 2005) state: "Ubiquitous computing - access to all information for anyone, anywhere, at any time - relies on speech for those whose eyes or hands are directed to other tasks or for those who cannot read or type (such as children, the blind, or the disabled)". Another advantage is that telephones are more popular than computers and more people feel comfortable with them. Services provided by voice are already available to the general public (e.g. Google Voice).

Multilingual - machine translation is not adequate for online documents because its performance is not perfect. The same is not true when using natural language interfaces with dialog support because the use of clarification can resolve translation errors and the communication can be effective and more efficient than having the user speaking a foreign language.

Access to unstructured information - important sources of information relevant for e-gov are originally created in natural language documents, such as forms, laws, regulations, etc. Those documents are usually available to the public in pdf and html formats. A computer system that does not feature NLP capacities cannot derive meaningful information from it, being limited to store and display. Systems able to understand the information of this type of documents could assist users more efficiently by selecting the information that is relevant in the client context.

Access for all - the above advantages contribute to reduce the digital divide. Written and spoken natural language interfaces facilitate the access of minorities as the visual impaired, people with speech disabilities, and people not familiar with ICT. The usage of ubiquitous telephone increases the potential to reach more users, including those who live in remote areas, are homebound, etc. Finally, multilingual support and the ability to search and contextualize unstructured documents can serve other minorities, such as immigrants, tourists and people with low literacy levels in general. Written interfaces are robust and speech technology is becoming mature as demonstrated by several commercial products in different languages (TTS systems: Microsoft Reader, Nuance RealSpeak, LoquendoTTS; ASR systems: Nuance Dragon Naturally Speaking, Microsoft SpeechFX).

5 RELATED WORK

Although a lot of research activity has been done in e-gov, so far, to our knowledge, just one project was dedicated to the study of using HLT in e-gov: HOPS, funded by the European Commission under Framework-Programme 6 (FP6) (Gatius et al., 2006).

Other e-gov projects use semantic technologies to specify, develop, deploy services, and are rather centered in solving problems as interoperability and service integration, which are very important problems and still need to be further addressed. See for example

OneStopGov (Chatzidimitriou and Koumpis, 2008), also FP6 funded, and Access-eGov (Sroga, 2008).

The authors are particularly interested in applying the expressed position in the scenario of municipal service delivery because it is often the closest point of service for citizens and enterprises. The implementation will integrate a web and speech interfaces, a question and answering (Q&A) module, a dialog manager, a knowledge manager, and an IE module. For TTS and ASR off-the-shelf software will be used.

The research has started by addressing the IE and the knowledge management problems by extending a semantic knowledge base ideas and public code (YAGO) to cope with Portuguese texts (Suchanek et al., 2007). Preliminary tests with a first prototype for the Q&A module, working with the collected data, are scheduled for near future. The first version of the dialog system will be developed using the CMU Olympus open-source framework with the Ravenclaw dialog manager (Bohus and Rudnicky, 2009).

6 CONCLUSIONS

The authors strongly believe in the potential of HLT to improve e-gov services and are working on the application of these ideas/technologies to new e-gov services for Portuguese municipalities. Other projects, such as HOPS, show that this is a challenging problem, which has been seldom addressed and requires more research. Although good results have been achieved in some HLT tasks, the integration of these technologies in complex systems as e-gov services needs to be further studied in order to have systems ready to serve any client.

Using HLT in e-gov is still a challenge because it requires research and adaptation to the specific area. The benefits are clear: reduction of the digital divide; more intuitive human interfaces; communication comparable to traditional face-to-face dialogs; more channels available; and more knowledgeable systems. These benefits are particularly relevant in e-gov because government must serve 100% of the population and because e-gov success also depends on how easy it is to use its services.

There is still a lot of work to be done to have liable applications in Portuguese language - our goal. We believe that our research can be useful to other languages in the same way we found fruitful to study, understand, and adapt to Portuguese the developments of HLT for other languages, such as English.

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